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A Return to the Cash Conversion Cycle and Corporate Returns

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A RETURN TO THE CASH CONVERSION CYCLE AND CORPORATE RETURNS

by

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ABSTRACT

A Return to the Cash Conversion Cycle

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A little over twenty years ago, Jose, Lancaster, and Stevens (1996) wrote a paper examining the relationship between profitability and ongoing liquidity management for firms over a twenty-year period, from 1974 to 1993. They test the relationship between the cash conversion cycle, ongoing liquidity management, and other methods of profitability using a regression analysis (Jose, Lancaster, and Stevens, 1996). This paper aims to do the same but with a selection of firms over a different twenty-year period, from 1993 to 2013. We implement Jose et al.'s methodology with updated data to see if contemporary data yields similar results: aggressive working capital management policies enhance profitability and performance. The previous literature found that the cash conversion cycle does have an implication for the profitability and the liquidity of a company. This study replicates these processes and examines the impact to stock returns in addition to traditional measures, ROA and ROE. We gather data from 1974-2017 from firms on Compustat and estimate regression analyses of the cash conversion cycle, ROA, and ROE. There is strong evidence that working capital management policies still affect profitability and performance. Using the same time period, we create a calendar time portfolios of high and low CCC firms. By applying the Fama-French factors, we find that firms with higher cash conversion cycles have lower risk-adjusted stock returns.

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I. INTRODUCTION AND LITERATURE REVIEW

In this paper, I revisit previous literature that examines the relationship between the cash conversion cycle and profitability of a company. The previous literature finds that the cash conversion cycle does have an implication for the profitability and the liquidity of a company. This study replicates these processes and also examines the impact to stock returns in addition to traditional measures, ROA and ROE. This paper hopes to find similar results as the previous literature, where a shorter cash conversion cycle has a positive impact on a company's profitability.

The cash conversion cycle "establishes the period of time required to convert a dollar of cash disbursements back into a dollar of cash inflow from a firm's regular course of operations" (Richards and Laughlin, 1980). It "measures the time between cash outlays for resources and cash receipts from product sales" (Jose, Lancaster, Stevens, 1996). The cash conversion cycle was introduced by Gitman who created a model that estimates a company's liquidity requirements. He wanted the model to be used to make point estimates of liquidity requirements that can then be used to estimate future liquidity requirements (Gitman, 1974).

The cash conversion cycle, in other words, is a measure of liquidity. The traditional measures of liquidity include the current ratio, quick ratio, cash ratio, and net working capital to total assets. While these are good ratios to use to observe the characteristics of a firm, they do not describe the capital management system of the firm. The current ratio specifically has been used widely as an indicator of liquidity. Richards and Laughlin (1980) warn that relying on these ratios is dangerous; "they fail to recognize that the basic liquidity protection against unanticipated discrepancies in the amount and timing of operating cash inflows and outflows is

provided by a firm's cash reserve investments in combination with its unused borrowing capacity rather than by total current asset coverage of outstanding current liabilities". In other words, these are static liquidity ratios that describe the firm at a single point in time. Richards and Laughlin (1980) state that "static liquidity indicators emphasize essentially a liquidation, rather than a going-concern, approach to liquidity analysis…Operating cash flow coverage, rather than asset liquidation value, is the crucial element in liquidity analysis". Gitman (1974) believed that the cash conversion cycle should not be used to replace traditional cash budgeting techniques. He believed that his model be used to make quick decisions about liquidity and should be used in tandem with traditional techniques.

The cash conversion cycle "measures the time between cash outlays for resources and cash receipts from product sales" (Jose, Lancaster, and Stevens, 1996). It provides a relationship between the income statement and the balance sheet. By combining these two financial statements it becomes a measure of time needed to convert cash disbursements to cash inflows. The cash conversion cycle is calculated by adding days in inventory and days in receivables and subtracting days in payables. It is related to the operating cycle in that the operating cycle adds days in payables considering the entire period. The cash conversion cycle subtracts days in payables because this measure "reflects the average time over which a company defers payment on the costs to support operating activities" (Richards and Laughlin, 1980). Richards and Laughlin (1980) state that a declining inventory and receivables turnover show that a "larger current asset investment that must be financed over a longer operating cycle interval", whereas a declining payables turnover shows a large buildup of financing provided by creditors. If the operating cycle is extended with declining inventory and receivables turnover then that increases

the possibility of liquidity issues, and a longer operating cycle with a declining payables turnover also increases the possibility of liquidity issues.

Working capital is the measure of a company's efficiency and short term financial health. The ratio is calculated by dividing current assets by current liabilities; it shows if the company has enough current assets to cover its current debt (Investopedia, Working Capital). It is important that the company manage its short term financial operating activities because these activities involve cash inflows and outflows that occur in one year or less. The management of these cash inflows and outflows is called working capital management and its purpose is to "make sure the company always maintains sufficient cash flow to meet its short-term operating costs and short-term debt obligations" (Investopedia, Working Capital Management). A company can manage its short term finances in at least two ways: managing the size of the firm's investment in current assets; and managing the financing of its current assets. Ross, Westerfield, and Jordan (2016) explain that if these two policies are managed together then a flexible working capital management policy would have a large investment in current assets and the investment would be financed with less short term debt. "With a flexible policy, the firm maintains a higher overall level of liquidity" (Ross, Westerfield, Jordan, pp 614-615).

Liquidity is how quickly an asset can be converted to cash without loss of value (Ross, Westerfield, Jordan, pp 23). Liquidity is very important for a company. If the company is more liquid then there is a smaller chance that it will suffer from financial distress. However, there is a trade off; more liquid assets are less profitable to hold (Ross Westerfield, Jordan, pp 23). Liquidity management, therefore, describes how managers reduce liquidity risk. Managers can compare liquid assets and short term liabilities to evaluate their exposure to liquidity risk (Investopedia, What is liquidity management).

The model Gitman proposes provides an estimate of the minimum liquidity required for a company for the upcoming year (Gitman, 1974). This is important to consider because, although there is much uncertainty when estimating the minimum liquidity level concerning actual cash flows, it gives managers a good starting point to develop a working capital management policy. There is a relationship between the cash conversion cycle and firm performance. Ebben and Johnson (2011) considered previous research and saw evidence that "supports the view that effective working capital management increases returns by reducing cost of capital and by allowing firms to achieve higher levels of asset turnover". Ebben and Johnson (2011) say that higher levels of receivables and inventory tend to require higher levels of capital, longer receivables cycles increase the risk of not collecting on accounts, and higher levels of inventory increase storage costs and the risk of inventory uselessness.

Jose, Lancaster, and Stevens (1996) suggest that when managing the cash conversion cycle there is a balance that must be maintained between liquidity and profitability. As I mentioned above there is a trade off between liquidity and profitability. Jose, Lancaster, and Stevens (1996) mention that an aggressive approach to liquidity management will result in a lower cash conversion cycle because the inventory period will be reduced, the accounts receivables period will be reduced, and the accounts payables period will be increased. A more passive approach to liquidity management means that the inventory and receivables periods will increase, while the payables period will decrease (Jose, Lancaster, and Stevens, 1996). A lower, or shorter, cash conversion cycle "preserves the firm's debt capacity since less short term borrowing is required to provide liquidity" (Jose, Lancaster, and Stevens, 1996). A higher, or longer, cash conversion cycle means that more financing is required for inventory and receivables (Ross, Westerfield, and Jordan, pp 614). Richards and Laughlin also mention that a

longer cash conversion cycle means that the company is more committed to cash and non-cash current assets and that the company is not as able to finance the investments in cash and non-cash current assets with current liabilities (Richards and Laughlin, 1980). This will have consequences if the company faces some difficult times because the company will not be as flexible in managing cash flows. If there is too much inventory or too many outstanding receivables, the cash flows the company does receive go to maintaining the payables or other current debt. But if there are high levels of inventory and large amounts of receivables outstanding then the cash inflows the company receives might not be enough to pay off current obligations. At this point, the company might be struggling to remain profitable.

A little over twenty years ago, Jose, Lancaster, and Stevens (1996) wrote a paper examining the relationship between profitability and ongoing liquidity management for firms over a twenty year period, from 1974 to 1993. They tested the relationship between the cash conversion cycle, ongoing liquidity management, and other methods of profitability using a regression analysis (Jose, Lancaster, and Stevens, 1996). This paper aims to do the same but with a selection of firms over a different twenty year period, from 1993 to 2017. The same methodology Jose, Lancaster, and Stevens used will be implemented, and this paper hopes to find the same, or similar results: aggressive working capital management policies enhance profitability and performance.

II. EMPIRICAL METHODOLOGY AND DATA

Data was taken from the annual Compustat-Capital IQ daily updates. We chose the years 1974 through 2017. The data from 1974 through 1993 will be used to replicate the Jose, Lancaster, and Stevens (1996) results. The data from 1994 through 2017 will be used to update the 1996 paper to see if the results hold.

For each firm, the cash conversion cycle, ROA and ROE are calculated. ROA is defined as earnings before interest and taxes (EBIT) divided by total assets (TA). ROE is defined as EBIT minus interest expenses (INT) divided by stockholders' equity (SEQ).

ROA = EBIT / TA

ROE = (EBIT – INT) / SEQ

The cash conversion cycle (CCC) is constructed as follows:

Days in Inventory = Inventory / (Cost of Goods Sold / 365)

Days in Receivables = Accounts Receivables / (Sales / 365)

Days in Payables = Accounts Payables / (Cost of Goods Sold / 365)

CCC = Days in Inventory + Days in Receivables – Days in Payables

For each variable, long-run averages are calculated, as opposed to yearly averages, which reduces the influence of outliers specific to any one year. I Winsorized each variable at the 1 and 99 percent levels to minimize the effect of outliers.

Some of the variation in the CCC variable is due to differences in products firms make and which industry each firm operates in. To control for these differences, each firm is grouped by industry using the four-digit SIC codes: 0000-1400 (Natural Resources), 1500-1750

(Construction), 2000-4000 (Manufacturing), 4001-4999 (Services), 5000-6000 (Retail/Wholesale), 6001-6499 (Financial Services), and 6500-9000 (Professional Services).

A market cap variable is created by taking the closing price and multiplying it by common stock shares outstanding. Then by taking the log of the market cap variable, we are able to find the size of each firm.

For the firm data from 1994 through 2017, we take data from the CRSP monthly data on WRDS for the years 1974 through 2017. We then merge the CRSP monthly data with the CUSIP numbers grabbed from the Compustat-Capital IQ daily updates. We merge this data with the data we originally pulled to replicate the Jose, Lancaster, and Stevens (1996) paper. Then by comparing the high CCC firms to the low CCC firms, we ran a regression controlling for risk factors using the five Fama-French (2015) factors including the Carhart momentum factor (1997).

The summary statistics for the CCC variable for the seven industry groupings are provided in Table 1. We compare the results from the replication of the original paper to the results when we updated the time period. For the time period of 1974 through 1993, the industry with the highest mean CCC is Financial Services, and the industry with the lowest mean CCC is the Service industry (disregarding the negative mean CCC for the Natural Resources industry). Financial Services might have the highest mean CCC because it is biased. Some of the firms in the Financial Services industry are highly regulated, such as banking, insurance, and finances. This distorts the relationship between CCC and the profitability measures. The next highest mean CCC is Construction. For the industries in the 25^{th} percentile, the Manufacturing industry has the highest CCC, and for the industries in the 75^{th} percentile, Financial Services has the highest CCC. When looking at the time period of 1994 through 2017, the industry with the

highest mean CCC is Financial Services as well, and the industry with the lowest mean CCC is Professional Services (disregarding the negative mean CCC for the Natural Resources industry. However, since the relationship for Financial Services might be biased, the next highest mean CCC is the Construction industry. For industries in the 25th percentile, the Construction industry has the highest CCC, and for industries in the 75th percentile, Financial Services has the highest CCC. When CCC standard deviation is scaled by the mean level of CCC, the Service industry has the highest CCC intra-industry volatility relative to the mean value for the time period 1974 through 1993. For years 1994 through 2017, Professional Services has the highest CCC intra-industry volatility relative to the mean value of CCC.

The CCC values for maximum CCC for both tested periods are similar. This is most likely because of the Winsorized variables. It eliminated the outliers, but also created some error. However, these values are still very large and it is not very reasonable for a company to have such large values for a cash conversion cycle. The CCC values for minimum CCC were also affected by the Winsorized variables. Again, these values are very small and it is not reasonable for a company to have these small values for a cash conversion cycle.

Table 1
Cash Conversion Cycle Summary Statistics for the Sample of Firms by Industry Classifications

Industry	Number of Firms		Mean CCC (Days)		Maximum CCC (Days)		Minimum CCC (Days)		Standard Deviation CCC (Days)	
	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017
Nautral Resources	7425	13007	-56.91	-78.10	2469.66	4679.82	-1883.66	-6672.68	393.83	685.77
Construction	1159	1663	168.16	170.18	2469.66	3428.51	-965.84	-4283.89	277.33	338.45
Manufacturing	45639	62112	136.07	85.43	2469.66	4679.82	-1671.70	-6672.68	142.00	403.14
Service	8360	14897	30.08	-3.44	2319.35	4679.82	-1883.66	-5119.80	126.39	270.74
Retail/Wholesale	11748	13943	77.38	56.29	2469.66	3832.50	-1883.66	-6672.68	127.17	224.83
Financial Services	2234	9160	206.75	214.56	2469.66	4679.82	-1883.66	-6672.68	591.61	1119.37
Professional Serivces	14063	36026	105.59	26.08	2469.66	4679.82	-1883.66	-6672.68	329.04	568.39
Total Sample	90628	150808	100.30	54.45	2469.66	4679.82	-1883.66	-6672.68	237.42	527.34

Industry	CCC Standard Deviation ÷ Mean CCC		25th Percentile		50th Percentile		75th Percentile	
	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017
Nautral Resources	-6.92	-8.78	-120.41	-151.15	13.21	4.89	82.83	67.54
Construction	1.65	1.99	42.29	47.87	76.57	84.83	211.54	249.98
Manufacturing	1.04	4.72	74.67	46.30	119.24	91.74	176.36	149.94
Service	4.20	-78.70	7.83	-13.02	29.78	17.20	52.63	41.85
Retail/Wholesale	1.64	3.99	19.94	8.57	65.18	46.16	113.81	92.04
Financial Services	2.86	5.22	-20.24	-20.50	59.13	64.79	276.65	368.49
Professional Serivces	3.12	21.79	10.03	-24.91	56.93	25.15	120.84	68.78
Total Sample	2.37	9.68	32.81	2.43	85.46	52.84	148.86	115.21

III. CORRELATIONS BETWEEN CCC AND RETURNS

The Pearson correlation coefficients are calculated for each industry for CCC-ROA, CCC-ROE, and ROA-ROE relationships. The coefficients are provided in Table 2. A strong relationship between CCC and ROA suggest that the relationship is sensitive to industry factors such as capital intensity, production processes, and competition. The correlations between CCC and ROA for years 1974-993 are positive, except for the Manufacturing and Service industries, with a significance level of 0.7 and lower. The CCC and ROA correlation is significant for Natural Resources, Manufacturing, and Retail/Wholesale. The correlations between CCC and ROE for years 1974-1993 are all negative except for Natural Resources and Retail/Wholesale, with significance levels of 0.08 and 0.88 respectively. The correlation coefficient for the Manufacturing industry became more negative when comparing the correlation between CCC-ROA and CCC-ROE. The correlation coefficient for the Service industry became more negative

when looking at the correlation between CCC and ROE and the correlation became more significant.

For the years 1994-2017, all correlations between CCC and ROA are positive, and are significant at the 0.01 level. For the years 1994-2017, all correlation coefficients between CCC and ROE are negative. All industry correlations are significant, except for Service and Financial Services. The Service and Financial Services industries were significant when examining the correlation between CCC and ROA, but when examining the correlation between CCC and ROE, the two industry coefficients became insignificant.

For the years 1974-1993, all correlation coefficients for ROA and ROE are positive and significant at the 0.01 level. For the years 1994-2017, all ROA-ROE correlation coefficients are negative and significant, except for Natural Resources and Financial Services which are significant at the 0.01 level. Retail/Wholesale is significant at the 0.1 level in comparison to the other industries.

Table 2

Pearson Correlation Coefficients for the Cash Conversion Cycle, ROA, and ROE by Industry Classification

Industry	CCC-ROA Correlation		CCC-ROE Correlation		ROA-ROE Correlation	
	1974-1993	1994-2017	1974-1993	1994-2017	1974-1993	1994-2017
Natural Resources	0.0403 (0.0005)	0.0859 (0)	0.0203 (0.0804)	-0.0341 (0.0001)	0.4091 (0)	0.0304 (0.0005)
Construction	0.0177 (0.5469)	0.3205 (0)	-0.0742 (0.0115)	-0.1278 (0)	0.3693 (0)	-0.1145 (0)
Manufacturing	-0.0237 (0)	0.3111 (0)	-0.046 (0)	-0.0422 (0)	0.421 (0)	-0.0242 (0)
Service	-0.0077 (0.4803)	0.2191 (0)	-0.0327 (0.0028)	-0.0053 (0.5147)	0.2984 (0)	-0.0633 (0)
Retail/Wholesale	0.0714 (0)	0.2323 (0)	0.0013 (0.8865)	-0.0172 (0.0417)	0.3107 (0)	-0.0151 (0.0755)
Financial Services	0.0368 (0.0822)	0.0469 (0)	-0.0142 (0.5017)	-0.0003 (0.9756)	0.3422 (0)	0.0658 (0)
Professional Services	0.0028 (0.7367)	0.2209 (0)	-0.0294 (0.0005)	-0.0269 (0)	0.3389 (0)	-0.0563 (0)
Overall Sample	0.0244 (0)	0.2024 (0)	-0.0117 (0.0004)	-0.0243 (0)	0.3797 (0)	-0.0278 (0)

p-values are reported in parentheses

IV. PATTERNS BETWEEN CCC AND PROFITABILITY MEASURE RANKINGS

Another way to analyze the relationship between CCC and profitability measures is to equal size groups based on profitability measure rankings. Firms are placed in eight equal groups based on rankings of ROA and ROE, then average CCC is calculated. This makes it possible to analyze the relationship between CCC and the profitability measures ROA and ROE by grouping, from low to high profitability. This is one way to neutralize the effect of outliers and measurement errors. The relationship between CCC and ROA is presented in Table 3.

Panel A represents the relationship between CCC and ROA for years 1974 through 1993. The industry with the lowest ROA and highest mean CCC is the Construction industry. The industries with the lowest ROA and the lowest mean CCC is the Service industry, with a mean CCC of 30.14 days, and the Natural Resources industry, with a mean CCC of -75.45 days. The

industry with the highest ROA and the highest mean CCC is the Manufacturing industry. The industry with the highest ROA and the lowest mean CCC is the Natural Resources industry. When examining average CCC for each ranking of ROA across industries, mean CCC increases as ROA increases and then decreases again for the highest ROA ranking.

Panel B represents the relationship between CCC and ROA for years 1994 through 2017. The industry with the lowest ROA and highest mean CCC is the Financial Services industry. The industries with the lowest ROA and the lowest, positive mean CCC is the Retail/Wholesale industry, with a mean CCC of 8.80 days. There are four industries with the lowest ROA and negative mean CCC: Natural Resources, Manufacturing, Service, and Professional Services; Professional Services has the lowest mean CCC, -210.05 days. The industry with the highest ROA and the highest mean CCC is the Construction industry. The industry with the highest ROA and the lowest, positive mean CCC is the Service industry, with a mean CCC of 8.89 days. Natural Resources has the highest ROA and the lowest, negative mean CCC of -71.89 days. When examining average CCC for each ranking of ROA across industries, the same pattern seen in Panel A holds; mean CCC increases as ROA increases and then decreases for the highest ROA ranking.

The relationship between CCC and ROE is presented in Table 4. Panel A represents the relationship between CCC and ROE for years 1974 through 1993. The industry with the lowest ROE and highest mean CCC is Financial Services. The industry with the lowest ROE and lowest mean CCC is the Service industry, with a positive mean CCC of 34.12 days. Natural Resources has a low, negative mean CCC of -77.90 days. The industry with the highest ROE and highest mean CCC is Financial Services. The industry with the highest ROE and lowest, positive mean CCC is the Service industry as well, with a mean of 7.44 days. Natural Resources

has a negative mean CCC of -51.36 days and is ranked with the highest ROE. When examining average CCC for each ranking of ROE across industries, mean CCC decreases as ROE increases.

Panel B represents the relationship between CCC and ROE for years 1994 through 2017. The industry with the lowest ROE and highest CCC is the Financial Services industry. The industry with the lowest ROE and lowest, positive CCC is the Retail/Wholesale industry, with a mean CCC of 55.27 days. The Service industry, Natural Resources, and Professional Services all have a negative, average CCC; Professional Services has the lowest, negative mean CCC of -17.57 days. The industry with the highest ROE and highest CCC is the Financial Services industry. The industry with the highest ROE and lowest, positive average CCC is the Retail/Wholesale industry, with a mean CCC of 11.15. Manufacturing, Service, Professional Services, and Natural Resources all have a negative, average CCC; Natural Resources has the lowest, negative mean CCC of -179.50 days.

Table 3

Average Cash Conversion Cycle (CCC) for Firms in Eight Groups Based on Return on Asset (ROA) Rankings Within Seven Industries

Panel A: 1974-1993

Lowest ROA									Highest ROA
Industry	**CCC for ROA (Group #1)**	**CCC for ROA (Group #2)**	**CCC for ROA (Group #3)**	**CCC for ROA (Group #4)**	**CCC for ROA (Group #5)**	**CCC for ROA (Group #6)**	**CCC for ROA (Group #7)**	**CCC for ROA (Group #8)**	**Highest Overall Mean CCC**
Natural Resources	-75.46	-59.40	-57.03	-102.09	-88.69	-74.81	-20.82	14.01	-58.04
Construction	153.11	195.44	249.07	225.97	158.06	139.80	111.87	124.10	169.68
Manufacturing	145.63	151.19	139.84	136.68	134.97	129.39	130.36	131.67	137.47
Service	30.14	22.61	23.94	30.27	35.68	31.64	30.34	31.14	29.47
Retail/Wholesale	55.69	85.24	84.94	80.17	81.95	80.61	75.20	74.36	77.27
Financial Services	186.22	41.99	-27.29	193.13	267.19	397.53	262.09	89.22	176.26
Professional Services	90.09	112.38	125.88	106.55	113.56	150.50	102.66	59.84	107.68
Equal-weighted mean CCC	83.63	78.49	77.05	95.81	100.39	122.10	98.81	74.91	91.40

Panel B: 1994-2017

Lowest ROA									Highest ROA
Industry	**CCC for ROA (Group #1)**	**CCC for ROA (Group #2)**	**CCC for ROA (Group #3)**	**CCC for ROA (Group #4)**	**CCC for ROA (Group #5)**	**CCC for ROA (Group #6)**	**CCC for ROA (Group #7)**	**CCC for ROA (Group #8)**	**Highest Overall Mean CCC**
Natural Resources	-94.33	32.23	-53.15	-134.21	-117.39	-88.36	-89.80	-71.89	-77.11
Construction	46.17	301.65	233.87	175.42	175.24	145.50	140.91	142.09	170.11
Manufacturing	-43.69	112.93	123.53	113.83	111.90	110.06	110.45	101.26	92.53
Service	-82.85	-6.36	7.50	15.12	17.45	17.80	14.87	8.89	-0.95
Retail/Wholesale	8.80	77.46	64.32	60.27	63.80	64.29	62.61	58.69	57.53
Financial Services	179.35	211.99	-169.55	340.53	399.21	493.79	211.55	98.79	220.71
Professional Services	-210.06	41.97	104.24	67.31	74.60	82.50	51.66	19.67	28.99
Equal-weighted mean CCC	-28.09	110.27	44.39	91.18	103.55	117.94	71.75	51.07	70.26

Table 4

Average Cash Conversion Cycle (CCC) for Firms in Eight Groupings Based on Return on Equity (ROE) Rankings Within Seven Industries

Panel A: 1974-1993

Lowest ROE								**Highest ROE**	
Industry	**CCC for ROE (Group #1)**	**CCC for ROE (Group #2)**	**CCC for ROE (Group #3)**	**CCC for ROE (Group #4)**	**CCC for ROE (Group #5)**	**CCC for ROE (Group #6)**	**CCC for ROE (Group #7)**	**CCC for ROE (Group #8)**	**Highest Overall Mean CCC**
Natural Resources	-77.91	-46.82	-72.84	-75.30	-79.32	-50.29	-1.35	-51.37	-56.90
Construction	212.44	278.22	200.83	176.20	139.53	91.97	118.51	115.73	166.68
Manufacturing	154.25	151.90	145.30	138.65	136.71	132.43	127.11	109.02	136.92
Service	34.12	30.63	38.29	32.97	32.60	32.56	28.57	7.44	29.65
Retail/Wholesale	67.77	89.73	91.35	83.90	82.20	74.43	74.08	55.84	77.41
Financial Services	257.93	231.02	161.67	257.08	175.36	208.34	203.03	143.10	204.69
Professional Services	105.86	128.74	107.08	145.45	198.72	91.08	68.25	40.11	110.66
Equal-weighted mean CCC	107.78	123.35	95.95	108.42	97.97	82.93	88.31	59.98	95.59

Panel B: 1994-2017

Lowest ROE								**Highest ROE**	
Industry	**CCC for ROE (Group #1)**	**CCC for ROE (Group #2)**	**CCC for ROE (Group #3)**	**CCC for ROE (Group #4)**	**CCC for ROE (Group #5)**	**CCC for ROE (Group #6)**	**CCC for ROE (Group #7)**	**CCC for ROE (Group #8)**	**Highest Overall Mean CCC**
Natural Resources	-16.22	37.03	22.73	-135.89	-118.42	-107.10	-114.87	-179.50	-76.53
Construction	248.81	275.13	231.70	189.47	144.01	110.81	114.70	53.22	170.98
Manufacturing	87.75	120.26	128.80	115.36	105.80	97.89	77.61	-42.23	86.40
Service	-7.74	-10.72	11.02	13.62	18.38	13.21	-3.17	-52.95	-2.29
Retail/Wholesale	55.27	81.57	66.24	61.32	65.57	59.15	50.36	11.15	56.33
Financial Services	257.69	383.61	281.64	235.97	27.70	57.84	272.39	207.04	215.48
Professional Services	-17.58	53.18	76.82	101.73	83.32	10.98	15.66	-129.37	24.34
Equal-weighted mean CCC	86.85	134.29	116.99	83.08	46.62	34.68	58.95	-18.95	67.82

V. INFLUENCE OF FIRM SIZE ON CCC

Larger firms tend to have lower CCC measures and higher profitability, however, there is the possibility that the relationship might be spurious. In order to determine if the relationship is spurious, size differences must be controlled for. To control for size differences, we use log sales as a measurement of size, since the log transformation reduces the influence of outliers. We regress CCC and log sales on the profitability measures, ROA and ROE. An initial regression for each industry is used to examine the relationship between CCC and ROA. Then a second regression for each industry is used with log size included in the equation. The results from the two regressions for CCC, log sales, and ROA can be seen in Table 5 when ROA is the dependent variable.

Before adjusting for size, most of the CCC coefficients are significant, except for in the industries Construction (1974-1993), Services (1974-1993), and Professional Services (1974-1993). When adjusting for size, the relationship is still significant, except in Construction and Services; Professional Services become significant after adjusting for size for years 1974 through 1993. This means that, independent of size, the CCC-ROA relationship holds for years 1974 through 1993. For years 1994-2017, all industries' coefficients are significant at the 0.01 level when adjusting for size.

Table 6 gives the results from the same two regressions for CCC, log sales, and ROE, when ROE is the dependent variable. For the years 1974 through 1993, before adjusting for size, most of the CCC coefficients are significant, except for Retail/Wholesale and Financial Services. When adjusting for size, all industries are no longer significant, except for Services and Professional Services. For the years 1994 through 2017, before adjusting for size, all industries' CCC coefficients are significant at the 0.01 level. Once the regression takes size into

account, Services, Retail/Wholesale, and Financial Services are no longer significant. This means that, independent of size, the CCC-ROE relationship holds for most industries for years 1994 through 2017.

Table 5
Cross Sectional Regressions of Cash Conversion Cycle (CCC) and Log Sales (LSALES) on Return on Assets (ROA) for Seven Industries

	Natural Resources						Construction					
	Full Sample		1974-1993		1994-2017		Full Sample		1974-1993		1994-2017	
Intercept	-0.0910***	-0.323***	-0.0244***	-0.132***	-0.130***	-0.478***	-0.0339*	-0.281***	0.0263***	-0.117***	-0.0671***	-0.417***
	(0)	(0)	(0)	(0)	(0)	(0)	(0.0544)	(0)	(8.58e-05)	(1.88e-07)	(0.00672)	(2.76e-10)
CCC	8.10e-05***	6.45e-05***	2.40e-05***	-1.77e-05***	9.00e-05***	8.02e-05***	0.000249***	0.000231***	1.07e-05	2.10e-05	0.000361***	0.000317***
	(4.90e-06)	(8.49e-05)	(0.000428)	(0.00445)	(1.54e-05)	(2.53e-05)	(0.00243)	(0.00178)	(0.554)	(0.187)	(0.00112)	(0.000912)
LSALES		0.0668***		0.0391***		0.0889***		0.0478***		0.0314***		0.0623***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.00665	0.120	0.00162	0.197	0.00738	0.150	0.0631	0.182	0.000314	0.134	0.103	0.245
F-Test	20.89	476.3	12.42	736.3	18.70	347.6	9.210	44.83	0.351	38.76	10.65	28.90
	0	0	0	0.765	0	0	0	0	0	0.765	0	0
	Manufacturing						**Services**					
	Full Sample		1974-1993		1994-2017		Full Sample		1974-1993		1994-2017	
Intercept	-0.117***	-0.564***	0.0563***	-0.146***	-0.189***	-0.783***	-0.00713**	-0.372***	0.0549***	-0.0867***	-0.0348***	-0.550***
	(0)	(0)	(0)	(0)	(0)	(0)	(0.0188)	(0)	(0)	(0)	(0)	(0)
CCC	0.000545***	0.000505***	-3.44e-05**	7.32e-05***	0.000576***	0.000484***	0.000406***	0.000354***	-9.06e-06	-7.10e-06	0.000444***	0.000352***
	(0)	(0)	(0.0349)	(3.60e-07)	(0)	(0)	(9.11e-10)	(4.45e-09)	(0.774)	(0.773)	(2.15e-09)	(7.70e-08)
LSALES		0.0978***		0.0431***		0.125***		0.0634***		0.0273***		0.0846***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.0876	0.278	0.000561	0.212	0.0968	0.328	0.0431	0.165	5.96e-05	0.162	0.0480	0.204
F-Test	498.4	3266	4.450	2268	478.9	2860	37.54	292.9	0.0822	217	35.88	258.1
	0	0	0	0.765	0	0	0	0	0	0.765	0	0
	Retail/Wholesale						**Financial Services**					
	Full Sample		1974-1993		1994-2017		Full Sample		1974-1993		1994-2017	
Intercept	-0.00276	-0.333***	0.0538***	-0.124***	-0.0324***	-0.552***	0.000259	0.0350***	0.0239***	-0.113***	-0.00537	-0.212***
	(0.664)	(0)	(0)	(0)	(4.54e-05)	(0)	(0.949)	(0)	(9.57e-07)	(0)	(0.270)	(0)
CCC	0.000448***	0.000455***	9.51e-05***	0.000137***	0.000538***	0.000500***	1.74e-05***	2.39e-05***	1.30e-05***	2.20e-05***	1.77e-05***	2.48e-05***
	(7.60e-09)	(2.59e-10)	(6.66e-05)	(0)	(4.28e-08)	(1.35e-08)	(1.67e-07)	(0)	(0.00212)	(9.56e-06)	(5.63e-07)	(1.72e-10)
LSALES		0.0601***		0.0364***		0.0860***		0.0350***		0.0338***		0.0379***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.0439	0.169	0.00510	0.191	0.0540	0.219	0.00214	0.0690	0.00135	0.156	0.00220	0.0702
F-Test	33.40	252.4	15.92	451.5	30.05	180.2	27.42	105.1	9.466	85.11	25.07	77.48
	0	0	0	0.765	0	0	0	0	0	0.765	0	0
	Professional Services						**Whole Sample**					
	Full Sample		1974-1993		1994-2017		Full Sample		1974-1993		1994-2017	
Intercept	-0.130***	-0.613***	0.00299	-0.180***	-0.171***	-0.814***	-0.0767***	-0.480***	0.0348***	-0.138***	-0.131***	-0.681***
	(0)	(0)	(0.209)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
CCC	0.000299***	0.000275***	2.21e-06	2.73e-05***	0.000328***	0.000274***	0.000256***	0.000236***	2.16e-05***	2.95e-05***	0.000277***	0.000240***
	(0)	(0)	(0.765)	(1.88e-05)	(0)	(0)	(0)	(0)	(1.07e-06)	(0)	(0)	(0)
LSALES		0.124***		0.0563***		0.155***		0.0883***		0.0414***		0.114***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.0440	0.217	8.04e-06	0.229	0.0488	0.259	0.0370	0.199	0.000597	0.213	0.0410	0.241
F-Test	323.9	1335	0.0895	1074	311.9	1208	849.6	5781	23.81	5246	805.7	4879
	0	0	0	0.765	0	0	0	0	0.765	0.765	0	0

p-values are reported in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6

Cross Sectional Regressions of Cash Conversion Cycle (CCC) and Log Sales (LSALES) on Return on Equity (ROE) for Seven Industries

	Natural Resources						**Construction**					
	Full Sample		**1974-1993**		**1994-2017**		**Full Sample**		**1974-1993**		**1994-2017**	
Intercept	-0.0751***	-0.243***	-0.0912***	-0.268***	0.0175***	-0.229***	0.0577***	-0.199***	0.000130	-0.348***	0.0175***	-0.106
	(0)	(0)	(0)	(0)	(2.14e-08)	(0)	(0.00508)	(0.00200)	(0.997)	(0.000687)	(2.14e-08)	(0.240)
CCC	-4.35e-05**	-5.67e-05***	4.41e-05*	-2.44e-05	-5.48e-05***	-6.57e-05***	-0.000302***	-0.000325***	-0.000244*	-0.000218	-5.48e-05***	-0.000361***
	(0.0123)	(0.00127)	(0.0732)	(0.311)	(0)	(0.00129)	(1.75e-05)	(3.69e-06)	(0.0966)	(0.145)	(0)	(3.41e-06)
LSALES		0.0482***		0.0642***		0.0421***		0.0499***		0.0762***		0.0362***
		(0)		(0)		(0)		(3.24e-07)		(6.71e-06)		(0.00543)
R^2	0.000572	0.0181	0.000412	0.0400	0.000593	0.0127	0.0114	0.0277	0.00551	0.0324	0.000593	0.0258
F-Test	6.262	126.4	3.211	151.8	46.70	49.68	18.51	26.87	2.766	14.59	46.70	15.72
	0	0	0	0	0	0	0	0	0	0	0	0
	Manufacturing						**Services**					
	Full Sample		**1974-1993**		**1994-2017**		**Full Sample**		**1974-1993**		**1994-2017**	
Intercept	0.0397***	-0.244***	0.0818***	-0.264***	0.0175***	-0.264***	0.0570***	-0.185***	0.0599***	-0.254***	0.0175***	-0.162***
	(0)	(0)	(0)	(0)	(2.14e-08)	(0)	(0)	(0)	(0)	(0)	(2.14e-08)	(1.43e-05)
CCC	-0.000131***	-0.000157***	-0.000234***	-4.83e-05	-5.48e-05***	-0.000173***	-4.02e-05	-7.54e-05	-0.000191*	-0.000187*	-5.48e-05***	-6.11e-05
	(9.96e-10)	(0)	(1.51e-07)	(0.278)	(0)	(0)	(0.492)	(0.195)	(0.0750)	(0.0746)	(0)	(0.340)
LSALES		0.0621***		0.0736***		0.0596***		0.0420***		0.0604***		0.0362***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.00163	0.0263	0.00212	0.0527	0.000593	0.0213	9.07e-05	0.0116	0.00107	0.0331	0.000593	0.00745
F-Test	37.34	633.3	27.58	589.8	46.70	302.2	0.473	61.27	3.171	60.04	46.70	24.93
	0	0	0	0	0	0	0	0	0	0	0	0
	Retail/Wholesale						**Financial Services**					
	Full Sample		**1974-1993**		**1994-2017**		**Full Sample**		**1974-1993**		**1994-2017**	
Intercept	0.0809***	-0.146***	0.0756***	-0.228***	0.0175***	-0.128***	0.103***	-0.0938***	0.0660***	-0.222***	0.0175***	-0.0641**
	(0)	(1.75e-09)	(0)	(0)	(2.14e-08)	(0.00178)	(0)	(0.000319)	(0.000794)	(1.86e-05)	(2.14e-08)	(0.0384)
CCC	-5.60e-05	-5.43e-05	7.08e-06	8.77e-05	-5.48e-05***	-9.20e-05	-1.48e-06	6.65e-06	-2.02e-05	-1.21e-06	-5.48e-05***	6.63e-06
	(0.328)	(0.358)	(0.927)	(0.248)	(0)	(0.203)	(0.838)	(0.359)	(0.250)	(0.945)	(0)	(0.388)
LSALES		0.0413***		0.0618***		0.0349***		0.0380***		0.0713***		0.0324***
		(0)		(0)		(2.42e-09)		(0)		(0)		(0)
R^2	0.000156	0.0132	1.73e-06	0.0329	0.000593	0.00809	2.85e-06	0.0146	0.000202	0.0423	0.000593	0.0105
F-Test	0.955	66.76	0.00834	102	46.70	18.42	0.0417	52.16	1.322	38.45	46.70	28.44
	0	0	0	0	0	0	0	0	0	0	0	0
	Professional Services						**Whole Sample**					
	Full Sample		**1974-1993**		**1994-2017**		**Full Sample**		**1974-1993**		**1994-2017**	
Intercept	-0.00922*	-0.181***	-0.0145*	-0.295***	0.0175***	-0.144***	0.0232***	-0.214***	0.0314***	-0.266***	0.0175***	-0.203***
	(0.0963)	(0)	(0.0997)	(0)	(2.14e-08)	(0)	(0)	(0)	(0)	(0)	(2.14e-08)	(0)
CCC	-6.44e-05***	-7.63e-05***	-8.49e-05***	-4.83e-05*	-5.48e-05***	-7.54e-05***	-5.21e-05***	-6.58e-05***	-3.81e-05***	-2.42e-05*	-5.48e-05***	-7.15e-05***
	(9.93e-07)	(1.01e-08)	(0.00104)	(0.0611)	(0)	(2.09e-07)	(0)	(0)	(0.00685)	(0.0733)	(0)	(0)
LSALES		0.0445***		0.0862***		0.0335***		0.0520***		0.0713***		0.0459***
		(0)		(0)		(0)		(0)		(0)		(0)
R^2	0.000756	0.00902	0.000864	0.0400	0.000593	0.00496	0.000479	0.0181	0.000136	0.0461	0.000593	0.0126
F-Test	23.95	137.8	10.76	199	46.70	53.65	50.92	1141	7.313	1236	46.70	492.1
	0	0	0	0	0	0	0	0	0	0	0	0

p-values are reported in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VI. CALENDAR TIME PORTFOLIO

There are implications for the relationship between CCC and the profitability measures. To examine the relationship even further, we create a calendar time portfolio. We rank each firm by CCC from best to worst (lowest CCC to highest CCC). We begin the portfolio by including the firms that report annual financial statements in the same quarter. The portfolio will rebalance every month; this will account for new annual financial statement reports, delisting, and acquisitions. We will buy the top 20% of firms with the highest CCC, while we will short the bottom 20% of firms with the lowest CCC. To see how the strategy performs, we examine the alphas in each time period, while controlling for risk factors. We use the Fama-French (FF) five factor model (Fama & French, 2015), including Carhart (1997) momentum factor, to control for risk factors in the regression model. The six factors we are using are market risk free return (MKTRF), small minus big (SMB), high minus low (HML), robust minus weak (RMW), conservative minus aggressive (CMA), and momentum (UMB). Each risk factor is calculated from average returns of the firms used to calculate the risk factor.

Table 7 presents the alpha values from each risk factor regression. The first estimation regresses the high CCC firms minus low CCC firms with three of the risk factors, MKTRF, SMB, and HML. For the full sample, the alpha value is negative and significant at the 0.01 level. The alpha value is interpreted as high CCC firms underperform low CCC firms by .41% or 41 basis points per month. For years 1974 through 1993 and years 1994 through 2017, the alpha values for the three factor model are also negative and significant.

The second estimation regresses the high CCC firms minus low CCC firms with four of the risk factors, MKTRF, SMB, HML, and UMB. For the full sample, the alpha value is negative and significant at the 0.01 level. Here the high CCC firms underperform the low CCC

firms by .37% or 37 basis points per month. When examining the alpha for years 1974 through 1993 and years 1994 through 2017, the coefficients are still negative but are no longer significant.

The third estimation regresses the high CCC firms minus low CCC firms with five of the risk factors: the first three FF factors, and additionally RMW and CMA. For the full sample, the high CCC firms underperform low CCC firms by .57% or 57 basis points per month. For years 1974 through 1993, the high CCC firms underperform low CCC firms by .41% or 41 basis points per month. For years 1994 through 2017, the high CCC firms underperform low CCC firms by .31% or 31 basis points per month.

Table 7
Fama-French Risk-Factor Alphas from Calendar Time Portfolio

	3 Factor Model	4 Factor Model	5 Factor Model	6 Factor Model
Full Sample	-0.00410***	-0.00372***	-0.00570***	-0.00525***
	(0.000854)	(0.00684)	(7.25e-06)	(0.000126)
1974-1993	-0.00486**	-0.00286	-0.00409*	-0.00278
	(0.0183)	(0.178)	(0.0698)	(0.212)
1994-2017	-0.00219*	-0.00229	-0.00309**	-0.00310**
	(0.0863)	(0.107)	(0.0198)	(0.0292)

p-values are reported in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The fourth calculation regresses the high CCC firms minus low CCC firms with the five risk factors from the previous regression model including UMB. For the full sample, the high CCC firms underperform the low CCC firms by .53% or 53 basis points per month. For years

1974 through 1993, the alpha coefficient is not significant. For years 1994 through 2017, the high CCC firms underperform the low CCC firms by .31% or 31 basis points per month.

As we move from a three factor to a five factor model, we add in RMW. RMW is the average return on robust operating profitability portfolios minus the average return on weak operating profitability portfolios. If CCC does improve the operating profitability of a firm, then RMW will capture the profitability effect. If the profitability of low CCC firms is driven solely by the profitability measures ROE and ROA, then RMW will capture it and there will not be alpha coefficients. Since we still find significant alphas, the CCC is doing something other than just increasing operating profitability. Similarly with the CMA factor, if low CCC simply frees up cash for investment, then the portfolio returns will load heavily on CMA and result in zero alpha.

VII. SUMMARY AND CONCLUSION

Long run averages of working capital management efficiency (CCC) and profitability measures (ROA and ROE) for a cross section of firms were used for this research. Analysis of the correlation between CCC, ROA, and ROE show that there is a relationship between these variables. Most of the correlation coefficients for each industry during the different time periods are positive. Analysis of ROA and ROE rankings and average CCC show that mean CCC changes as ROA or ROE changes. This again shows that there is a relationship between CCC and profitability measures. Then a regression analysis of CCC and the profitability measures while controlling for size shows that profitability is not affected by the size of firms. If examining the results from the as a whole, more aggressive working capital management, or

lower CCC, is associated with higher profitability. This can be seen for Natural Resources, Service, Professional Services, and Retail/Wholesale for years 1974 through 1993 and 1994 through 2017. This can also be seen for Manufacturing for years 1994 through 2017. There seems to be a negative relationship between CCC and the profitability measures for most of the industries, and this relationship is not affected by size.

By regressing the FF factors on the firms, we see that profitability is affected by CCC when controlling for risk factors. From these results we can use this information to buy the firms with low CCC and sell the firms with high CCC to take advantage of the return differences. When the six factor model is applied to the full sample, the annualized return is 6.49%. When the six factor model is applied to years 1994 through 2017, the annualized return is 3.78%. Low CCC firms seem to have better stock performance than high CCC firms. It appears that after adjusting for various forms of risk, an investment in low CCC firms will outperform high CCC firms in terms of stock returns.

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