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An Analysis of the Relationship Between Net Working Capital and Firm Financial Performance

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ABSTRACT

Academia has continued to profess the importance of working capital through qualitative evidence. With that said, the quantitative body of existing research is still somewhat limited. This paper analyzes the relationships between net working capital and four measures of firm financial performance: net sales, normalized operating income, operating cash flow, and stock price. Regressions are run and correlations are determined for each factor versus net working capital. Data derives from three indices: S&P 500, S&P 500 Retailing, and S&P 500 Information Technology. Assessing the significance of the relationships, the study has considerable implications for corporate finance and stock selection.

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Chapter 1

Introduction

In the field of corporate finance, managers have long espoused the benefits of efficient working capital management. This paper will seek to determine whether or not significant relationships exist between net working capital and measures of firm performance. More specifically, this study will look to quantify the extent of the influence of working capital on four key metrics: net sales, normalized operating income, operating cash flow, and stock price. Strong qualitative arguments for its considerable impact persist in academia; however, the body of empirical studies is relatively limited in assessing the magnitude of this effect. Furthermore, few past studies have analyzed such relationships on both an industry-independent and industry-specific basis. In the study, the industry-agnostic aspect will be represented by Standard & Poor's 500 index data. Data sets from narrower indices for the retailing and information technology fields will also be highlighted.

This research is primarily intended for corporate finance professionals in solidifying the level of importance which should be placed on net working capital as well as in adjusting working capital mandates in order to aid overall operating efficiency. Secondly, the results will provide insights to investors in allocating capital to companies which have demonstrated an enhanced working capital policy. As with prior research, this paper aims to guide future studies on the subject matter.

Chapter 2 includes a review of definitions of working capital, qualitative support for its importance, and various empirical studies conducted on the topic. Subsequently, Chapter 3 encompasses the hypothesis of the outlined study. Chapter 4 then describes the methodology used in the study, including the calculations of correlations and regressions associated with the

relationships under focus. To illustrate the results of the study, Chapter 5 contains a number of tables and charts for each set of index data. Chapter 6 analyzes the outcomes compared to the expectations previously presented and suggests alterations as well as recommendations for future research. Finally, Chapter 7 summarizes the major elements and takeaways of this paper.

Chapter 2

Literature Review

Definition of Net Working Capital

The definition of net working capital (NWC) along with its relationship to financial performance vary across the existing body of literature. In simplest, accounting-based terms, net working capital refers to the difference between current assets (CA) and current liabilities (CL) at a given point in time. CA and CL have a duration of the greater of one year versus a firm's operating cycle. Based on this definition, NWC is a balance sheet variable isolated by company and time period. To reflect a more dynamic perspective, the change in net working capital (CNWC) between fiscal years should be considered.

While the basic NWC calculation seems straightforward on the surface, the makeup of its individual components diverges across articles and studies. Most research as alluded to by Kieschnick, Laplante, and Moussawi (2013) analyzes NWC in terms of net operating working capital, or trade working capital, which is determined by the sum of accounts receivable (AR) and inventories less accounts payable (AP). Working capital management (WCM) heavily depends on these three items. In addition, a firm's working capital requirement (WCR) is frequently determined by the necessary levels of AR and inventories net accounts payable. Moreover, the optimal level of NWC often relies on the cash conversion cycle (CCC), or net trade cycle, as a form of measurement. The CCC consists of the days sales outstanding (DSO) and days inventory outstanding (DIO) in excess of days payable outstanding (DPO) (Kengelbach, Lindenberg, Moldenhauer, and Wens). The key benchmark of WCM assessment, CCC represents the length of time between the initial purchases for raw materials and the final

sales from finished goods. Thus, the oversight regarding receivables, inventories, and trade credit is critical. (Kieschnick, Laplante, and Moussawi).

Nevertheless, this definitive evaluation of NWC excludes other current operating accounts such as prepaid expenses and short-term debt. Accordingly, another metric to utilize is non-cash net working capital. While cash constitutes a current asset, Damodaran (1996) explains to exclude it as a cash buildup does not represent a cash outflow unlike, for instance, an investment in inventories. While acknowledging this aspect, Stockfis (2012) in contrast notes that increases in excess cash and temporary investments should be accounted for since they do not represent a cash flow available to shareholders. Ultimately, the more simplistic operating NWC serves as the primary interpretation across the existing body of research with limited attention paid to non-cash or, more broadly, non-operating NWC as pertinent to the company and industry under discussion.

Importance of Working Capital Management

Financial managers have long-emphasized the importance of net working capital due to its associations with liquidity, profitability, and overall firm value. According to an estimate by Kieschnick, Laplante, and Moussawi (2013), more than 27% of firm assets among U.S. corporations are invested in NWC. Net working capital represents the cash tied up due to the daily operations of a firm. In other terms, it quantifies the discrepancy between operating cash flows and cash flows from the cash budget. A positive WCR necessitates additional financing, while a negative WCR boldly suggests that operating assets provide more long-term financing (Turner). More explicitly, cash flow from assets is equivalent to operating cash flows less net

capital spending (NCS) and CNWC (Damodaran). Comparable to long-term capital expenditures, or NCS, investments in NWC decrease current free cash flow (FCF) while impacting future FCF. An increase in NWC links to a reduction in FCF, as it requires cash funding. On the other hand, a decline in NWC serves as a source of cash since less capital must be allocated (Turner). NWC thereby serves as a measurement of near-term liquidity. While the short-term effects are clear, the long-term impacts are less unequivocally observed. To provide an example, stock-outs due to an inability to retain sufficient inventory on hand, meaning an especially high DIO, reduce current profitability. At the same time, they also lead 21% to 43% of customers on average to patronize another store and thereby inhibit future sales growth (Kieschnick, Laplante, and Moussawi). Given the significance of NWC, effective WCM thus represents a major element of capital budgeting.

While the relationship between NWC and FCF may outwardly suggest an inverse relationship between net working capital and profitability, studies have reached various conclusions about working capital efficiency. This efficacy is important partly because there exists a tradeoff between capital expenditures (CAPEX) and net working capital investments. Historically, CAPEX has significantly outweighed NWC as it reflects more long-term growth. Furthermore, changes in NWC may reverse for short-term firm projects, as firms initially increase their NWC and later return to their previous level at the termination of the venture. Accordingly, CAPEX is generally considered more sizeable and expensive than NWC investment as a whole, and a company may select to enhance NWC rather than making costly adjustments to its amount of fixed investment (Fazzari and Petersen).

Empirical Studies

Kieschnick, Laplante, and Moussawi (2013) conducted the first apparent empirical study of the relationship between shareholder wealth and corporate WCM. Reviewing the performance of 3,786 U.S. corporations on average per year from 1990 to 2006, they find that a \$1 investment in net operating working capital (NOWC) is generally valued at \$0.52 by shareholders, below the \$1.49 valuation placed on cash and marketable securities. Additionally, access to capital markets, leverage levels, and bankruptcy concerns magnify the effects of NOWC investments. Thus, the study suggests that NWC investment overall inhibits FCF, and financing decisions substantially impact the scale of this effect.

Aktas, Croci, and Petmezas (2015) demonstrate that firms should target an optimal level of net working capital in order to deploy resources to their most valued use. Generally, companies maintain a lower level of NWC throughout their life cycle. For nascent firms with a low level of working capital, increasing NWC allows for accelerating growth in sales and earnings. Additionally, smaller companies have fewer financing alternatives to manage NWC versus larger firms. In contrast, more mature firms or changing consumer demand preferences may reduce the allocation of investments between NWC and CAPEX. An overallocation in working capital may destroy shareholder value as it requires added financing costs and may inhibit alternative value-creating investments like cash acquisitions. Furthermore, a high NWC level financed by debt translates into higher interest expense and, subsequently, a heightened risk of bankruptcy. Analyzing 15,541 individual firms between 1982 and 2011, Aktas, Croci, and Petmezas conclude there exists a non-linear relationship between NWC and stock performance. More specifically, a direct relationship exists for firms with an NWC below the industry-median adjusted NWC while an inverse relationship is prevalent for firms with above-average NWC.

Additionally, a one standard deviation movement converging towards the ideal level in a given year is correlated with about a 0.9% increase in excess stock returns for the following year. Overall, based on the study, firms should target their optimal level of NWC in order to best utilize internally-generated funds to assume profitable investment opportunities and thereby maximize financial performance.

In their analysis of Spanish corporations, Baños-Caballero, García-Teruel, and Solano (2012) bridge the results of these aforementioned studies. Specifically, they conclude that the rate at which firms adjust to reach their target NWC levels depends on a trade-off among costs. They must balance the magnitude of the costs incurred by diverging from working capital optimization with financing considerations such as access to external capital markets which result in increased costs to arrive at the target level. Generally, companies with more favorable access to debt markets more quickly adjust to their target NWC level. Thus, short-term financing decisions are a critical component of NWC efficiency.

As previously referenced, the importance of NWC has been continually promoted by financial managers. Outside of such a qualitative perspective, only a few empirical studies have looked at the benefits of NWC on specific attributes of financial resilience such as sales growth and profit margins. Highfield, Hill, and Kelly (2010) emphasize viewing operating assets and liabilities jointly through WCR. For the 1996 to 2006 period, they observe the working capital behavior of 3,343 companies with a combined mean WCR of \$296 million which represents 23% of the average capital structure. Regressing multiple factors against the WCR, they conclude that, after adjusting for industry-based variances, operating and financing conditions significantly impact NWC. Specifically, they used WCR metrics at time t and compared to primarily lagged statistics defined as t minus $t-1$. A negative correlation between WCR and

lagged sales growth significant at the 1% level was observed, consistent with the assumption that corporations tighten financing policy alongside revenue acceleration. The same inverse relationship exists with uncertain demand, external cost of financing, and financial stress. On the other hand, a direct relationship is present between capital market access, consistent with aforementioned studies. A positive relationship also exists between WCR and operating cash flow, as companies with higher operating cash flows more cautiously manage NWC. This industry-agnostic evaluation illustrates strong relationships between operating NWC and metrics of firm performance.

While most studies utilize operating NWC in their analyses, Khasawneh, Masadeh, and Salamat (2018) focus on non-cash NWC across three industrial sectors: production, retailing, and services. They examine 7,000 U.S. companies over the five-year period from 2010 to 2015. Ultimately, they determine that NWC does not have a major effect on profitability, specifically sales inventory ratios. While inventory volumes influence firm profitability, they are not considered in WCM determination based on the study. Evidence exists that some NWC variables are inversely associated with profitability which would lead to a recommendation of moving inventory levels below benchmarks. Nevertheless, given the overall weak correlation between NWC and profitability from the results, Khasawneh, Masadeh, and Salamat emphasize monitoring industry-wide NWC averages as the focus of WCM.

The necessity of effectively managing NWC is widely recognized and analyzed by financial managers as well as in academia. Still, the empirical data is lacking on the subject as a whole. Specifically, limited attention has been paid to changes in non-cash NWC versus key metrics of firm performance such as sales growth, profitability, and operating cash flows. Moreover, an industry-agnostic versus industry-level adjusted analysis of non-cash working cash

flow post-financial recession has not been thoroughly discussed in the existing body of literature.

Ultimately, this thesis will look to address these underrepresented aspects of working capital management as indicators of firm value and profit maximization.

Chapter 3

Hypothesis

In assessing the outcomes of the study, it is considered that firms generally decrease their NWC over their life cycles to maximize efficiency as detailed in the previous chapter.

Additionally, other factors such as financing considerations and capital expenditures affect this trend. Adding to the substantial presence of potential confounding variables, other aspects like regulations, stock buybacks, and management changes further influence stock price. Moreover, a lot of attention centers on inventory which represents a substantial asset for industries such as retailing versus more technology-oriented businesses.

Overall, it is expected that there exists a weak inverse relationship between non-cash net working capital and firm operating metrics as well as a statistically nonsignificant relationship between non-cash net working capital and stock returns. Additionally, it is anticipated that the strength of the correlations are contingent on the industry under focus. Specifically, retailing companies are predicted to have the strongest relationships between NWC and operating metrics, indicated by the most inverse correlations. In contrast, information technology and software firms are presumed to have the weakest relationships. The base case results, represented by the S&P 500, are expected to fall between the two other indices.

Chapter 4

Methodology of the Study

Methodology Overview

The study relies upon raw data from financial software to analyze the relationship of non-cash net working capital to firm performance. The Standard and Poor's (S&P) 500 Index along with two related industry-specific indices are referenced with constituents derived from Bloomberg. Using Microsoft Office Excel and FactSet, four key metrics are included on an annualized and calendarized basis alongside net working capital for the relevant time horizon. The regressions and correlations for each metric versus NWC are determined on an index-specific basis. Ultimately, the significance of these relationships indicates the level of importance of working capital as it relates to firm operating performance as well as potential strategies for effective working capital management.

Sourcing Index Constituents

The following three indices serve as the focus of the study: the S&P 500 Index (SPX), the S&P 500 Retailing Group Index (S5RETL), and the S&P 500 Information Technology Sector Index (S5INFT). The S&P 500 represents an industry-agnostic basis to analyzing the net working capital of maturing firms. For a contrasting pair of industry-level analyses, retailing is examined versus information technology. Traditionally, retailing is viewed as an inventory-intensive business more centered on WCM than the less capital-intensive business of information technology. To determine index members, the index code as previously

given in parentheses is entered into the Bloomberg Terminal with data as of December 31, 2008.

The final lists exclude any unlisted, delisted, or acquired firms in order to ensure a continuous stream of data for the time period of the study. For the S&P 500, the initial 500 constituents is reduced to 457 as 1 was unlisted, 3 were delisted, and 39 were acquired. The S&P 500 Retail index excludes 1 delisted company, bringing the total to 26 members. Regarding the S&P 500 IT index, the initial 74 firms are decreased to 65 firms due to 1 unlisted member and 8 acquired members. The list of companies which constitute each index for purposes of the study, including all discarded firms, are found in Appendices A, B, and C.

Initial Data Collection

For each index, the list of member tickers is entered into a Microsoft Office Excel worksheet. The time horizon of 2009 – 2021 is selected as it encompasses the period from the end of the Great Recession to the most recent year in completion. The FactSet Excel Add-In is utilized to retrieve the necessary data fields with all metrics reported on a calendarized, annualized basis and presented in U.S. dollars. NWC is defined for the purposes of the study as total current assets net of cash minus total current liabilities. FactSet formulas populate the total current assets, cash, and total current liabilities based on the company ticker and year with an Excel formula to determine working capital. A sample FactSet pull used for cash is =FDS(Ticker,"FF_CASH_ONLY(CAL_R,"&Year&",,,,USD)").

The four financial items under analysis consist of net sales, operating income before unusual items, operating cash flow, and stock price. To limit confounding variables and focus on factors more directly influenced by net working capital, operating metrics are the primary

elements of the study. Operating income before unusual items is selected as the proxy for operating profit to inhibit the effects of changes in accounting standards and other exterior developments. Company stock prices as of December 31 of each year provide an indication of market value for a secondary concentration of the research. For all variables under consideration, any data points lacking FactSet information or meaningful data are omitted.

After amassing the metrics for the relevant companies and years, summary statistics are calculated. Specifically, the median by year is determined utilizing an Excel formula for all five factors: net working capital, net sales, operating income before unusual factors, operating cash flow, and stock price. Given the variation in the dataset with the presence of considerable outliers, the median is the chosen measure versus the mean. The five sets of values for each index are then copied into a separate Excel worksheet at the time of data collection. All metrics are stated in millions of U.S. dollars.

Calculations of Regressions, Correlation Coefficients, and Confidence Intervals

Using the median values previously calculated, five linear regressions are run for each index. More specifically, the four financial items under analysis are regressed individually against non-cash net working capital. NWC serves as the explanatory, or independent, variable (X) in order to determine its influence on the other metrics, the dependent variables (Y). The standard equation for a linear regression is:

$$Y = \alpha + \beta X + \epsilon$$

Where:

Y represents the dependent variable

α represents the y-intercept

β represents the slope

X represents the independent variable

ϵ represents the error term

To run the individual regressions, Excel's Data Analysis tool is used. The Y-Intercept and Slope are determined for each pair and index with the P-value indicating the level of significance of each relationship. The R Square term is incorporated in the analysis to reflect how much of the variation in the data is explained by the fluctuations in NWC. Additionally, the key summary statistic of the study, the correlation coefficient r , is assessed to measure the strength of the relationships. The Multiple R term of the regression reflects the absolute value of the correlation coefficient, and the sign of the Slope mirrors the sign of the correlation coefficient.

The final element of the analysis involves determining confidence intervals for the 15 correlation coefficients. Specifically, upper and low bounds at the 95% and 99% confidence levels are found first by using Fisher's transformation:

$$CI' = r' \pm Z_{1-\alpha/2} * S'$$

Where:

CI' represents the lower or upper bound of the confidence interval with Fisher's transformation

r' represents the correlation with Fisher's transformation where $r' = \frac{1}{2} \ln \left(\frac{1+r}{1-r} \right) = \tanh^{-1}(r)$

$Z_{1-\alpha/2}$ represents the Z statistic given confidence level $1 - \alpha$

S' represents the standard deviation with Fisher's transformation where $S' = \frac{1}{\sqrt{n-3}}$ in which n is the number of observations in the sample, notably 13 in the study

To revert the confidence interval to correlation terms, each bound is adjusted according to the following equation:

$$CI = \frac{e^{(2*CI')} - 1}{e^{(2*CI')} + 1} = \tanh(CI')$$

Where:

CI represents the lower or upper bound of the confidence interval in correlation terms

The results of the aforementioned statistics are summarized in the following chapter.

Methodology Limitations

The collected data is limited in its size and scope. S&P 500 indices are utilized for consistency and simplicity. With that said, they inhibit the number of data points, particularly for the retailing and information technology data sets. The time span of thirteen years further reduces the number of observations for the regressions and correlations, heightening standard errors and thereby expanding the widths of the confidence intervals. Furthermore, the methodology detailed relies on the availability and accuracy of FactSet figures. Potential adjustments and expansions to the study are elaborated in Chapter 5.

Chapter 5

Results of the Study

Results Overview

The summarized results include the regressions, correlation coefficients, and various confidence intervals for all three indices. In particular, the most and least metrics correlated with non-cash net working capital are highlighted. Furthermore, the statistical significance of the regressions, measured by the p-value, as well as the explanatory extent of NWC, measured by R^2 , are reviewed. The four key financial factors rely on the following abbreviations: net sales (“Sales”), operating income before unusual items (“Op Inc”), operating cash flow (“OCF”), and stock price (“Price”).

S&P 500 Index Results

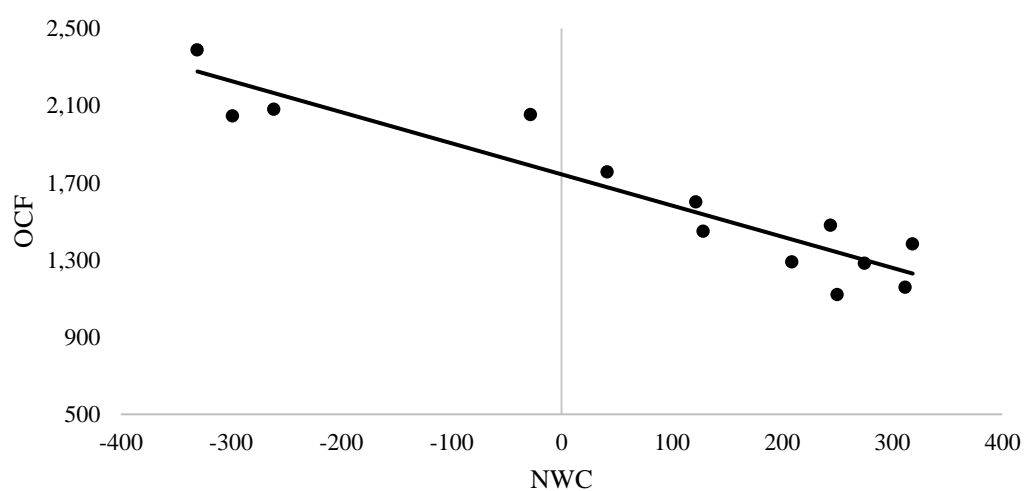
The S&P 500 index data serves as the strongest argument for the importance of net working capital analyzed in the study. The linear regressions in detail for the four factors are included in Appendix D. As demonstrated in the table below, all metrics display strong inverse relationships with NWC with the absolute value of correlation coefficients exceeding 0.80. Additionally, the results appear statistically significant at the 0.1% level.

Figure 1: S&P 500 Correlations and Significance Levels for Financial Measures

	r	R Square	p-value
Sales	-0.8406	0.7066	0.0003
Op Inc	-0.8059	0.6495	0.0009
OCF	-0.9351	0.8744	0.0000
Price	-0.8898	0.7917	0.0000

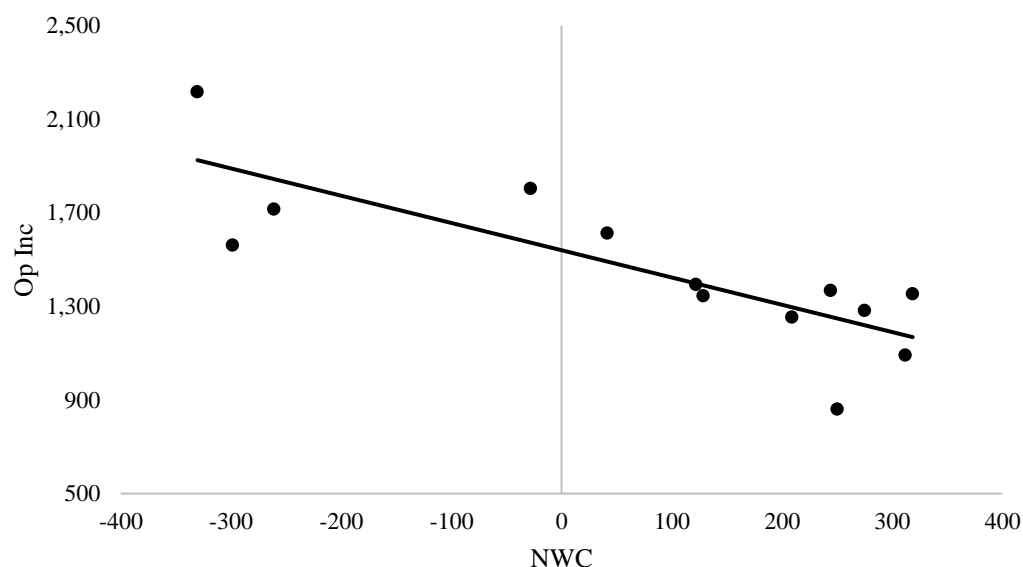
The single most strongly correlated metric to net working capital within the scope of the study is operating cash flow with a strong inverse correlation of -0.93. Moreover, the R Square term indicates that 87% of the variation in OCF is explained by the fluctuation in NWC. To further illustrate the strength of this relationship, the median data points are included below along with the regression line.

Figure 2: S&P 500 Linear Regression of Net Working Capital and Operating Cash Flow



In contrast, the least correlated metric to NWC for the relevant index is operating income. Specifically, the correlation is -0.80 and the R Square term suggests that NWC variation accounts for 65% of the operating income data spread. Figure 3 presents the associated data plot with the regression line.

Figure 3: S&P 500 Linear Regression of Net Working Capital and Operating Income



The confidence intervals for all metrics under focus provide additional support for the extent of the relationships between variables. As shown in the table below, the correlation coefficients for all factors remain negative for the 95% as well as 99% confidence intervals.

Figure 4: S&P 500 Confidence Intervals for Correlation Coefficients

	95% Lower Bound	95% Upper Bound	99% Lower Bound	99% Upper Bound
Sales	-0.9511	-0.5395	-0.9666	-0.3874
Op Inc	-0.9396	-0.4585	-0.9587	-0.2919
OCF	-0.9808	-0.7924	-0.9869	-0.7080
Price	-0.9668	-0.6646	-0.9774	-0.5415

S&P 500 Retailing Index Results

The linear regressions run for the S&P 500 Retailing index data are found in Appendix E. Sales, operating cash flow, and price demonstrate strong inverse relationships with net working

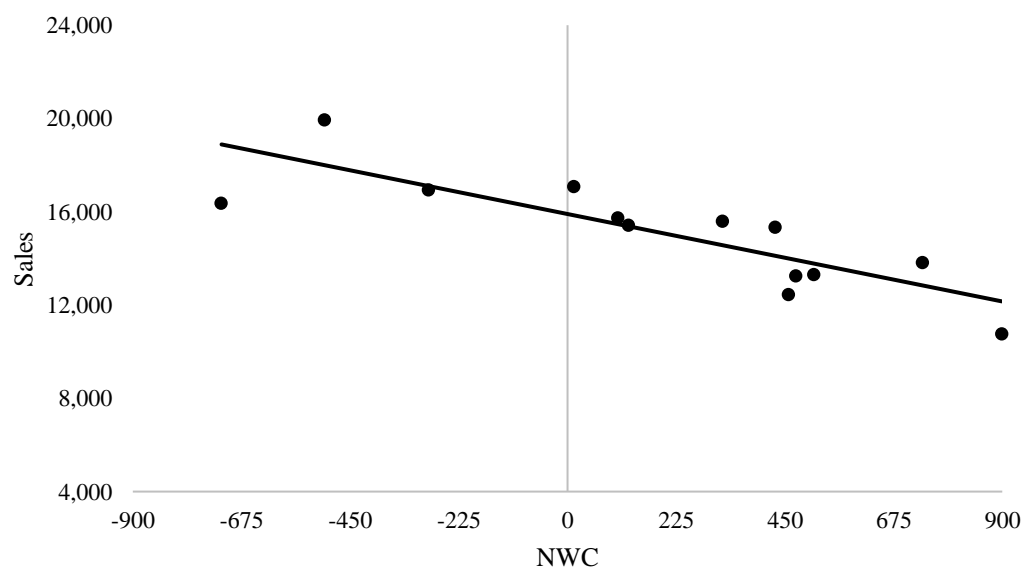
capital with the absolute value of correlation coefficients exceeding 0.70 as well as results statistically significant at the 0.1% level.

Figure 5: Retailing Correlations and Significance Levels for Financial Measures

	r	R Square	p-value
Sales	-0.8350	0.6972	0.0004
Op Inc	-0.2127	0.0453	0.4853
OCF	-0.8062	0.6500	0.0009
Price	-0.7458	0.5562	0.0034

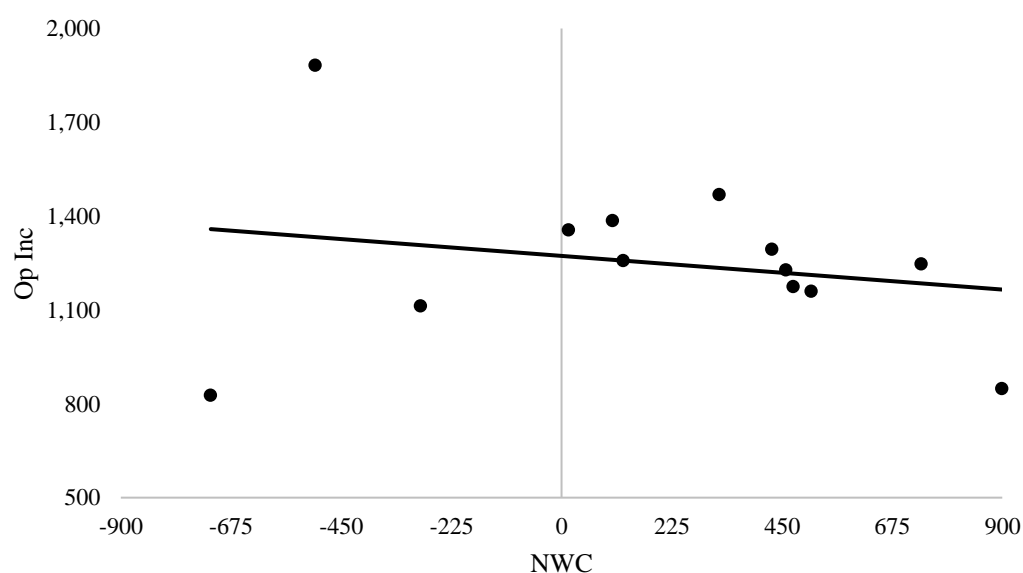
Based on the 26 firms analyzed in the second set of regressions, sales appears to be the variable most correlated with NWC for the retailing industry. Specifically, it has a strong inverse relationship indicated by a correlation of -0.83 with an R Square figure suggesting that nearly 70% of the NWC variation accounts for the sales variation. The 13 observations along with the line of best fit are found below.

Figure 6: Retailing Linear Regression of Net Working Capital and Sales



The metric in striking exception to the other outcomes in the study, operating income, does not suggest any significant relationship with NWC. Excluding the two leftmost data points in the graph below, specifically for 2020 and 2021, the correlation actually appears slightly positive. Overall, there is no clear relationship between the two variables for the retailing industry based on the data collected.

Figure 7: Retailing Linear Regression of Net Working Capital and Operating Income



As seen below, the confidence intervals for the three metrics with notable ties to NWC all remain negative for the 95% along with the 99% confidence intervals. The wide range for the intervals related to operating income and net working capital further emphasizes the lack of significance in the relationship.

Figure 8: Retailing Confidence Intervals for Correlation Coefficients

	95% Lower Bound	95% Upper Bound	99% Lower Bound	99% Upper Bound
Sales	-0.9493	-0.5260	-0.9653	-0.3713
Op Inc	-0.6836	0.3832	-0.7741	0.5360
OCF	-0.9398	-0.4592	-0.9588	-0.2928
Price	-0.9191	-0.3307	-0.9445	-0.1477

S&P 500 Information Technology Index Results

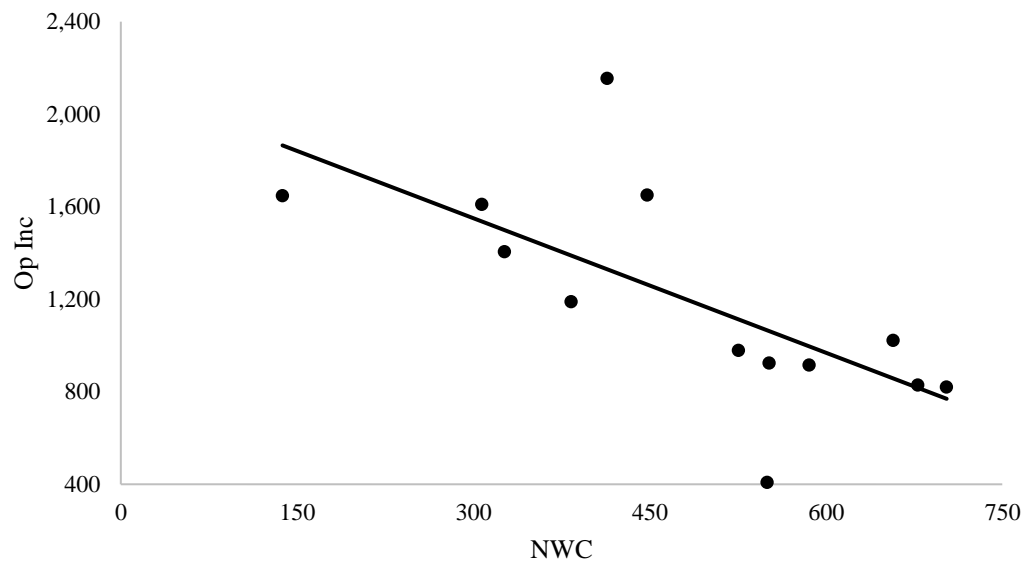
Compared to the previous two indices, companies in the information technology industry appear to have financial performance metrics with a weaker correlation to non-cash net working capital, likely due to little or no inventory dollars on the balance sheet. Appendix F encompasses the linear regressions run for the S&P 500 Information Technology index. As in the summarized data below, the absolute value of the correlation coefficients surpasses 0.50, and the results are significant at a minimum at the 5% level.

Figure 9: IT Correlations and Significance Levels for Financial Measures

	r	R Square	p-value
Sales	-0.6486	0.4207	0.0165
Op Inc	-0.6797	0.4620	0.0106
OCF	-0.6665	0.4442	0.0129
Price	-0.5669	0.3214	0.0434

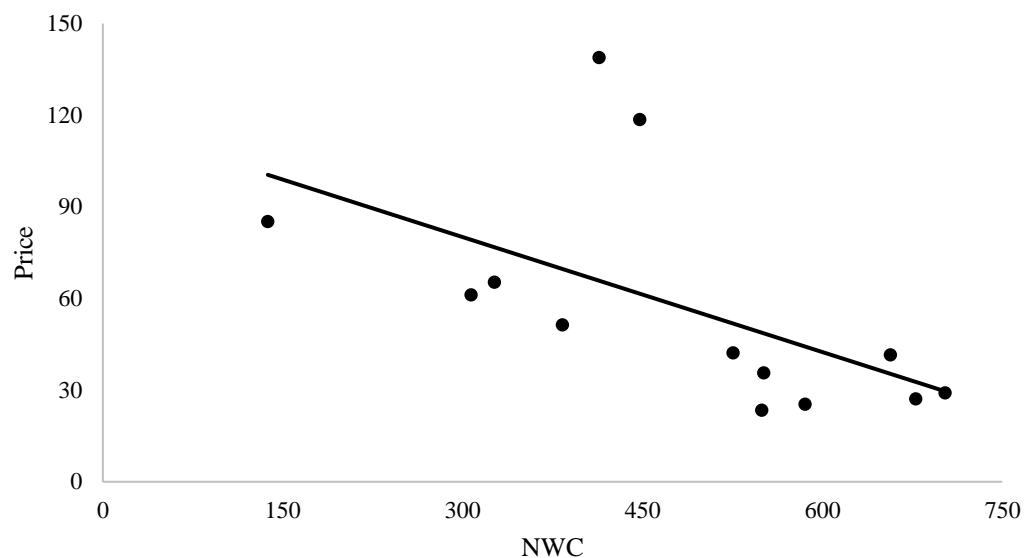
In stark contrast to the previous two sets of correlations, the metric most closely tied to NWC for information technology in the study is operating income. Still, the correlation of -0.68 is relatively weak compared to other findings, and the R Square term indicates that only 46% of the variation is explained by NWC. The observations along with the associated regression line are included below.

Figure 10: IT Linear Regression of Net Working Capital and Operating Income



The least correlated variable for the industry under focus is price with a correlation coefficient of -0.57 and an R Square term suggesting that slightly over 32% of the variation in the metric is accounted for by fluctuations in NWC. Figure 11 contains the regression line and 13 relevant data points with two clear outliers for the years 2020 and 2021 which reduce the strength of the correlation.

Figure 11: IT Linear Regression of Net Working Capital and Price



As previously indicated by the lower significance levels compared to the previous two sets of regressions, the confidence intervals are fairly wide. The correlations remain negative with 95% confidence, but the inverse relationship only sustains with 99% confidence for operating income. The confidence intervals are present in the table below.

Figure 12: IT Confidence Intervals for Correlation Coefficients

	95% Lower Bound	95% Upper Bound	99% Lower Bound	99% Upper Bound
Sales	-0.8838	-0.1520	-0.9198	0.0416
Op Inc	-0.8954	-0.2058	-0.9279	-0.0141
OCF	-0.8905	-0.1825	-0.9245	0.0102
Price	-0.8518	-0.0231	-0.8972	0.1700

Chapter 6

Analysis and Application of the Study

Hypothesis Evaluation

As a whole, the initial hypothesis is rejected. With the exception of the retailing industry correlation between NWC and operating income, the four metrics demonstrate relatively strong relationships with net working capital for all three indices significant at a minimum at the 5% level. The result most divergent from expectation is the formidable link between NWC and stock price. In its simplest definition, a company's stock price represents the expected value of future dividend cash flows. Focusing on the cost aspect of net working capital investments as generally reducing operating cash flows, it seems reasonable that there exists an inverse relationship despite the impact of other variables.

As anticipated, the information technology sector displays the weakest correlations; however, retailing does not have the most significant results. Instead, the broader S&P 500 index shows the greatest evidence for a largely inverse relationship between NWC and key performance measures. Several factors may account for these results. Chiefly, the data set for the S&P 500 benchmark with 457 constituents vastly exceeds the retailing industry data set with a mere 26 firms. In addition, while retailing is generally presumed to have a strong relationship with a key component of the change in net working capital, inventory, other industries like the capital-intensive industrials and the accounts receivable-oriented services may have more notable correlations over the time horizon. Furthermore, the COVID-19 pandemic especially impacted 2020 and 2021 financial results for retailing firms which leads to outliers that substantially alter the direction and strength of the regressions.

Application of the Results

Implementing the conclusions from the study, firms may observe a heightened efficiency in working capital management. Primarily, maturing firms should overall look to decrease non-cash net working capital in order to maximize operating performance. While the results do not indicate the ideal level of working capital which is more specific to industry and firm, they do suggest that *ceteris paribus* a decrease in NWC for a maturing firm is associated with increases in sales, operating cash flow, and, to a lesser extent, operating income.

Outside of a corporate finance perspective, a secondary application concerns stock performance for investors. Sizable maturing firms appear to decrease net working capital over time due to declining investments in new projects, cheaper financing options, improved operating efficiency, and other factors. While this alone should not be used as the determinant of company stock outperformance or even stock appreciation, it does provide for some argument that maturing or low growth firms which largely maintain or substantially increase their net working capital over time may prompt concern or at least further investigation before various entities elect to invest in their stock.

Extension of the Study

While the results within the scope of the study appear strikingly significant as a whole, expanding upon both the data set and quantitative analysis may enhance the prescriptive power of the results. The indices selected at a single point in time provide a limited number of companies, especially for the retailing and information technology industries. Alternatively, all of the constituents included over a twenty- or thirty-year period may be represented. To add to

the lists of firms, adjusted indices may be manually created to exclude acquired, delisted, and unlisted businesses while retaining the initial number of members given on Bloomberg.

Moreover, the strength of the results may be furthered by elongating the time horizon to thirty or more years.

As previously noted, a few outliers substantially influence some of the correlations. Besides increasing the number of observations by widening the time horizon, the frequency of the data may be adjusted. Specifically, instead of calendarized years, quarterly metrics may be utilized and possibly weekly data for stock prices. The caveat to this alteration, though, is that this may increase the noise in the data set, particularly when considering weekly returns versus annual returns. With this said, the major adjustment to improve upon the study revolves around incorporating more specific recommendations rather than generalizations about firms and trends. To make the conclusions less broad, net working capital targets should be determined on both an industry-agnostic and industry-defined basis.

Alternative Data Collection

Besides improving the outlined methodology, other data sets or aspects of net working capital may be examined. Different industries such as healthcare, industrials, and materials may serve as the focal points of the study. To further narrow the scope of the study, subsectors may be considered like beauty, apparel, and food and beverage. Moreover, alternative indices to Standard and Poor's include the Dow Jones, Nasdaq, and Russell 2000. The previously presented data set also primarily relies on more mature firms; however, some evidence indicates that more nascent firms increase net working capital in early years which would significantly alter the

direction of the correlations. Thus, the data may be divided into subsets of large cap and small cap companies. Alternatively, high growth firms may be assessed separate from low growth firms. Another area to explore, unrepresented in the current study, concerns declining companies. Specifically, it may be interesting to assess whether or not firms which have failed or lost considerable market share have a more inefficient working capital management than sustaining businesses. Beyond adjusting for types and maturities of businesses, the results for countries other than the United States may be analyzed. For instance, it may be interesting to consider net working capital developments for firms in developing versus developed nations assuming the applicable data is available. Condensing the data set to only heavily industrialized nations may provide insight into NWC differences among the world's foremost markets.

Alternative Quantitative Analysis

In addition to selecting difference data sources, the quantitative aspects of the analysis may be altered to reach other conclusions about the relationships between net working capital and firm performance. While the definition of NWC is presented as non-cash for the purposes of the described study, other descriptions are applicable as discussed in Chapter 2. Specifically, a narrower interpretation may constitute trade working capital. Alternatively, future research may rely on a broader translation like total net working capital which is inclusive of cash and cash equivalents. Instead of directly including working capital, related metrics such as working capital ratios may serve as the spotlight.

Furthermore, the study concentrates on operating metrics without significant adjustments for various factors. Regressing items such as earnings, free cash flow, and book value against net

working capital may better demonstrate the influence of NWC on firms as a whole. On the other hand, financing considerations and other alterations may be implemented in order to further isolate the impact of net working capital. For example, future studies may account for the financing policy of firms indicated by their division of debt and equity as well as the investing policy of companies based on their amount of working capital versus capital expenditures. As previously mentioned, target levels of NWC should be emphasized. Lastly, moving away from the exhaustive corporate finance aspects of this topic, more attention may be paid to stock returns. For instance, it seems interesting to ascertain whether or not firms with WCR below the recommended level perform better, on average, compared to their counterparts. Additionally, while large, successful firms demonstrate a strong inverse relationship, the same may not hold for failing firms. In particular, another study may assess if established companies that maintain or increase their net working capital generate inferior future returns to those that decrease their NWC.

Chapter 7

Conclusion

Much of the existing qualitative research and empirical data suggest that net working capital investments overall decrease free cash flow with potential adjustments for company-specific investing and financing policies. Past quantitative studies largely center on NWC in terms of trade capital and recommend moving NWC levels below industry averages. In this paper, the non-cash net working capital for constituents of one industry-agnostic and two industry-specific indices is analyzed against four financial measures over the period from 2009 to 2021 utilizing Bloomberg and FactSet data.

Ultimately, the results are consistent with previous studies which indicate an inverse relationship between NWC and profitability for mature firms. With that said, the correlations for the selected data sets appear stronger and more significant than those presented elsewhere. Furthermore, the same relationships seem to hold true for less inventory-intensive businesses like information technology. Overall, the results support the arguments for firms to focus on working capital efficiency as well as to decrease NWC levels throughout their life cycles. Considering the presence of significant outliers for 2020 and 2021 in light of the COVID-19 pandemic, future research is necessary to solidify the observed trends and ascertain whether or not they sustain post-pandemic. Further studies should especially focus on assessing whether or not declining NWC, contingent on industry and maturity, translates into enhanced stock returns for investors. Net working capital represents a critical part of a firm's holistic operations and merits further analysis in order to maximize profitability.

Appendix A

S&P 500 Index Constituents

Status/Ticker	Company	Status/Ticker	Company
Acquired	Affiliated Computer Services Inc	Acquired	Allergan Inc/United States
Acquired	Altera Corp	Acquired	Beam Suntory Inc
Acquired	BJ Services Co	Acquired	Centex LLC
Acquired	Chubb Corp/The	Acquired	Compuware Corp
Acquired	Constellation Energy Group Inc	Acquired	Dell Inc
Acquired	DIRECTV	Acquired	Dun & Bradstreet Corp/The
Acquired	EI du Pont de Nemours and Co	Acquired	EI Paso LLC
Acquired	Embarq Corp	Acquired	EMD Millipore Corp
Acquired	ETC Sunoco Holdings LLC	Acquired	Forest Laboratories Inc
Acquired	International Game Technology	Acquired	Johnson Controls Inc
Acquired	L3 Technologies Inc	Acquired	Life Technologies Corp
Acquired	LSI Corp	Acquired	Monsanto Co
Acquired	National Semiconductor Corp	Acquired	Nicor Inc
Acquired	Novellus Systems Inc	Acquired	Oracle America Inc
Acquired	Pall Corp	Acquired	Progress Energy Inc
Acquired	Prologis	Acquired	Qwest Communications International Inc
Acquired	Smith International Inc	Acquired	Spectra Energy LLC
Acquired	Sprint Communications Inc	Acquired	TECO Energy Inc
Acquired	UST LLC	Acquired	Wachovia Corp
Acquired	XL Group Ltd	Delisted	Dow Chemical Co/The
Delisted	Linde Inc/CT	Delisted	Office Depot Inc
Unlisted	Yahoo! Inc - Set up for Fundamental Purp	A	Agilent Technologies Inc
AA	Alcoa Corp	AAPL	Apple Inc
ABC	AmerisourceBergen Corp	ABT	Abbott Laboratories
ACAS	ACAS LLC	ADBE	Adobe Inc
ADI	Analog Devices Inc	ADM	Archer-Daniels-Midland Co
ADP	Automatic Data Processing Inc	ADSK	Autodesk Inc
AEE	Ameren Corp	AEP	American Electric Power Co Inc
AES	AES Corp/The	AET	Aetna Inc
AFL	Aflac Inc	AGN	Allergan Ltd/Ireland
AIG	American International Group Inc	AIV	Apartment Investment and Management Co
AIZ	Assurant Inc	AKAM	Akamai Technologies Inc
AKS	Cleveland-Cliffs Steel Holding Corp	ALL	Allstate Corp/The
AMAT	Applied Materials Inc	AMD	Advanced Micro Devices Inc
AMGN	Amgen Inc	AMP	Ameriprise Financial Inc
AMT	American Tower Corp	AMZN	Amazon.com Inc
AN	AutoNation Inc	ANDV	Andeavor
ANF	Abercrombie & Fitch Co	ANTM	Anthem Inc
AON	Aon PLC	APA	APA Corp
APC	Anadarko Petroleum Corp	APD	Air Products and Chemicals Inc
APH	Amphenol Corp	APOL	Apollo Education Group Inc
ATI	Allegheny Technologies Inc	AVB	AvalonBay Communities Inc

AVP	Avon Products Inc	AVY	Avery Dennison Corp
AXP	American Express Co	AYE	Allegheny Energy Inc
AZO	AutoZone Inc	BA	Boeing Co/The
BAC	Bank of America Corp	BAX	Baxter International Inc
BBBY	Bed Bath & Beyond Inc	BBWI	Bath & Body Works Inc
BBY	Best Buy Co Inc	BCR	CR Bard Inc
BDK	Black & Decker Corp/The	BDX	Becton Dickinson and Co
BEN	Franklin Resources Inc	BF/B	Brown-Forman Corp
BHI	Baker Hughes Holdings LLC	BIG	Big Lots Inc
BIIB	Biogen Inc	BK	Bank of New York Mellon Corp/The
BLL	Ball Corp	BMC	BMC Software Inc
BMS	Amcor Flexibles North America Inc	BMY	Bristol-Myers Squibb Co
BNI	Burlington Northern Santa Fe LLC	BRCM	Broadcom Corp
BSX	Boston Scientific Corp	BTUUQ	Peabody Energy Corp
BXP	Boston Properties Inc	C	Citigroup Inc
CA	CA Inc	CAG	Conagra Brands Inc
CAH	Cardinal Health Inc	CAM	Cameron International Corp
CAT	Caterpillar Inc	CBE	Cooper Industries PLC
CBRE	CBRE Group Inc	CCEP	Coca-Cola Europacific Partners PLC
CCL	Carnival Corp	CELG	Celgene Corp
CEPH	Cephalon Inc	CF	CF Industries Holdings Inc
CHKAQ	Chesapeake Energy Corp	CHRW	CH Robinson Worldwide Inc
CI	Cigna Corp	CIEN	Ciena Corp
CINF	Cincinnati Financial Corp	CITGQ	CIT Group Inc/Old
CL	Colgate-Palmolive Co	CLX	Clorox Co/The
CMA	Comerica Inc	CMCSA	Comcast Corp
CME	CME Group Inc	CMI	Cummins Inc
CMS	CMS Energy Corp	CNP	CenterPoint Energy Inc
CNX	CNX Resources Corp	COF	Capital One Financial Corp
COL	Rockwell Collins Inc	COP	ConocoPhillips
COST	Costco Wholesale Corp	COV	Covidien Ltd
CPB	Campbell Soup Co	CPPRQ	Old Copper Co Inc
CRM	salesforce.com Inc	CSC	Computer Sciences Corp
CSCO	Cisco Systems Inc/Delaware	CSX	CSX Corp
CTAS	Cintas Corp	CTRA	Coterra Energy Inc
CTSH	Cognizant Technology Solutions Corp	CTXS	Citrix Systems Inc
CVG	Convergys Corp	CVH	Coventry Health Care Inc
CVS	CVS Health Corp	CVX	Chevron Corp
D	Dominion Energy Inc	DE	Deere & Co
DFODQ	Dean Foods Co	DFS	Discover Financial Services
DGX	Quest Diagnostics Inc	DHI	DR Horton Inc
DHR	Danaher Corp	DIS	Walt Disney Co/The
DOV	Dover Corp	DRI	Darden Restaurants Inc
DTE	DTE Energy Co	DUK	Duke Energy Corp
DVA	DaVita Inc	DVN	Devon Energy Corp
DYNIQ	Dynegy Inc/Old	EA	Electronic Arts Inc
EBAY	eBay Inc	ECL	Ecolab Inc
ED	Consolidated Edison Inc	EFX	Equifax Inc

EIX	Edison International	EKDKQ	Eastman Kodak Co
EL	Estee Lauder Cos Inc/The	EMC	EMC Corp
EMN	Eastman Chemical Co	EMR	Emerson Electric Co
EOG	EOG Resources Inc	EQR	Equity Residential
EQT	EQT Corp	ESRX	Evernorth Health Inc
ETFC	E*TRADE Financial Corp	ETN	Eaton Corp PLC
ETR	Entergy Corp	EXC	Exelon Corp
EXPD	Expeditors International of Washington I	EXPE	Expedia Group Inc
F	Ford Motor Co	FAST	Fastenal Co
FCX	Freeport-McMoRan Inc	FDO	Family Dollar Stores Inc
FDX	FedEx Corp	FE	FirstEnergy Corp
FHI	Federated Hermes Inc	FHN	First Horizon Corp
FIS	Fidelity National Information Services I	FISV	Fiserv Inc
FITB	Fifth Third Bancorp	FLR	Fluor Corp
FLS	Flowserve Corp	FTRCQ	Frontier Communications Corp
GD	General Dynamics Corp	GE	General Electric Co
GENZ	Genzyme Corp	GHC	Graham Holdings Co
GILD	Gilead Sciences Inc	GIS	General Mills Inc
GL	Globe Life Inc	GLW	Corning Inc
GME	GameStop Corp	GNW	Genworth Financial Inc
GOOGL	Alphabet Inc	GPC	Genuine Parts Co
GPS	Gap Inc/The	GR	Goodrich Corp
GS	Goldman Sachs Group Inc/The	GT	Goodyear Tire & Rubber Co/The
GWW	WW Grainger Inc	HAL	Halliburton Co
HAR	Harman International Industries Inc	HAS	Hasbro Inc
HBAN	Huntington Bancshares Inc/OH	HCBK	Hudson City Bancorp Inc
HD	Home Depot Inc/The	HES	Hess Corp
HIG	Hartford Financial Services Group Inc/Th	HNZ	Kraft Heinz Foods Co
HOG	Harley-Davidson Inc	HON	Honeywell International Inc
HOT	Starwood Hotels & Resorts Worldwide LLC	HPQ	HP Inc
HRB	H&R Block Inc	HSH	Hillshire Brands Co/The
HSP	Hospira Inc	HST	Host Hotels & Resorts Inc
HSY	Hershey Co/The	HUM	Humana Inc
IBM	International Business Machines Corp	ICE	Intercontinental Exchange Inc
IFF	International Flavors & Fragrances Inc	INTC	Intel Corp
INTU	Intuit Inc	IP	International Paper Co
IPG	Interpublic Group of Cos Inc/The	ISRG	Intuitive Surgical Inc
ITT	ITT Inc	ITW	Illinois Tool Works Inc
IVZ	Invesco Ltd	J	Jacobs Engineering Group Inc
JBL	Jabil Inc	JCI	Johnson Controls International plc
JEF	Jefferies Financial Group Inc	JNJ	Johnson & Johnson
JNPR	Juniper Networks Inc	JNS	Janus Henderson US Holdings Inc
JNY	Jones Group Inc/NY	JPM	JPMorgan Chase & Co
JWN	Nordstrom Inc	K	Kellogg Co
KBH	KB Home	KDP	Keurig Dr Pepper Inc
KEY	KeyCorp	KG	KP Pharmaceuticals LLC
KIM	Kimco Realty Corp	KLAC	KLA Corp
KMB	Kimberly-Clark Corp	KO	Coca-Cola Co/The

KR	Kroger Co/The	KSS	Kohl's Corp
L	Loews Corp	LEG	Leggett & Platt Inc
LEN	Lennar Corp	LH	Laboratory Corp of America Holdings
LHX	L3Harris Technologies Inc	LLTC	Linear Technology Corp
LLY	Eli Lilly & Co	LM	Legg Mason Inc
LMT	Lockheed Martin Corp	LNC	Lincoln National Corp
LO	Lorillard LLC	LOW	Lowe's Cos Inc
LUMN	Lumen Technologies Inc	LUV	Southwest Airlines Co
LXK	Lexmark International Inc	M	Macy's Inc
MA	Mastercard Inc	MAR	Marriott International Inc/MD
MAS	Masco Corp	MAT	Mattel Inc
MBI	MBIA Inc	MCD	McDonald's Corp
MCHP	Microchip Technology Inc	MCK	McKesson Corp
MCO	Moody's Corp	MDLZ	Mondelez International Inc
MDP	Meredith Corp	MDT	Medtronic PLC
MEE	Alpha Appalachia Holdings LLC	MER	Merrill Lynch & Co Inc
MET	MetLife Inc	MFE	McAfee Inc
MHS	Medco Health Solutions Inc	MI	Marshall & Ilsley Corp
MKC	McCormick & Co Inc/MD	MMC	Marsh & McLennan Cos Inc
MMM	3M Co	MO	Altria Group Inc
MOLX	Molex LLC/US	MRK	Merck & Co Inc
MRO	Marathon Oil Corp	MS	Morgan Stanley
MSFT	Microsoft Corp	MSI	Motorola Solutions Inc
MTB	M&T Bank Corp	MTLQQ	Motors Liquidation Co
MTW	Manitowoc Co Inc/The	MU	Micron Technology Inc
MUR	Murphy Oil Corp	MWV	WestRock MWV LLC
MWW	Monster Worldwide Inc	MYL	Mylan NV
NBL	Noble Energy Inc	NBR	Nabors Industries Ltd
NCC	National City Corp	NDAQ	Nasdaq Inc
NEBLQ	Noble Holding Corp PLC	NEE	NextEra Energy Inc
NEM	Newmont Corp	NI	NiSource Inc
NKE	NIKE Inc	NLOK	NortonLifeLock Inc
NOC	Northrop Grumman Corp	NOV	NOV Inc
NOVL	Micro Focus Software Inc	NSC	Norfolk Southern Corp
NTAP	NetApp Inc	NTRS	Northern Trust Corp
NUE	Nucor Corp	NVDA	NVIDIA Corp
NWL	Newell Brands Inc	NYT	New York Times Co/The
NYX	NYSE Euronext	OMC	Omnicom Group Inc
ORCL	Oracle Corp	OXY	Occidental Petroleum Corp
PARA	Paramount Global	PAYX	Paychex Inc
PBCT	People's United Financial Inc	PBG	Pepsi Bottling Group Inc/The
PBI	Pitney Bowes Inc	PCAR	PACCAR Inc
PCG	PG&E Corp	PCL	Plum Creek Timber Co Inc
PCP	Precision Castparts Corp	PDCO	Patterson Cos Inc
PEAK	Healthpeak Properties Inc	PEG	Public Service Enterprise Group Inc
PEP	PepsiCo Inc	PFE	Pfizer Inc
PFG	Principal Financial Group Inc	PG	Procter & Gamble Co/The
PGR	Progressive Corp/The	PH	Parker-Hannifin Corp

PHM	PulteGroup Inc	PKI	PerkinElmer Inc
PM	Philip Morris International Inc	PNC	PNC Financial Services Group Inc/The
PNW	Pinnacle West Capital Corp	POM	Pepco Holdings LLC
PPG	PPG Industries Inc	PPL	PPL Corp
PRU	Prudential Financial Inc	PSA	Public Storage
PTV	Pactiv LLC	PXD	Pioneer Natural Resources Co
QCOM	QUALCOMM Inc	QLGC	QLogic LLC
R	Ryder System Inc	RAI	Reynolds American Inc
RDC	Rowan Cos Ltd	RF	Regions Financial Corp
RHI	Robert Half International Inc	RL	Ralph Lauren Corp
ROH	Rohm and Haas Co	ROK	Rockwell Automation Inc
RRC	Range Resources Corp	RRD	RR Donnelley & Sons Co
RSG	Republic Services Inc	RSHCQ	RS Legacy Corp
RTN	Raytheon Co	RTX	Raytheon Technologies Corp
RX	IQVIA Inc	SBUX	Starbucks Corp
SCHW	Charles Schwab Corp/The	SEE	Sealed Air Corp
SGP	Schering-Plough Corp/Pre-merger with Mer	SHLDQ	Sears Holdings Corp
SHW	Sherwin-Williams Co/The	SIAL	Sigma-Aldrich Corp
SITC	SITE Centers Corp	SJM	J M Smucker Co/The
SLB	Schlumberger NV	SLM	SLM Corp
SNA	Snap-on Inc	SNDK	SanDisk LLC
SNI	Scripps Networks Interactive Inc	SO	Southern Co/The
SOV	Santander Holdings USA Inc	SPG	Simon Property Group Inc
SPGI	S&P Global Inc	SPLS	Staples Inc
SRCL	Stericycle Inc	SRE	Sempra Energy
STI	SunTrust Banks Inc	STJ	St Jude Medical Inc
STR	Dominion Energy Questar Corp	STT	State Street Corp
STZ	Constellation Brands Inc	SUNEQ	SunEdison Inc
SVU	SUPERVALU Inc	SWK	Stanley Black & Decker Inc
SWN	Southwestern Energy Co	SWY	Safeway Inc
SYK	Stryker Corp	SYG	Sysco Corp
T	AT&T Inc	TAP	Molson Coors Beverage Co
TDC	Teradata Corp	TEG	Integrus Energy Group Inc
TEL	TE Connectivity Ltd	TER	Teradyne Inc
TFC	Truist Financial Corp	TFCFA	TFCF Corp
TGNA	TEGNA Inc	TGT	Target Corp
THC	Tenet Healthcare Corp	TIE	Titanium Metals Corp
TIF	Tiffany & Co	TJX	TJX Cos Inc/The
TLAB	Infinera Optical Holding Inc	TMO	Thermo Fisher Scientific Inc
TNL	Travel + Leisure Co	TPR	Tapestry Inc
TROW	T Rowe Price Group Inc	TRV	Travelers Cos Inc/The
TSN	Tyson Foods Inc	TSS	Total System Services Inc
TT	Trane Technologies PLC	TWX	Time Warner Inc
TXN	Texas Instruments Inc	TXT	Textron Inc
UNH	UnitedHealth Group Inc	UNM	Unum Group
UNP	Union Pacific Corp	UPS	United Parcel Service Inc
USB	US Bancorp	VALPQ	Valaris plc
VAR	Varian Medical Systems Inc	VFC	VF Corp

VIAB	Viacom Inc	VIAV	Viavi Solutions Inc
VLO	Valero Energy Corp	VMC	Vulcan Materials Co
VNO	Vornado Realty Trust	VRSN	VeriSign Inc
VZ	Verizon Communications Inc	WAT	Waters Corp
WBA	Walgreens Boots Alliance Inc	WEC	WEC Energy Group Inc
WFC	Wells Fargo & Co	WFM	Whole Foods Market Inc
WFTIQ	Weatherford International PLC	WHR	Whirlpool Corp
WINMQ	Windstream Holdings Inc	WM	Waste Management Inc
WMB	Williams Cos Inc/The	WMT	Walmart Inc
WU	Western Union Co/The	WY	Weyerhaeuser Co
WYE	Wyeth LLC	WYNN	Wynn Resorts Ltd
X	United States Steel Corp	XEL	Xcel Energy Inc
XLNX	Xilinx Inc	XOM	Exxon Mobil Corp
XRAY	DENTSPLY SIRONA Inc	XRX	Xerox Holdings Corp
XTO	XTO Energy Inc	YUM	Yum! Brands Inc
ZBH	Zimmer Biomet Holdings Inc	ZION	Zions Bancorp NA

Appendix B

S&P 500 Retailing Constituents

Status/Ticker	Company	Status/Ticker	Company
Delisted	Office Depot Inc	AMZN	Amazon.com Inc
AN	AutoNation Inc	ANF	Abercrombie & Fitch Co
AZO	AutoZone Inc	BBBY	Bed Bath & Beyond Inc
BBWI	Bath & Body Works Inc	BBY	Best Buy Co Inc
BIG	Big Lots Inc	CPPRQ	Old Copper Co Inc
EXPE	Expedia Group Inc	FDO	Family Dollar Stores Inc
GME	GameStop Corp	GPC	Genuine Parts Co
GPS	Gap Inc/The	HD	Home Depot Inc/The
JWN	Nordstrom Inc	KSS	Kohl's Corp
LOW	Lowe's Cos Inc	M	Macy's Inc
RSHCQ	RS Legacy Corp	SHLDQ	Sears Holdings Corp
SHW	Sherwin-Williams Co/The	SPLS	Staples Inc
TGT	Target Corp	TIF	Tiffany & Co
TJX	TJX Cos Inc/The		

Appendix C

S&P 500 Information Technology Index Constituents

Status/Ticker	Company	Status/Ticker	Company
Acquired	Affiliated Computer Services Inc	Acquired	Altera Corp
Acquired	Compuware Corp	Acquired	Dell Inc
Acquired	LSI Corp	Acquired	National Semiconductor Corp
Acquired	Novellus Systems Inc	Acquired	Oracle America Inc
Unlisted	Yahoo! Inc - Set up for Fundamental Purp	A	Agilent Technologies Inc
AAPL	Apple Inc	ADBE	Adobe Inc
ADI	Analog Devices Inc	ADP	Automatic Data Processing Inc
ADSK	Autodesk Inc	AKAM	Akamai Technologies Inc
AMAT	Applied Materials Inc	AMD	Advanced Micro Devices Inc
APH	Amphenol Corp	BMC	BMC Software Inc
BRCM	Broadcom Corp	CA	CA Inc
CIEN	Ciena Corp	CRM	salesforce.com Inc
CSC	Computer Sciences Corp	CSCO	Cisco Systems Inc/Delaware
CTSH	Cognizant Technology Solutions Corp	CTXS	Citrix Systems Inc
CVG	Convergys Corp	EA	Electronic Arts Inc
EBAY	eBay Inc	EMC	EMC Corp
FIS	Fidelity National Information Services I	FISV	Fiserv Inc
GLW	Corning Inc	GOOGL	Alphabet Inc
HPQ	HP Inc	IBM	International Business Machines Corp
INTC	Intel Corp	INTU	Intuit Inc
JBL	Jabil Inc	JNPR	Juniper Networks Inc
KLAC	KLA Corp	LHX	L3Harris Technologies Inc
LLTC	Linear Technology Corp	LXK	Lexmark International Inc
MA	Mastercard Inc	MCHP	Microchip Technology Inc
MFE	McAfee Inc	MOLX	Molex LLC/US
MSFT	Microsoft Corp	MSI	Motorola Solutions Inc
MU	Micron Technology Inc	NLOK	NortonLifeLock Inc
NOVL	Micro Focus Software Inc	NTAP	NetApp Inc
NVDA	NVIDIA Corp	ORCL	Oracle Corp
PAYX	Paychex Inc	QCOM	QUALCOMM Inc
QLGC	QLogic LLC	SNDK	SanDisk LLC
SUNEQ	SunEdison Inc	TDC	Teradata Corp
TEL	TE Connectivity Ltd	TER	Teradyne Inc
TLAB	Infinera Optical Holding Inc	TSS	Total System Services Inc
TXN	Texas Instruments Inc	VIAV	Viavi Solutions Inc
VRSN	VeriSign Inc	WU	Western Union Co/The
XLNX	Xilinx Inc	XRX	Xerox Holdings Corp

Appendix D

S&P 500 Index Regressions

<i>Sales Regression Statistics</i>	
Multiple R	0.840619979
R Square	0.706641949
Adjusted R Square	0.679973035
Standard Error	1050.043763
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	29215201.59	29215201.59	26.4968403	0.000319479
Residual	11	12128510.94	1102591.904		
Total	12	41343712.53			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	11522.55335	307.0905318	37.52168222	5.81809E-13	10846.65164	12198.45505
NWC	-6.621076316	1.28626825	-5.147508164	0.000319479	-9.452133645	-3.790018987

<i>Op Inc Regression Statistics</i>	
Multiple R	0.805904428
R Square	0.649481947
Adjusted R Square	0.61761667
Standard Error	210.7235345
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	905056.0241	905056.0241	20.38212118	0.000879737
Residual	11	488448.4877	44404.40797		
Total	12	1393504.512			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1540.18056	61.62714788	24.99191693	4.83899E-11	1404.540122	1675.820998
NWC	-1.165364762	0.258129234	-4.514656263	0.000879737	-1.733503374	-0.597226149

<i>OCF Regression Statistics</i>	
Multiple R	0.935120156
R Square	0.874449707
Adjusted R Square	0.863036044
Standard Error	150.5266194
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	1735946.781	1735946.781	76.61429162	2.74997E-06
Residual	11	249240.8947	22658.26315		
Total	12	1985187.676			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1744.002272	44.02226006	39.61637293	3.21384E-13	1647.109931	1840.894613
NWC	-1.613958463	0.18439004	-8.752959021	2.74997E-06	-2.019798204	-1.208118721

<i>Price Regression Statistics</i>	
Multiple R	0.88976035
R Square	0.79167348
Adjusted R Square	0.772734705
Standard Error	8.662242095
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	3136.56908	3136.56908	41.80172677	4.64265E-05
Residual	11	825.3788192	75.03443811		
Total	12	3961.947899			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	61.55747612	2.533315873	24.29917121	6.55901E-11	55.98168548	67.13326676
NWC	-0.068604338	0.010610955	-6.46542549	4.64265E-05	-0.091958892	-0.045249784

Appendix E

S&P 500 Retailing Index Regressions

<i>Sales Regression Statistics</i>	
Multiple R	0.835009192
R Square	0.697240351
Adjusted R Square	0.669716747
Standard Error	1360.396258
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	46882208.59	46882208.59	25.33245068	0.000382066
Residual	11	20357457.75	1850677.977		
Total	12	67239666.34			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	15902.53152	411.1705444	38.6762421	4.17835E-13	14997.55125	16807.51179
NWC	-4.166606107	0.827835113	-5.033135273	0.000382066	-5.988658906	-2.344553309

<i>Op Inc Regression Statistics</i>	
Multiple R	0.21273779
R Square	0.045257367
Adjusted R Square	-0.041537418
Standard Error	272.1101155
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	38608.68665	38608.68665	0.521429569	0.485300406
Residual	11	814483.0642	74043.91493		
Total	12	853091.7509			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1272.934719	82.24343731	15.47764492	8.18996E-09	1091.918134	1453.951304
NWC	-0.119569642	0.165585804	-0.722100803	0.485300406	-0.484021539	0.244882255

<i>OCF Regression Statistics</i>	
Multiple R	0.806215433
R Square	0.649983325
Adjusted R Square	0.618163628
Standard Error	253.635235
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	1314090.686	1314090.686	20.42707417	0.00087257
Residual	11	707639.157	64330.83246		
Total	12	2021729.843			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1636.177931	76.65952998	21.34343808	2.65781E-10	1467.451443	1804.904419
NWC	-0.697575282	0.154343378	-4.519632084	0.00087257	-1.037282766	-0.357867798

<i>Price Regression Statistics</i>	
Multiple R	0.745769462
R Square	0.55617209
Adjusted R Square	0.515824098
Standard Error	12.96616648
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	2317.450435	2317.450435	13.78438097	0.003424825
Residual	11	1849.336205	168.1214732		
Total	12	4166.786639			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	59.22569216	3.918935899	15.11269735	1.05328E-08	50.6001724	67.85121192
NWC	-0.029294335	0.007890236	-3.712732278	0.003424825	-0.046660628	-0.011928042

Appendix F

S&P 500 Information Technology Index Regressions

<i>Sales Regression Statistics</i>						
Multiple R	0.648643313					
R Square	0.420738147					
Adjusted R Square	0.368077979					
Standard Error	2279.354933					
Observations	13					

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	41510079.11	41510079.11	7.989684805	0.016471949
Residual	11	57150048.02	5195458.911		
Total	12	98660127.13			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	12230.02315	2018.642796	6.058537535	8.20835E-05	7787.020312	16673.02599
NWC	-11.23769684	3.975689772	-2.82660305	0.016471949	-19.98813103	-2.487262648

<i>Op Inc Regression Statistics</i>						
Multiple R	0.679738431					
R Square	0.462044334					
Adjusted R Square	0.413139274					
Standard Error	361.623766					
Observations	13					

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	1235502.924	1235502.924	9.447781665	0.010589272
Residual	11	1438489.229	130771.7481		
Total	12	2673992.154			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	2131.808991	320.2613158	6.656467346	3.5798E-05	1426.918587	2836.699394
NWC	-1.93875272	0.630750344	-3.073724396	0.010589272	-3.327024867	-0.550480573

<i>OCF Regression Statistics</i>	
Multiple R	0.666488253
R Square	0.444206591
Adjusted R Square	0.393679918
Standard Error	487.1258188
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	2086155.079	2086155.079	8.791526548	0.012858633
Residual	11	2610207.197	237291.5634		
Total	12	4696362.276			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	2590.892976	431.4084703	6.005660886	8.85388E-05	1641.369335	3540.416617
NWC	-2.519264843	0.849653166	-2.965050851	0.012858633	-4.389338853	-0.649190833

<i>Price Regression Statistics</i>	
Multiple R	0.566882576
R Square	0.321355855
Adjusted R Square	0.259660933
Standard Error	31.52394566
Observations	13

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	5176.282097	5176.282097	5.20878937	0.043362305
Residual	11	10931.35065	993.7591499		
Total	12	16107.63275			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	117.7444887	27.9182434	4.217474824	0.001442497	56.29684925	179.1921281
NWC	-0.12549011	0.054984604	-2.282277233	0.043362305	-0.246510407	-0.004469812

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ACADEMIC VITA

MARIA R. HOWE

EDUCATION

The Pennsylvania State University | Schreyer Honors College University Park, PA
Smeal College of Business | B.S. in Finance | *College Marshal* May 2022
The College of the Liberal Arts | *Minor in Economics*

RELEVANT EXPERIENCE

Perella Weinberg Partners New York, NY
Investment Banking Summer Analyst Jun 2021 – Aug 2021

- Collaborated with six deal teams across Healthcare M&A, Consumer & Retail M&A, and Restructuring
- Produced a prospective list of M&A targets for a ~\$3 bn international fashion and cosmetics retailer
- Ran valuation models, generated capital structure tables, facilitated the due diligence process, and created management presentation slides for buy-side, sell-side, and distressed debt transactions
- Presented a proposed beauty acquisition and associated model to senior management for the final project

Nittany Lion Fund, LLC. University Park, PA
Vice President of Operations | *Lead Fund Manager* | *Co-Director of Portfolio Analytics* Dec 2019 – Dec 2021

- Served as a Lead Fund Manager of the Financials portfolio valued at ~\$2 MM within Penn State's ~\$14 MM student-run investment fund by completing equity reports and pitches with a goal of outperforming the S&P 500
- Founded the Women on Wall Street program within the 400-member Penn State Investment Association
- Generated equity analyses using discounted cash flow models, dividend discount models, comparables, and ratio analyses by utilizing data gathered from the Bloomberg Terminal, FactSet, and SEC filings
- Monitored investment transactions, facilitated the voting process on all stock pitches, and conducted interviews

Transamerica Corporation Cedar Rapids, IA
Actuarial Intern | *Variable Annuity Valuation* May 2019 – Aug 2019

- Automated quarterly reports for the VA Valuation - IFRS Fair Value team using Power BI
- Contributed to IFRS 17 Scrum Testing, made MG-ALFA model changes, and assisted with quarterly files

LEADERSHIP & ACTIVITIES

Volunteer Income Tax Assistance Program University Park, PA
President | *Site Coordinator* | *Tax Preparer* | *Vice President* | *Secretary* Sep 2018 – Present

- Named the chapter's first ever student site coordinator, entrusted with overseeing operations and final reviews
- Volunteered 200+ hours to provide a free tax service for students, staff, and community residents
- Completed more than 50 federal, state, and local income tax returns for low to moderate income individuals
- Led a virtual tax education for 40 business students on filing income taxes while promoting the organization
- Oversaw the organization's email, scheduling, appointment requests, and fundraising/recruitment advertising

Association of Residence Hall Students University Park, PA
Vice President | *Director of Finance* Oct 2018 – Present

- Managed the ~\$80,000 budget for the on-campus student government by providing recommendations for budget requests, annual allocations, and weekly student presenters along with processing all transactions
- Discussed student concerns regarding Housing and Food Services (HFS) and proposed solutions
- Advocated for on-campus students at sponsored events, HFS advisory meetings, and tabling initiatives

Finance Department University Park, PA
Teaching Assistant | *Research Assistant* Jan 2020 – Present

- Allocated 250 hours for 530+ students enrolled in Honors Corporate Finance and the Business Certificate Program
- Tutored individual students, held office hours, graded Microsoft Excel problems, and proctored exams
- Trained new teaching assistants, presented during class review sessions, and created grading rubrics
- Interviewed 30 business owners for a Student Engagement Network Research Fellowship

Accounting Department University Park, PA
Teaching Assistant | *Research Assistant* May 2021 – Present

- Held review sessions and graded/proctored exams for students enrolled in Intermediate Financial Accounting
- Quantified the impact on 760 companies of new revenue recognition standards for a FASB presentation
- Examined bond terms for 75 sustainability linked loans (SLL) to assess ESG improvement incentives

HONORS, SKILLS & INTERESTS

Honors: Summa Cum Laude, Golden Key Honor Society, The President's Freshman Award, The President Sparks Award, Evan Pugh Scholar Award, Koch Family Scholarship, Schreyer Academic Excellence Scholarship

Skills: Experience in VBA, MG-ALFA, and Power BI; passed Society of Actuaries Exam P - Probability

Interests: Fine dining, Playing the piano, Rooftop yoga, Hiking in Acadia National Park, Classical novels