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Working capital management: Financial and valuation impacts

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ABSTRACT

This paper examines the longitudinal impact from 1990 to 2017 of continuous improvement programs and aggressive working capital practices on accounts receivable turnover, inventory turnover, days payables outstanding, and cash conversion cycle. We find statistically significant shifts in the means and in the skew for these variables consistent with stricter financial management and less risk taking in trade credit. The results are strongest in the transportation and communications industry and weakest in financial services. These metrics are associated with equity valuation impacts and with improved profitability as captured by return on invested capital.

1. Introduction

Working capital can be a competitive advantage for firms.[1] In recent years major corporations have discovered that there are important cash flow streams available to them if they aggressively manage their working capital accounts (accounts receivable, inventory, accounts payable, and advance payments) (Reason, 2002). Moreover, a recent study by PWC found that improvements in working capital management can help boost performance metrics such as Return on Common Equity.[2]

According to Cohen and Cyert (1975, p. 8), "all owners of productive resources will be earning the maximum return consistent with consumer demands for final products and consistent with the resource owners' preferences." The theory of the firm has not changed and resources should receive their highest uses and earn the highest returns for the stakeholders. The use of working capital is necessary to provide for the timing differences in the cash flow streams devoted to inventory, accounts payable, and accounts receivable and, for some durable goods manufacturers, advance payments or progress collections.

Under the Jensen and Meckling (1976) version of the firm's objective function, the components of working capital (cash, accounts receivable, inventory, and accounts payable) are part of the objective of maximizing shareholder value by the management of the firm. The financial metrics that are computed are critical to business operations and involve contracts with suppliers (accounts payable and DPO); raw material inventory, work-in-process inventory and finished goods inventory (DSI) (workers and contractors contracts as part of COGS); and the end consumer (accounts receivable and DSO along with the product warranty). Under the theory advanced by Jensen and Meckling (1976), the working capital measures cited above all deal with the same process and should be highly correlated with one another, as well as being correlated with the firm's operating cycle measure (Cash Conversion Cycle, CCC). Our empirical results confirm this high degree of correlation and support the theory advanced by Jensen and Meckling (1976) and their version of the firm's objective function.

Our study adds to the existing body of literature where research on working capital ratios and practices (aggressive vs. conservative) has been limited (Atkas, Croci, and Petmezas 2015, Afza & Nazir, 2007, Sathyamoorthi, 2002) and most have focused on differences between industries (Filbeck and Krueger, 2005; Gombola & Ketz, 1983, Weinraub & Visscher, 1998).

There are at least three areas of investigation of working capital practices that need to be examined further. First, it is likely that large firms would be able to implement improvements working capital management practices over a 20 year time period. However, given that those improvements are in evidence for the entire group (S&P 500), do those improvements vary by industry? Are certain ratios associated with those improvements in specific industries? Do these ratio changes

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[1] Firms such as Dell and even GE, recent issues not withstanding, became famous for working capital management techniques such as extending days payable while minimizing inventory and maximizing speed of accounts receivable collections.

[2] *Pressure in the System Working Capital Study*, Price Waterhouse Cooper 2017, https://www.pwc.com/gx/en/services/advisory/deals/business-recovery-restructuring/working-capital-opportunity.html.

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impact improvements in cash flow, risk, and/or firm valuation?

This study examines these issues through the longitudinal impact from 1990 to 2017 of continuous improvement programs and aggressive working capital practices on standard financial measures related to working capital management and process improvements, such as accounts receivable turnover, inventory turnover, days payables outstanding, and cash conversion cycle. We find that the probability distributions of most of those aforementioned measures have experienced shifts in their means, as well as an alteration in their skew. The working capital metric changes are generally largest in the transportation and communications industries (SIC code 4000-4999), and weakest – often in the direction – in the financial services industry (SIC code 6000-6999).

Our evidence counters past research that indicated the effects of aggressive working capital management policies were short term and limited. For instance, Weinraub and Vischer 1998 found that the working capital policies were stable over time, whereas Soenen, 1993 discovered a negative relationship between the length of the cash conversion cycle and firm profitability. We find that every industry grouping studied had several of the standard measures experience the means shifts and the skew changes. The days payables outstanding experienced the fewest significant shifts or changes in skew across the industry groupings studied.

When internal financial measures experience significant shifts in magnitude or direction, then we need to investigate if those changes had an impact on the external value of the firm. We conducted regressions using Tobin's Q (a relative measure) and Return on Invested Capital (ROIC) as dependent variables. We also found that the cash conversion cycle had the strongest economic impact on these metrics, but that all working capital metrics are individually and jointly associated with changes in Tobin's Q and ROIC.[3] The measures used extensively in previous research, total current assets/total assets and total current liabilities/total assets, had explanatory power, but those measures contain some accounts that are not associated with the central purpose of this research.

Additionally, we demonstrate that common working capital ratios display considerable skewness and non-normality. Unless it is possible to transform the data such that it displays normality, working capital ratios therefore should not be included in model building for bankruptcy prediction, determining bond ratings and credit scores, or used in models where it is traditional to assume normality for the ratio distributions. Furthermore, all industry groupings investigated herein displayed non-normal distributions. This is a shift from historical evidence. Deakin (1976) found that 8 of 11 ratios were normally distributed using a sample of 1124 firms from the period 1954 to 1971. The current study discovered non-normal distributions for the more then 7000 firms included in this research for the period 1990–2017.

Our results have significant implications for practitioners and researchers alike. Working capital ratios are used in combination, individually, or as part of a model or algorithm to predict the likelihood of bankruptcy, determine bond ratings or credit scores, in security analysis, payment rates for progress collections, and many other uses. (Deakin, 1976, So, 1994). Yet as Deakin showed, if the financial ratio under consideration doesn't have a normal distribution, then it is questionable whether it should be used in conjunction with other non-normally distributed ratios for the purposes cited above. Deakin found that eight (8) of his eleven (11) ratios exhibited normality after transformations and also when segregated into certain industry groupings (six: drugs, metals miscellaneous, textile products, textiles, retail foods, and retail department stores). Our results show that probability distributions have changed suggesting new attention should be given to the functional form of prediction models for financial health metrics. Our works fits into the broader pattern of evidence for non-normal distributions in financial markets shown by Fox (2009) among others.

The remainder of the paper is organized as follows: Section 2 provides a brief background on the changes in working capital management practices by firms and discusses the methodology and hypotheses of this study, Section 3 examines the empirical findings of the study, while in Section 4 we detail our conclusions and suggestions for future researchers.

2. Background and methodology

2.1. Background

As a result of TQM, Six Sigma, and lean program initiatives, many larger companies introduced improvements to increase the speed and accuracy of credit approval processes from 24 to 48 h to several minutes; complete digitization of credit application, approval, and invoicing processes with no paper records; reductions in sales force record keeping and meeting processes to increase actual sales time with customers to increase cash and credit sales productivity; making suppliers responsible for inventory availability on store shelves, and movement of inventory from the warehouse to store backrooms and shelves using technology such as radio frequency identification (RFID) electronic product codes and pallet tags; and asset utilization programs that have improved working capital management efficiency, and improved cash flow and operating profits. Since firms have had success with continuous improvement programs, they have witnessed regular process improvements and resultant profitability increases and not simply one-time gains. Consequently, aggressive working capital management practices may improve both liquidity and profitability, and not emphasize one at the expense of the other.

The process improvements stimulated by continuous improvement programs have been accompanied by technology and software improvements that have reduced the levels of capital reinvestment necessary to maintain the going concern value of the firm in many manufacturing or capital intensive industries. It also should be noted that larger firms are more likely to pursue and experience the benefits of continuous improvement programs and have the resources to invest in those initiatives.

While some have argued (Mulford & Ely, 2003; Fink, 2003; Fink, 2004) that cash flows generated through working capital management (improving inventory turnover, aggressive accounts receivable collection policies or supplier management programs, lengthening accounts payable payment periods, etc.) are transitory and, therefore, are not indicative of a fundamental improvement in the business model, there is limited empirical evidence (and what exists is contradictory) on whether these practices (a) have changed the underlying probability distributions of the related financial ratios, (b) persisted over several years rather than just 2 or 3 years as implied by Mulford and Ely who purport that changes are transitory or temporary, (c) whether these changes in working capital management policies have impacted market values positively (or negatively) (Cheng, Liu, & Schaefer, 1996; Freeman & Tse, 1992; Philips, 2002; and Givoly & Hayn, 2002), or (d) whether we understand the model for cash flows through the firm adequately (Arcelus & Srinivasan, 1993) to properly conduct empirical tests or forecast cash flows (Quirin, O'Bryan, & Wilcox, 1999). It also is possible that economic conditions and monetary and fiscal policy (e.g.,inflation, interest rates, GDP growth, money supply growth) may result in shifts in working capital policy over time. These shifts may impact the optimal working capital metrics of Baños-Caballero, García-Teruel, and Martínez-Solano (2014) and Aktas et al. (2015).

Historically, studies examining corporate controllership practices have focused on working capital management as a balance between liquidity (higher working capital) and profitability (lower working capital) that may vary by industry, with some industries more conducive

[3] Tobin's Q is sometimes criticized as a metric for firm valuation within the literature. To address this concern, in untabulated results we use excess returns on a four-factor model with qualitatively similar results.

to aggressive practices (Hawawini, Viallet, & Vora, 1986; Weinraub & Visscher, 1998; Ding, Guariglia, & Knight, 2013). However, the success, beginning in the 1980s, of quality management programs such as TQM (1984) and Six Sigma (1986), benchmarking processes for continuous improvement programs recommended by the Malcolm Baldrige Award competition (1987), the point-of-sale inventory management successes of Wal-Mart (1983), supplier management successes of GM (1993) and Volkswagen (1996) under Jose Ignacio Lopez, make-to-order lean manufacturing processes implemented by Dell (1993), and other examples of asset management improvements, stimulated companies to seek improvements in their processes that had an impact on their working capital accounts or their capital investment practices. These improvements can result in higher cash flows, reduced investment in accounts receivable, inventory, and the long term assets used to support those accounts (e.g., warehouse and distribution facilities, office space allocated to credit and collection, as well as purchasing departments), and, for some firms, led to higher accounts payable and advance payment (progress collections) balances.

In addition to balance sheet benefits, many firms can experience higher profitability and reductions in their risk when they realize these aforementioned improvements. Gitman (1974), Smith (1980), Gentry, Vaidyanathan, and Lee (1990), and Shin and Soenen (1998) have used the total cash cycle, cash conversion cycle, weighted cash conversion cycle, and net trade cycle as important working capital measures and examined their impact on firm profitability.

It also is important to note that this research does not purport to delineate the determinants of working capital policy by industry, nor does it show which variables have greater explanatory power for certain industries (Kieschnick, Laplante, & Moussawi, 2013). However, there does seem to be some suggestion that certain measures capture the impact of policy determinants in specific industries.

Boisjoly and Izzo (2009) showed that a random subset of 50 of the S &P 500 firms experienced changes in the financial ratios associated with working capital management, i.e., accounts receivable turnover, inventory turnover, days payables outstanding, working capital turnover, working capital per share, cash conversion cycle, but the probability distributions of those measures have shifted which reflects continued application of continuous improvement and aggressive working capital management practices, and the distributions have had changes in their skewness. These changes occurred over the 16 year period 1990–2005 and are neither transitory, nor gradual, but rather consistent.

2.2. Methodology & hypotheses

The use of working capital accounts as buffers between the next phase of the cash conversion cycle reflects an older version of the understanding of the operating cycle of the firm.[4] That is, raw materials get purchased from a supplier on credit and the product is made and during that entire time and perhaps even longer, credit is extended from the supplier to the producer creating days payables outstanding (DPO). The product then is produced and during that phase of the cycle we see work-in-process (WIP) inventory and finished goods inventory which is added to raw materials inventory that we started the cycle with originally. This creates days inventory outstanding (DIO). The finished goods inventory is then sold to an ultimate customer with credit extended, e.g., net 30 days or 2/10, net 30 (2% discount if paid within 10 days and the net is due in 30 days if the discount is not taken). This creates days sales outstanding (DSO).

As shown above when combined appropriately the formula yields the cash conversion cycle (CCC). Each element of the CCC measured the time gap between the stages of the operating cycle and each cycle was considered to have a standard length depending upon the industry under consideration. However, the changes in lean management, six sigma, aggressive working capital management practices and other advances have made each phase of the cash conversion cycle, and each measure derived therefrom, and opportunity to create value, improve cash flow, profitability, improve cycle times, and lower costs. As firms like Dell and GE demonstrated that they could save billions of dollars by managing working capital more aggressively, more firms copied these "best practices" and the measures were transformed across the industrial sectors.

Our first and second hypotheses are that firms have improved working capital management as measured by cash conversion cycle, days payables outstanding, inventory turns, and accounts receivable turns. This supposition is based on the fact that anecdotal evidence suggests firms have spent two decades of sustained effort to improve working capital management.[5] While not all firms are equally successful in these efforts of course, it is reasonable to assume that these metrics have improved in the aggregate.

H1. Compared to pre-2000, the post-2000 mean for cash conversion cycle is lower where CCC is measured as Cash Conversion Cycle = DSO + DIO – DPO

H2. Compared to pre-2000, the post-2000 mean for days payables outstanding, inventory turns, and accounts receivable turns are higher.

Just as the cash conversion cycle (hypothesis 1) and its components (hypothesis 2) presents an opportunity to improve cash flow, profitability, and lower costs, the group of working capital management metrics can improve the overall profitability of the firm, as well as the overall value of the firm as proxied for by Tobin's Q.

As shown in popular textbooks,[6] short term financial planning should result in the investment in working capital being financed with long term debt, plus a flexible portion of working capital where additional seasonal variations are financed with short term debt, or with a compromise approach which combines the two elements.

The textbook presentations assume that the levels of working capital accounts (Cash, Accounts Receivable, Inventory, and Accounts Payable) are influenced by the safety margins necessary to prevent a cash shortage, inventory stockout, or receivables/payables defaults. The aggressive working capital policies presented there represent aggressive pursuit of cash flow, additional profitability, earlier receivable payments at the net date, and extension of payables beyond the supplier due dates. In fact, some companies have managed their working capital to maintain negative net working capital on a continuing basis.

Our third hypothesis examines whether improvement in these accounting metrics translates to what shareholders ultimately care about – share valuation. Our hypothesis is that improved working capital metrics should have a feed through effect to variables of interest to external stakeholders including return on investment and Tobin's Q. To the extent that firms are devoting real resources to improving internal corporate finance metrics, we hypothesize that the rationale for doing this should be improvement in the metrics shareholders in the firm generally care about; profitability (as captured by Return on Invested Capital), and valuation (as proxied for by Tobin's Q).

H3: Improvement in working capital metrics are associated with improved ROIC and Tobin's Q.

We set out to examine the effects of working capital management practices by industry over time. To do this, we gather data from the Center for Research on Securities Prices (CRSP) and S&P's Compustat on all firms available for the period 1990–2017. We gather data to construct working capital metrics based on grouping the firms by single digit SIC codes. These general industry classifications allow us to see if the results vary by industry type. In addition, we used cross section-

[4] Formulated as (DSO + DIO-DPO).

[5] See for instance the Hacket Group's *2018 Working Capital Survey*: https://www.thehackettgroup.com/us-working-capital-survey-1807/.

[6] See for instance Ross, S and Westerfield, R, 2019. *Essentials of Financial Management* p 534 Table 16.5.

time series groupings for each year during the sample period 1990 to 2017.

The primary tool that we use in our analysis is Ordinary Least Squares (OLS) regressions with the working capital metric on the left hand side (LHS), and various control metrics on the right hand side (RHS). This approach enables us to determine the strength of the association between the left hand and right hand side variables. Since our goal is to determine how working capital management tools have been used over time, our RHS primary variable of interest is a binary variable capturing whether the observation occurred pre-2001 or post-2000. The choice of this particular year to bisect our sample period is driven by the bursting of the dotcom bubble and the associated recession which led firms to look for ways to improve financial performance, cash flow generation, and profitability.[7] However, our results are generally robust to the use of alternative binary variables including post-1999, post-2001, post-2002, post-2003, post-2004, and post-2005. While other binary variables to bisect the sample period may produce similar results, they start to be less meaningful as they cause the sample periods to become more lopsided on either end of the binary variable. Alternative methodologies to this approach include first-differences of means around a point in time, or difference-in-differences estimators. In untabulated results, these techniques produce similar findings to the methodology that is used, however we focus on OLS given its widespread application and intuitive interpretation of results.

3. Results

To examine these hypotheses, we begin by examining the univariate statistics for the variables of interest. Table 1 below reports the means, medians, and standard deviations for various working capital metrics across our sample period. The means differ from the median considerably indicating the presence of significant skewness in each of the variables. This suggests certain firms may be focusing more on working capital management than others. One possible driver of this is firm size. Past research has found that larger firms may put more emphasis on working capital management in part because they have greater market power than smaller firms. As such, it may be important to distinguish large firms from small in our analysis. All subsequent regressions include a binary variable for large cap firms. Here large cap firms are defined by top quartile by market capitalization.

Table 1 also reports the means for various working capital metrics based on each single digit industry grouping and during our sample from 1990 to 2017. SIC 1000 818 firm-year observations is our smallest grouping and represents Agriculture, Mining, Forestry and Construction. SIC code 2000 industries includes firms in the food, tobacco, textiles, apparel, lumber and wood products, furniture, paper, printing and publishing, chemicals, and petroleum and coal products sectors. SIC code 3000 includes manufacturing industries including rubber and plastics, leather and leather products; stone, clay, glass and concrete; primary metal industries; fabricated metal; industrial and commercial machinery and computer equipment; electrical equipment and components; transportation equipment; measurement, analyzing and controlling devices; and miscellaneous manufacturing industries. SIC code 4000 includes firms engaged in the transportation, communications, and utilities industries. SIC codes 5000 include firms from wholesale and retail trade industries. SIC code 6000 includes firms in the financial services industry. SIC code 7000 includes business and personal services firms. SIC codes 8000 includes health services, legal services, education and social services, art, architecture, engineering, and accounting services, while SIC code 9000 includes household and government services, and conglomerates.

While the task of determining inter-industry differences in optimal working capital management is beyond the scope of our purpose (demonstrating the long-term improvement in working capital across industry and its association with improvements in firm value), we take a tentative step in exploring those differences in Table 2. This examination also sets the stage for construction of our OLS approach. Table 2 below shows means across the sample period for different industries grouped by 4-digit SIC code. The primary conclusion to be drawn from the table is that there is considerable variation in the means between industries across various measures of working capital effectiveness. While industry circumstances dictate what is possible in working capital management (e.g. the auto industry is always likely to have higher inventory levels than the supermarket industry or the software industry), it is clear that certain SIC groupings are more successful at managing working capital than others. An industry specific analysis of working capital management promises to be a fruitful exploration for interested researchers in the future. Given the differences in industry means, this suggests it is important to control for industry effects in any OLS setting examining working capital which we do by including industry dummies alongside a firm fixed effects model.[8]

Table 3 reports the means for various working capital metrics based on each year during our sample from 1990 to 2017. To compensate for outliers skewing results, we winsorize the data to remove top and bottom 1% of observations. Doing this helps us to avoid having our results driven by outliers which do not reflect the broader population of firms and their working capital practices. While the means are noisy across working capital metrics, the results are broadly supportive of the view that working capital management has improved over time. This trend is supportive of H1 and H2.

One goal of this study is to understand if there is a relationship, causal or otherwise between working capital metrics and firm valuation and profitability metrics. Table 4 below examines this issue by looking at correlations across our variables of interest. Broadly speaking the results reveal three important trends.

First, all four of the working capital measures, days payables outstanding (*DPO*), cash conversion cycle (*CCC*), inventory turns (*Inv Turns*) and accounts receivable turns (*AR Turns*) are highly correlated with one another despite the fact that each measures separate aspects of working capital management. These high correlations generally suggest that firms performing well on one metric also perform well on the others consistent with sustained firm effort improving multiple areas of balance sheet and working capital management.

Secondarily, the correlations show modest relationships between firm valuation (*Tobin's Q)* and profitability (*ROIC*). Given the noise in the data and the broad panel data set being used, such modest correlations are to be expected and highlights the importance of multivariate regression to isolate the impact of individual working capital metrics on metrics of interest to investors.

Third, there is a meaningful correlation between larger firm size (*Large Cap*) and working capital management metrics consistent with the view that larger firms have different capacity regarding balance sheet management perhaps due to their size and scope. This reinforces the importance of accounting for firm size in some fashion in our multivariate analysis.

Although there is no single year that indicates a shift in working capital management practices, one reasonable place to divide the data is based on the year 2000. Post-2000 most firms in our sample had

[7] The assumption of the year 2000 as a turning point in the availability of internet services is a convenient if imprecise breaking point. Beyond the year 2000, internet services were widely available and they had already begun having major economic impacts as documented by Forman, Goldfarb, and Greenstein (2012).

[8] SIC 6000 represents the financial industry and is particularly different from the other industries. While we include SIC 6000 firms in our subsequent results for completeness, our results are not qualitatively different when the financial industry firms are excluded because we control for industry in our regressions, suggesting our results are not driven by that single industry.

Table 1
Mean and overall medians for working capital metrics by industry grouping.

	AR Turns	CCC	DPO	Inv Turns	ROIC	Reinvest	Tobins Q	Obs
Overall Median	5.99	69.36	27.03	12.17	0.096	0.68	1.35	188,433
Overall Mean	2.82	317.16	173.04	7.20	0.06	1.47	1.92	188,433
SIC 0	4.59	173.39	32.47	2.89	0.063	1.60	1.60	818
SIC 1000	0.67	451.30	220.04	2.86	0.058	0.23	1.55	11,987
SIC 2000	2.45	151.65	73.51	4.79	0.014	1.49	1.84	27,792
SIC 3000	3.63	153.30	52.89	3.46	0.026	2.52	1.86	50,512
SIC 4000	2.21	122.03	68.42	14.57	0.099	0.96	1.50	20,899
SIC 5000	7.83	74.17	31.26	6.21	0.091	0.19	1.75	17,563
SIC 6000	0.18	1374.56	898.23	1.30	0.214	1.56	1.40	24,199
SIC 7000	2.20	145.38	41.34	17.48	0.046	1.23	3.27	25,166
SIC 8000	2.86	114.65	35.19	16.43	−0.009	0.83	1.92	7400
SIC 9000	1.37	300.40	101.03	2.69	−0.475	2.44	2.34	2097

Table 2
Industry working capital metrics.

Industry	Reinvestment	DPO	W. Cap. Turns	ROI	AR Turns	Inv. Turns
SIC 1000	9.21	64.9	6.53	6.75	8.81	16.42
SIC 2000	14.42	56.84	49.29	13.67	10.16	8.42
SIC 3000	7.15	43.56	8.63	8.39	6.43	6.67
SIC 4000	2.49	43.91	89.31	4.55	10.56	24.95
SIC 5000	14.33	37.6	2.24	9.74	98.23	11.44
SIC 6000	9.52	25.16	1.88	8.81	8.23	53.72
SIC 7000	9.45	83.9	4.34	12.03	7.18	68.06
SIC 8/9000	13.48	43.17	23.75	11.65	8.15	31.03

Table 3
Trends in working capital management over time.

Year	AR Turns	CCC	DPO	Inv. Turns	ROIC	Reinvest	Tobin's Q	Obs
1990	2.21	195.54	60.32	4.04	0.062	6.03	1.47	7340
1991	0.63	487.25	174.08	4.39	0.082	0.54	1.57	6273
1992	2.25	185.02	50.80	4.94	0.084	6.81	1.71	6637
1993	1.25	282.43	100.69	4.02	0.002	1.03	1.75	7167
1994	1.51	197.06	110.55	5.58	0.071	1.32	1.68	7631
1995	1.82	168.47	103.15	5.10	0.056	6.47	1.79	8402
1996	1.45	212.94	111.77	5.02	0.069	3.67	1.97	8541
1997	1.65	175.90	119.71	4.94	0.052	0.65	1.93	8379
1998	1.60	181.20	118.91	5.09	0.016	0.57	1.94	8534
1999	1.20	217.86	163.36	4.80	0.022	1.59	2.12	8444
2000	1.23	199.19	165.37	5.37	0.008	5.10	2.21	8017
2001	1.33	196.57	162.46	4.29	−0.020	0.04	1.80	7400
2002	1.35	203.39	156.84	4.03	0.013	1.57	1.58	7102
2003	1.29	170.48	179.84	5.38	0.017	3.98	1.62	6942
2004	0.96	224.53	222.91	5.38	0.009	0.67	1.84	6835
2005	1.02	207.11	233.34	4.36	0.049	1.56	1.83	6681
2006	0.84	337.31	239.85	2.60	0.039	3.22	1.84	6508
2007	0.68	396.77	262.82	2.93	0.036	1.69	1.88	6312
2008	0.70	333.67	289.90	3.53	0.059	0.68	1.64	6166
2009	1.15	497.17	166.04	1.06	0.022	10.23	1.42	5950
2010	0.90	439.91	156.72	1.92	0.079	4.94	4.52	5707
2011	0.21	368.15	199.37	4.12	0.041	0.87	1.64	5650
2012	0.68	405.78	209.17	4.54	0.109	0.54	1.84	5720
2013	0.72	378.70	202.54	5.02	0.094	7.07	1.91	5680
2014	0.70	399.27	266.15	2.51	0.034	4.84	1.85	5605
2015	0.56	534.42	284.01	2.22	0.140	3.59	1.89	5411
2016	0.71	312.11	269.41	5.26	0.031	0.14	1.79	5124
2017	0.81	231.78	286.17	5.54	0.069	2.52	1.89	4275
Summary	0.87	337.14	180.94	3.62	0.048	2.93	1.89	188,433

access to the internet, computer usage was widespread in office settings, and continuous improvement was a trend that was well established. As a result, in our subsequent analysis, we include a *Post Y2000* binary variable to capture whether an observation occurred before or after December 31, 1999. The goal here is to examine if working capital management improved on average across firms during the post-2000 period versus the pre-2000 period. Table 5 below uses this approach to examine changes in cash conversion cycle (*CCC*).

Column 1 of the table examines the change in CCC before and after the year 2000 taking into account both firm industry and firm specific effects. By using firm fixed effects, the regressions capture the impact of the pre/post 2000 period on each firm in isolation. The coefficient on *Post Y2000* is −4.62 and is statistically significant at the 1% level. The interpretation of this, is that after the year 2000, the average firm in the sample had a cash conversion cycle that was 4.62 days shorter than in the period before the year 2000.

While the initial significance and sign of the coefficient indicates that CCC improved across the sample, it could be that this result is a function of a consistent trend in cash conversion cycles through the sample rather than an effect of working capital management practices that became widespread after the year 2000. To address this possibility, we include a lagged CCC variable in column 2. The resulting coefficient on *CCC* remains similar in magnitude, sign, and significance. Likewise, in column 3 controlling for large firms versus small firms does nothing to change the result that *CCC* has fallen significantly in the post-2000 period. Finally column 4 yields the same result taking into account

Table 4
Correlations among variables.

	TobinQ	ROIC	CCC	DPO	ARTurn	InvTurn	Reinvest	ARTurn	InvTurn	BigFirm
TobinQ	1.000									
ROIC	0.064	1.000								
CCC	−0.001	−0.043	1.000							
DPO	0.000	−0.030	0.735	1.000						
ARTurn	0.000	−0.026	0.735	0.993	1.000					
InvTurn	−0.002	−0.046	0.901	0.405	0.383	1.000				
Reinvest	0.001	−0.001	−0.001	0.000	0.000	−0.001	1.000			
ARTurn	0.001	0.016	−0.004	−0.001	−0.004	0.000	0.001	1.000		
InvTurn	0.002	0.014	−0.004	−0.001	0.003	−0.011	0.000	−0.002	1.000	
BigFirm	−0.015	0.094	−0.021	−0.003	−0.007	−0.018	0.003	−0.011	−0.010	1.000
Post_Y2000	−0.040	−0.123	0.006	0.005	0.004	0.007	0.000	0.004	0.021	−0.003

Table 5
CCC across industry and years.

	CCC	CCC	CCC	CCC
Post Y2000	−4.62***	−5.71***	−5.80***	−6.95***
	(0.000)	(0.000)	(0.000)	(0.000)
Lagged CCC		0.003***		0.003***
		(0.000)		(0.000)
Large Cap			8.16***	8.77***
			(0.000)	(0.000)
SIC 4000				−85.81***
				(0.000)
SIC 6000				329.12***
				(0.000)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Other Industry Dummies	Yes	Yes	Yes	Yes
Heterscedaticity Robust Errors	Yes	Yes	Yes	Yes
Constant	159.15***	146.42***	158.62***	145.65***
R Squared	0.2259	0.2467	0.2265	0.2702
Observations	144,337	144,337	144,337	144,337

Table 6
Changing terms in inventory turns, days payable, and accounts receivable turns.

	Inventory turns	DPO	Accounts receivable turns
Post Y2000	4.09***	7.55***	0.980***
	(0.000)	(0.000)	(0.000)
Lagged Inventory Turns	0.006***		
	(0.000)		
Lagged DPO		0.678***	
		(0.000)	
Lagged AR Turns			0.022***
			(0.000)
SIC 4000	44.93***	−17.85***	−5.13***
	(0.000)	(0.000)	(0.000)
SIC 6000	−7.68***	493.04***	18.71***
	(0.000)	(0.000)	(0.000)
Large Cap	−0.469	8.82***	−0.575***
	(0.000)	(0.000)	(0.000)
Firm Fixed Effects	Yes	Yes	Yes
Other Industry Dummies	Yes	Yes	Yes
Heteroscedaticity Robust Errors	Yes	Yes	Yes
Constant	159.15***	18.48***	158.62***
R Squared	0.1677	0.9110	0.2766
Observations	144,337	144,337	144,337

lagged CCC values, as well as firm size. In column 4, we also break out results for the industries where the effects are strongest in each direction. The financial services industry (*SIC 6000*) experiences an increase in CCC compared to other industries after controlling for other factors. It is the only industry with a positive coefficient. The industry with the most negative CCC coefficient is the transportation and communication industry (*SIC 4000*), though its magnitude is similar to the other industries save for financial services. This implies that the transportation and communications industries have been particularly aggressive in working capital management, while the financial services industry likely has limited ability to influence its working capital metrics given the nature of the banking and securities businesses.

Overall these results are indicative of a cash conversion cycle that shrunk following the year 2000. While we cannot isolate the single cause for this result among the many changes that occurred during the period, the results are consistent with the view that the introduction of working capital management policies improved firm cash conversion cycles.

Having started the multivariate analysis by examining cash conversion cycle, we now turn our attention to the other metrics of interest in a similar framework. Table 6 examines inventory turns, days payables outstanding (*DPO*) and accounts receivable turns in the same framework as Table 5.

The results are similarly significant for each of the additional working capital metrics. The coefficient on *Post Y2000* is significant at the 1% level for all three metrics and indicates that for the sample period after the year 2000, the average firm saw inventory turns increase by 4.09x each year, days payable (measuring terms on credit received from suppliers) increased by 7.55 days, and accounts receivable turns increased by 0.98x per year. Each of these metrics is consistent with firms operating more efficiently and improving the strength of their financial positions after the year 2000. These coefficients are based on accounting for lagged values of credit metrics, a binary variable for large cap firms, industry dummy variables, and including firm fixed effects. The R-squared values in each case show that the regression model captures a reasonable proportion of the variation in the data. That is especially true in the case of *DPO* which tends to be less volatile than the other metrics.

Again, we break out the two industries where the results are strongest after controlling for other factors; financial services (*SIC 6000)* and transportation and communications (*SIC 4000*). The results for these variables shown in the table are the coefficients on the binary variables representing these two industries. As before, all industries except financial services fall in the same direction but a marginally weaker magnitude to *SIC 4000*, while the results for financial services are quite different. Similar to our conclusion regarding the cash conversion ratio, these results imply that the transportation and communications industries have been particularly aggressive in working capital management, while the financial services industry is probably limited in this regard.

While it appears that working capital management metrics shifted in the latter part of our sample, this result is only of limited interest if it does not translate to the metrics investors care about and that managers are judged on; valuation and profitability. In Table 7 we examine the relationship between one metric for profitability, return on invested capital (ROIC) and our working capital management metrics. We

Table 7
Profitability impacts of changing credit terms.

	ROIC	ROIC	ROIC	ROIC	ROIC
CCC ($\times 10^{-3}$)	−0.645***				−0.565***
	(0.000)				(0.000)
Inventory Turns ($\times 10^{-3}$)		0.155***			0.144***
		(0.000)			(0.000)
Accounts Receivable Turns ($\times 10^{-3}$)			0.482***		0.402***
			(0.000)		(0.000)
DPO ($\times 10^{-3}$)				−0.156***	−0.132***
				(0.000)	(0.000)
Lagged ROIC	0.475***	0.475***	0.476***	0.477***	0.471***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Large Cap	−0.004	0.007	−0.002	0.003	0.007
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Heteroscedaticity Robust Errors	Yes	Yes	Yes	Yes	Yes
Constant	1.79***	1.81***	1.78***	1.70***	1.91***
R Squared	0.5356	0.5401	0.5380	0.5274	0.5601
Observations	144,337	144,337	144,337	144,337	144,337

Table 8
Valuation Impacts of Changing Credit Terms.

	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
CCC ($\times 10^{-3}$)	−0.236***				−0.191***
	(0.001)				(0.007)
Inventory Turns ($\times 10^{-3}$)		0.761***			0.718***
		(0.002)			(0.004)
Accounts Receivable Turns ($\times 10^{-3}$)			0.860**		0.534*
			(0.026)		(0.091)
DPO ($\times 10^{-3}$)				−0.729**	−0.628**
				(0.021)	(0.049)
Lagged Tobin's Q	0.445***	0.441***	0.443***	0.443***	0.442***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Large Cap	−0.073***	−0.077***	−0.078***	−0.076***	−0.074***
	(0.006)	(0.006)	(0.005)	(0.007)	(0.009)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Heteroscedaticity Robust Errors	Yes	Yes	Yes	Yes	Yes
Constant	6.55***	6.80***	6.44***	6.25***	7.01***
R Squared	0.3220	0.3211	0.3218	0.3209	0.3242
Observations	144,337	144,337	144,337	144,337	144,337

measure return on invested capital based on the net income of a firm divided by its market capitalization in a particular period (see Table 8).

The table below reveals a significant association between all four of our working capital metrics and ROIC. The statistical significance, magnitude, and direction of each metric hold both individually and jointly as shown in columns 1–4 and column 5 of the table. For ease of reading, we have removed the leading three zeros on the coefficient of each working capital metric. Thus the interpretation of each coefficient is in basis points. A one unit (one day) increase in *CCC* is associated with a drop in ROIC of 6.45 basis points, or 5.65 basis points when all metrics are included together. Given the effect of 5–6 day drop in *CCC* as found in Table 5, the coefficients here suggest that post year 2000, changes in *CCC* are associated with a roughly 25–40 basis point increase in ROIC (5 day drop*5.65 basis points). This is an economically meaningful figure that suggests value for investors from greater focus on working capital management.

The other metrics have similar interpretations; improved inventory turns increase ROIC by ~1.5 basis points (column 2 and 5), accounts receivable turns increase ROIC by ~4 basis points (column 3 and 5), and improved *DPO* increases ROIC by ~1.3 basis points (column 4 and 5). Using the post year 2000 effects shown in Table 6, we can estimate the impact of improved working capital management as being approximately 8 basis for inventory turns, 5 basis points for AR turns, and 12 basis points for days payable improvements. Cumulatively, the four working capital metrics are associated with an additional 50 basis points in ROIC in the post 2000 period. In the context of a mean ROIC of 6%, that 50 basis point improvement is meaningful indeed. These results are in the context of controls for lagged ROIC, a large cap dummy, year dummies, industry dummies, and firm fixed effects, and the statistical significances hold when using robust standard errors to account for possible heteroscedasticity in the data.

Finally, we examine the linkage between firm valuation as proxied for by Tobin's Q and our working capital management variables. As with ROIC in Table 7, we examine the impact of each working capital variable separately (columns 1–4) and jointly in column 5. The results show a linkage between Tobin's Q and our proxies for working capital management. Improvement in *CCC* and *DPO* (lower values) and in inventory turns and accounts receivable turns (higher values) are all associated with statistically meaningful increases in valuation under Tobin's Q. As before, these effects are after accounting for lagged values of Tobin's Q, size, industry, year, and firm fixed effects. The evidence supports the view that better working capital management practices are associated with higher equity market valuations. Our evidence is consistent with working capital improvements as a channel to higher firm

valuation, but we acknowledge the possibility of other unknown factors driving both valuation and working capital management and leave it to future researchers to examine this possibility.

4. Conclusions and future research recommendations

Some of the largest firms in the U.S represented have experienced significant changes in the distribution shapes of most of the standard financial measures used to measure working capital and process improvement practices for an extended period of time: 1990–2017. These changes are not limited to a segment of the study period and are across the entire 27 years studied. The effects also are across every industry category studied, although those groups are at the one digit industry classification. Therefore, the largest firms seem to have engaged in continuous improvement or working capital management programs that resulted in improved performance. These improvements have been shown to positively affect the market values of the firms in both an absolute (total market value of the firm) and relative (Tobin's Q) sense. These market value improvements were apparent in all industry groupings studied with some working capital measures being more important to certain industry groups.

These findings have implications for industry managers. Specifically, there are three major points of interest to industry. First, firms benefit from implementing working capital management practices not only based on their internal operational key performance indicators (KPIs), but also based on external valuation of the firm by outsiders. This reinforces the importance of such efforts for industry. Second, different industries have made different levels of progress in achieving progress on management of working capital. For practitioners in the mining and construction fields (SIC codes 1000–2000), finance (SIC code 6000–7000) and the business services field (SIC code 7000–8000), greater opportunities for improvement remain. Third, there is significant variation and skewness across all industries suggesting that management of working capital varies greatly within individual industries. This creates an opportunity for managers to improve performance in laggard firms by following the best practices set forward by competitors. Such opportunities are likely to be greatest at smaller firms, but are present at some larger firms as well.

Future research can focus on whether certain financial measures capture more of the impact of working capital management policy changes due to the nature of the industry. For example, a service industry that does not produce parts or components may have very low inventory and very low payables balances so that inventory turnover and days payables outstanding may have little impact on performance whereas accounts receivable turnover may be very important and closely parallel the cash conversion cycle. Likewise, an agricultural food processor may find the cash conversion cycle may be very important here.

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