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Are working capital decisions truly short-term in nature?☆

Gaurav Singh Chauhan

Finance and Accounting Area, Indian Institute of Management Indore, Indore, Madhya Pradesh 453556, India

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ABSTRACT

We investigate the extent of short-term flexibility in firms' working capital management decisions. Contrary to the firms' perceived ability to frequently modulate their working capital allocations, we find systematic and persistence differences in working capital allocations across and within industries. Specifically, industries and firms within industries with relatively higher or lower working capital allocations remain so for a sustained period of time, often exceeding 15 years. Contrary to the past literature suggesting that such allocations are driven by firms' concerns over improving inter-temporal cash flows and sales or absorbing shocks to their capital expenditure schedules, we find that firm-specific time-invariant factors rather primarily drive them.

1. Introduction

Corporate working capital decisions are often cited as short-term financial decisions. Textbook treatment of working capital management concurs with this idea (see, e.g., Brealey, Myers, & Allen, 2016, and Brigham & Ehrhardt, 2015). Such perceptions often stem from the short-term turnover cycles associated with working capital components viz: credit receivables, inventories and trade payables. For many firms, these components turn over several times in a typical year of operation.

Past literature seems to evaluate the efficiency of firms' working capital management by comparing the relative working capital allocations across firms (see, e.g., Frankel, Levy, & Shalev, 2017 and Ek & Guerin, 2011). Presumably, firms can swiftly modulate their working capital to conform to the optimal allocations in their respective industry (see, e.g., Aktas, Croci, & Petmezas, 2015 and Baños-Caballero, García-Teruel, & Martínez-Solano, 2010). As per this literature, such modulations may provide the required tactical asset allocation to enhance firm value. Accordingly, we should expect frequent modulations in firms' working capital allocations within the industry over time. For example, we expect firms with relatively higher (lower) working capital allocation within an industry to decrease (increase) their allocations over time. Similarly, firms within an industry are likely to operate with a similar working capital allocation that is presumably optimal for the industry. However, interestingly, such modulations in working capital allocations and industry-wide optimal allocations are not empirically observed in the data.

In this paper, we show that typical firms' working capital allocations across and within industries, while markedly different, are quite persistent. Specifically, industries and firms within industries with relatively higher or lower working capital allocations remain so for a sustained period, often exceeding 15 years. In our sample of U.S. industrial firms spanning 30 years, while a typical industry spends almost 85% of the time in a predominant quartile, more than three-fourths of the firms within these industries spend more than 50% of their time in a single quartile, when sorted according to their relative working capital allocations within industries in a given year. Occasionally, even when firms change their allocations to make transitions across quartiles, the magnitude of these changes are often not quite enough to make transitions beyond the adjacent quartiles. Thus, firms with the higher and lower relative allocations of working capital co-exist within industries and differences in their allocations tend to persist. While these findings reflect Nunn's (1981) view of 'permanent' working capital allocation, they are contrary to the common perception in the existing literature presuming working capital as a relatively flexible source of internal financing or sales modulation, even in the short run (see, e.g., Cunat, 2007). A typical firm's working capital allocation, relative to other assets, is far from being short-term in nature.

To illustrate our point here, for example, Fig. 1 plots the ratio of net operating working capital[1] to average total assets for two firms each from the Apparel and the Restaurant industries in the USA, along with their respective industry medians calculated using the full sample consisting of all available firms in these industries during the period

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E-mail address: gauravs@iimidr.ac.in.

[1] We measure net operating working capital as accounts receivable plus inventories minus accounts payable.

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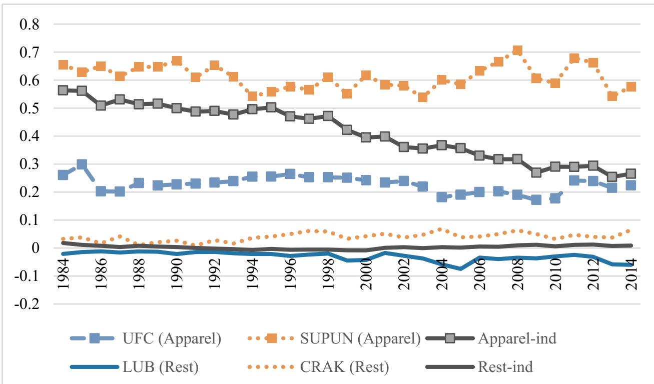

Fig. 1. Working capital allocations of two firms in the Apparel and Restaurant industry.
Notes: This figure shows the ratio of net operating working capital to average total net assets for two firms each in the Apparel and Restaurant industry, along with their industry median allocations over time.

between 1984 and 2014. While Unifirst Corp (UFC) and Superior Uniform Group Inc. (SUPUN) belong to the Apparel industry, Luby's Inc. (LUB) and Cracker Barrel Old Country Store (CRAK) belong to the Restaurant industry. Noticeably, the industry median for the Apparel industry is significantly higher as compared to the Restaurant industry. Further, the difference persists for the entire sample period. Importantly, while Unifirst and Luby's both have their ratios less than their respective industry medians, Superior Uniform and Cracker Store have them more than their medians.[2] These firms seem to retain their positions relative to their industry medians throughout the sample period. In other words, these firms do not significantly modulate their working capital allocations quite often even within their respective industries. Taking cues from these findings, we suspect that the past literature largely overstates the potential for adjusting working capital to increase firm value (or financial flexibility).

To systematically explore persistence in firms' working capital allocations, we investigate as to what extent firms' initial working capital allocations determine the current allocations, in the presence of other cross-sectional determinants that could change every period. We find that initial working capital allocations, set by the firms several years in the past, play a dominant role in predicting current allocations. In economic terms, one standard deviation change in initial working capital allocations could explain more than half of the variation in the current allocations. On the contrary, although the effect of many time-varying factors remains statistically significant, their economic significance is hardly comparable to that of the initial working capital allocations.

Upon quantifying the relative share of time-invariant and time-varying factors in explaining the variation in firms' working capital allocations, we find that within-firm variation is systematically much lower than the between-firm variation. We note that the average within-firm variation in working capital allocations is only about one-third of the between-firm variation in our sample. The analysis of covariance, using the type III partial sum of squares and otherwise, further reveals that the firm-fixed effect contributes more than 95% of the explained variation in the current allocations. These results confirm the all-pervasive influence of unknown time-invariant characteristics in determining firms' working capital allocations.

Our findings of persistent working capital allocations contradict the idea of working capital acting as a tactical tool for value creation. Contrary to the past literature, to the extent time-invariant factors drive working capital allocations, it is possible that these factors represent firms' specific strategic considerations rather than concerns over improving intertemporal cash flows and sales. Relative persistence in working capital allocations within industries also contradicts the existence of a standard industry-wide optimal allocation for the constituent firms and the notion that firms could be better-off by moving toward such optimal. Further, a priori there seems to be no active trade-off between working capital and fixed assets, as suggested by Fazzari and Petersen (1993).

The exploration in this paper is related to the sub-optimal behavior of many firms found in the past literature discussing varied corporate finance themes in the past. For example, Maksimovic and Phillips (2002) re-examine the findings on the early corporate diversification papers, e.g., Berger and Ofek (1995). The authors find contrary evidence to the past literature that most diversified firms should refocus to increase shareholder wealth. Similarly, MacKay and Phillips (2005) suggest no standard industry-wide optimal financial structure in place towards which firms within industries should gravitate. The authors, on the contrary, find that firms' relative positions within their industries are the outcomes of equilibrium forces.

The remainder of the paper is organized as follows. Section 2 discusses the past literature suggesting short-term attributes of working capital allocations. Section 3 shows systematic differences and persistence in working capital allocations across and within industries. Section 4 further investigates for such persistence and identifies relative contributions of time-varying and time-invariant factors in explaining the firms' current working capital allocations. While Section 5 presents the discussion and implications of our findings in this paper, Section 6 concludes the paper.

2. Background literature

Past literature often discusses the short-term flexibility offered by working capital in dealing with contingencies such as possible stock-outs, supply-side frictions, and input price fluctuations (see, e.g., Corsten & Gruen, 2004; Fazzari & Petersen, 1993; and Blinder & Maccini, 1991). Similarly, working capital can be effective in reducing short-term information asymmetry between buyers and sellers; for example, by improving customer perceptions by allowing customers to verify the product quality before paying for it. Adequate working capital can also boost inter-temporal sales in the face of cyclical market demand helping firms to remain competitive (see, for e.g., Wilson & Summers, 2002; Wilner, 2000; Ng, Smith, & Smith, 1999; Petersen & Rajan, 1997; Deloof & Jegers, 1996; Brennan, Maksimovic, & Zechner, 1988). Further, suppliers' trade credit is perceived as a relatively more flexible source of financing rather than bank borrowing. In a way, trade credit often acts as insurance against firms' liquidity shocks (Cunat, 2007). Working capital also seems to act as an inter-temporal buffer to accommodate unexpected shocks in capital expenditures and hence smoothen its course (Ben-Nasr, 2016Fazzari & Petersen, 1993).

Perceiving flexible short-term dynamics of working capital, past literature offers practical advice to managers for boosting their firms' sales by incurring incremental investments in working capital or improving their cash flow positions by the release of excess cash tied up in working capital (see, e.g., Filbeck, Krueger, & Preece, 2007, and Ek & Guerin, 2011). Further, literature also suggests short-term managerial rewards to alleviate slack in the deployment of working capital relative to other firms in the industry (see, e.g., Frankel et al., 2017; Aktas, Croci, Ozbas, & Petmezas, 2016 and De Angelis & Grinstein, 2015).

[2] For the sake of exposition, we chose the two firms in each of these industries such that the ratio of net operating working capital to average total assets for them is significantly lower than the industry median for one of the firm and significantly higher for another in the year 2000, which lies in the middle of the data sample period. Further, the two firms have the ratio of net operating working capital to average total assets available during the entire sample period.

Management consultants also cite firms' inefficiency in managing working capital in the short run. For example, one such consultant reports excess or unnecessary working capital deployed by the firms in the range of $330 to $590 billion in 2011. They see this unnecessary portion as an opportunity to boost their cash flow positions equivalent to 3–6% of their annual sales (Ernst & Young, 2010). Another consulting firm provides anecdotal evidence of an Asian firm cutting its working capital by 30% and funding a significant acquisition with the help of the released funds, without the need for substantial and costly external financing (Buchmann, Roos, Jung, & Martin, 2008).

Considering the trade-off in short-term opportunities, past studies also suggest optimal allocation for firms' working capital. For example, Ben-Nasr (2016), Aktas et al. (2015) and Baños-Caballero, García-Teruel, and Martínez-Solano (2014) suggest an inverted U-shaped relationship such that the value or performance of firms operating with relatively higher (lower) working capital decreases (increases) with the working capital deployed. Other studies suggest a strictly negative relationship between firms' value or operating performance and their working capital (see, e.g., de Almeida & Eid, 2014; Kieschnick, Laplante, & Moussawi, 2013; Filbeck et al., 2007; García-Teruel & Martinez-Solano, 2007; Deloof, 2003; Wang, 2002; Shin & Soenen, 1998). Further, Baños-Caballero et al. (2010) find rapid convergence toward the optimal working capital allocations whenever firms deviate from them.

3. Persistent working capital allocations

3.1. Working capital allocations across industries

We begin our analysis by observing the median working capital allocations across different industries over time. Specifically, we focus on the differences in these allocations across industries at any given point in time and also the extent to which these differences persist. We measure working capital allocations by the ratio of net operating working capital to the average total net assets during a year.[3] For a particular year, net operating working capital is calculated as accounts receivable plus inventories minus accounts payable, and total net assets as the difference between total assets and accounts payable.[4] We use annual financial statement data from Compustat for all non-financial U.S. firms (excluding utilities and real estate firms) and segregate them into industries based on Fama-French 49-industry classification. Subsequently, we estimate the median ratio of net operating working capital to total net assets for each industry and all the years from 1984 through 2014. We then use representative years to sort industries according to these median ratios and then segregate them into four quartiles for all the years based on this sort. Importantly, the set of industries identified in the four quartiles, based on the representative years, remains the same for all the years. Subsequently, we calculate the averages of these medians for industries in the four quartiles for all the years from 1984 through 2014.[5] Fig. 2 plots such averages for the industries in the four quartiles for the representative year 2000. The other representative years used are 1990 and 2010, for which the plots are very similar to that of Fig. 2.[6] We do not report these figures here for the sake of brevity.

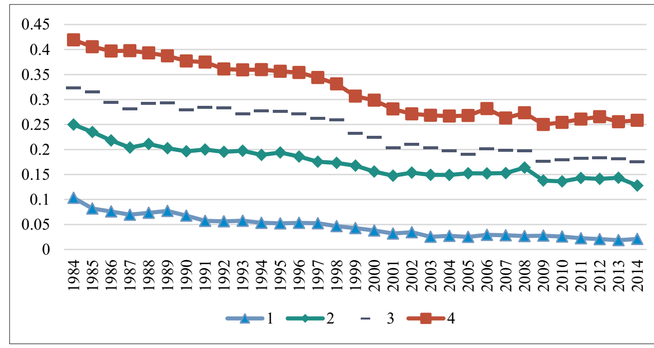

Fig. 2. Movement in the median working capital allocations for industries in the four quartiles

Notes: This figure shows that the average of the median for the ratio of net operating working capital to total net assets for the industries in the four quartiles for the representative year 2000. The four quartiles are formed using the representative years (1990, 2000 and 2010) to sort industries according to the median ratio of net operating working capital to total net assets for all the years from 1984 through 2014. Importantly, the set of industries identified in the four quartiles, based on the representative years, remains the same for all the years.

Fig. 2 shows that the average working capital allocations for industries in the four quartiles are always distinguishably different. This is true even after controlling for the sample composition in the four quartiles throughout the analysis. For example, even when sorting industries according to their median working capital allocations in the year 2000, these industries differ similarly in their median allocations for any year between 1984 and 2014 (both inclusive). In fact, the difference between the working capital allocations of any two adjacent quartiles is non-trivial at any point in time and persists throughout the period from 1984 through 2014. Thus, the working capital allocations in Fig. 2 seem to be sticky such that relatively they do not change much over a very long period. Therefore, it is possible that these allocations are characteristic of specific industries, consistent with the findings in the past literature (see, e.g., Hawawini, Viallet, & Vora, 1986; Weinraub & Visscher, 1998; and Filbeck & Krueger, 2005).

We gather additional insights into the persistence of working capital allocations across industries by observing the movement in their relative rankings each year from 1984 to 2014. For each year we sort industries based on their median working capital allocations and assign them respective quartile numbers. Subsequently, we observe the change in these numbers for the industries over time. Panel A of Table 1 shows that a typical industry spends 84% of its total time in the sample in a single quartile. More specifically, while three-fourths of the industries spend more than 75% of their time in a single quartile, more than half of the industries spend more than 90% of their time in just one quartile. Further, Panel B of Table 1 shows the average number of years spent in specific quartiles by industries based on their existence in a predominant quartile. For example, industries predominantly appearing in

[3] Total net assets in the denominator of the ratio are average of the current and previous years. Past literature has used the ratio of net operating working capital to sales (NWC/S) or the firms' cash conversion cycles (CCC) as a measure of working capital. While NWC/S measures firms' effectiveness in using their working capital per unit of sales, CCC measures the average time duration between the cash payment made to the suppliers for getting the supplies and the cash receipts upon the sale of the final product. Quite importantly, the ratio NWC/S or CCC may not serve as a measure of firms' working capital allocations per se.

[4] Compustat reports the figures for total assets as the sum of current, fixed and other assets. Figures for current assets are provided in gross terms, i.e., ignoring the current liabilities. Since we refer to firms' working capital allocation as the fraction of assets invested in net operating working capital, we subtract account payables (a form of current liability) from the total assets which are then reported as total net assets in this paper.

[5] For the representative year of 2000, the industries appearing in the first quartile with the smallest medians are the restaurant, entertainment, gold, pharmaceuticals, communication, oil and gas, personal services, transportation, coal, mines, and computer software industry. The industries appearing in the fourth quartile with the largest medians are the construction material, electrical equipment, recreation, laboratory equipment, aircraft, wholesale, consumer goods, machinery, construction, textile and apparel industry.

[6] We choose the year 2000 as it approximately represents the mid-point of all the years of our dataset. The years 1990 and 2010 are accordingly chosen to be equidistant from the year 2000.

quartile 1 spend 29.7 years, on average, in quartile 1 out of the 31 total years of data analyzed.

Considering the information in Fig. 2 and Table 1, we can infer that while there seem to be permanent differences in working capital allocation across industries, there is no relative transitory convergence of these differences at any point in time. Further, firms' working capital allocations within industries seem to be characteristic of that industry.

3.2. Working capital allocations within industries

We next turn to study the differences in firms' working capital allocations within industries. For each industry, we sort the firms based on their ratio of net operating working capital to total net assets in a representative year.[7] For the set of firms in the four quartiles based on this sort in each industry, we then calculate the medians of the ratio of net operating working capital to total net assets for all the years from 1984 to 2014. In this way, the set of firms appearing in the four quartiles remains the same for all years.

To begin with, we observe whether firms within industries have systematically different working capital allocations and whether the differences in these allocations persist over time. For this, we take the difference of the median ratio of net operating working capital to total net assets between adjacent quartiles in each industry for each year based on the sort using the representative year. Specifically, we take the difference between quartiles 2 and 1, 3 and 2, and 4 and 3. Subsequently, we estimate the fraction of observations greater than zero for each group of differences. Results in Panel C of Table 1, for the representative year 2000, suggest that at least 86% of the observations of a higher-order quartile are greater than those in a quartile immediately preceding it.

Subsequently, we also test the statistical significance of the difference in medians for the set of firms in any two adjacent quartiles for all industries using the two-sample Wilcoxon (1945) rank-sum (or Mann & Whitney, 1947) test. The results of this test suggest that the medians in the higher-order quartiles are significantly greater than those of the adjacent lower-order quartiles even at a 1% significance level. We repeat the above analysis for a constant sample of firms for which the data is available throughout from 1984 to 2014 and find similar persistent differences in working capital allocation for any two adjacent quartiles.

Similar to studying relative rankings of different industries, we delve deeper into the cross-section of firms to study their relative positions within industries in different quartiles over time. For each year we sort firms within their respective industries based on their ratio of net operating working capital to total net assets and assign them respective quartile numbers. We then observe these numbers over time. We report our findings in Table 2 for four sample compositions viz: the samples of firms for which the data is available for at least 5 and 15 years; the constant sample of surviving firms for all the years from 1984 to 2014, and the full sample. Panel A of Table 2 suggests that, on average, a typical firm spends approximately two-thirds of its time in only one quartile. More specifically, more than three-fourths of the firms spend more than half of their time in their predominant quartile while almost all firms spend at least a third of their time in their predominant quartile. Further, working capital allocations of more than two-thirds of the firms remain either lower or higher than their industry medians for three-fourths of the years of their existence in the sample. Similarly, all the firms spend at least half of their time in their predominant half.

Panel B of Table 2 shows the average number of years spent in different quartiles based on their predominant quartiles. For example, for the constant sample, firms predominantly in quartile 1 spend about 19 years in quartile 1 and only about 8.5 years in quartile 2. Importantly, the time spent in the second-most predominant quartile is much lower than that spent in the predominant quartile. Further, the second-most predominant quartile is always adjacent to their predominant quartile. Thus, working capital allocations do not drift much to cause a significant change in the firms' relative ranking within their respective industries over time.

The observations in this section highlight non-trivial persistence in the relative working capital allocations for the U.S. firms within their respective industries, suggesting that working capital decisions are not quite short-term in nature. Relative working capital allocations appear to be stationary for a long period, often exceeding 15 years. Now that we have a preliminary idea of the persistence in relative working capital allocations, we turn to quantify the extent of within-firm persistence and explore several factors and their relative contributions in explaining the variation in working capital allocations across firms.

4. Determinants of working capital allocations

The analysis in the previous section suggests that there are wide differences in the working capital allocations — that appear stationary — across firms within industries. However, such differences could simply highlight cross-sectional differences across firms with higher or lower working capital allocations. For example, larger firms may systematically choose to deploy lower or higher working capital as compared to smaller firms. In this section, we take a closer look at the relative contributions of time-varying and time-invariant factors in explaining firms' working capital allocations. While studying the persistence of working capital allocations, we follow the analytical frameworks of Lemmon, Roberts, and Zender (2008) and DeAngelo and Roll (2015), studying persistence in corporate leverage. Specifically, we undertake three different analyses to gauge these contributions.

First, we study the relative impact of the initial working capital allocations, amidst several cross-sectional determinants, in explaining the contemporaneous working capital allocations. Persistence in working capital allocations suggests a significant impact of initial allocations in determining current working capital allocations. Second, we assess the longer-term impact of the cross-sectional determinants, when these determinants could change significantly. If managers change their relative working capital allocations infrequently, the longer-term effect of cross-sectional determinants could be significant as compared to their short-term effect. Finally, we undertake a variance decomposition analysis to precisely quantify the marginal effect of time-invariant and time-varying factors, including their possible interactions.

4.1. Cross-sectional determinants of working capital

We begin by describing several cross-sectional determinants of working capital. Past literature has discussed the role of several firm-specific attributes influencing the working capital deployed by the firms (see, for e.g., Petersen & Rajan, 1997; Kieschnick, Laplante, & Moussawi, 2006; Chiou, Cheng, & Wu, 2006; Cunat, 2007; Hill, Kelly, & Highfield, 2010; Baños-Caballero et al., 2010 and 2014). We discuss the potential impact of several firm-specific attributes on the working capital allocations in Appendix A.

4.2. Data and summary statistics

We use annual financial statement data for all non-financial firms (excluding utilities and real estate sector firms) for which the data is available in Compustat for the period from 1984 through 2014.[8] Our analysis in this paper especially requires non-missing values of all three

[7] For the sake of brevity, we show results for the year 2000 as a representative year but results for other representative years of 1990 and 2010 are very similar and are available from the authors.

[8] Since several variables for many firms are not available regularly every quarter basis and since the analysis in this paper require non-missing data on several firm-specific variables and also focus on a sample of firms surviving throughout, we choose to work with annual frequency of data. Accordingly, we acknowledge that our results could not provide insights into the seasonal changes in working capital allocations that could be better captured through quarterly data. We leave such exploration for future research.

working capital components viz: accounts receivable, inventories and accounts payable, along with non-missing values of total assets used to estimate firms' relative allocation of working capital and other assets. For all the multivariate analyses, we require non-missing values of relevant variables except for research and development expenses, for which we replace missing values with zero. Further, we have excluded firm-year observations with the annual sales less than $10 million, the ratio of net fixed assets to total net assets (total assets minus accounts payables) greater than one, the debt-to-total asset ratio less than zero and greater than one, the ratio of operating income before depreciation to total net assets less than zero and the difference in gross fixed assets over previous year less than zero. We winsorize all the variables of interest at their tails representing one-percentile at each end.[9]

After excluding firm-year observations for missing values of relevant variables and applying the above-mentioned filters, we have the full sample consisting of 9582 firms. We often focus on a constant sample of 228 firms surviving throughout the analysis. Additionally, we also elaborate on certain results using samples of firms having data on working capital for at least 5 and 15 years. These samples consist of 6304 and 1957 firms respectively.

Appendix B describes several cross-sectional determinants of working capital used in the past literature, along with their measurements and definitions. Appendix C shows the summary statistics of all the variables of interest for the full and constant samples of firms. Consistent with past studies analyzing different sample compositions (see, e.g., Lemmon et al., 2008), surviving firms are larger, older and more profitable than the full-sample firms on average. Further, surviving firms seem to be less risky, be less financially distressed, have lesser sales growth but higher sales volatility, have higher market share and invest less in working capital as a proportion of their working capital base when compared to other firms generally. We also report pairwise correlations for all the variables of interest in Appendix D. No pair of firm-specific variables seems to be heavily correlated.

4.3. The role of initial working capital allocation

We begin a systematic investigation into the persistence of firms' working capital allocations by comparing the cross-sectional similarity in working capital allocations at different points in time. Specifically, we identify the correlation between the cross-sectional distributions of working capital allocations at time t and t + k, where k is the time difference between the two cross-sections. We estimate these correlations for the time difference ranging from one to 15 years. For example, we estimate the correlation between working capital allocations one year apart for the years 1984 and 1985, 1985 and 1986 and so on and then average them to represent the 1-year correlation. Similarly, we use the average of the correlations between years 1984 and 1984 + k, 1985 and 1985 + k and so on to represent k-year correlation. Subsequently, we square these average correlations to reflect R-squared (R^2) between two cross-sections k-years apart. These R-squared represent the percentage variation explained by the cross-section k-years apart.

Fig. 3 plots these R-squared for cross-sections up to 15 years apart, i.e., k = [1, 15], for the constant sample of 228 firms surviving throughout the analysis. Although the fraction of explained variation consistently declines with the time difference between the two cross-sections, we find that the working capital allocations 15 years back could still explain roughly half of the initial variation in working capital allocations. Thus, the simple correlation between these two cross-sections that are 15 years apart is approximately 71%. While such high correlations between the two cross-sections — so distant from each other — are consistent with the inter-quartile persistence that we identify in the previous section, they also suggest the important role of firms' initial working capital allocations in predicting future allocations. We now turn to assess this role formally.

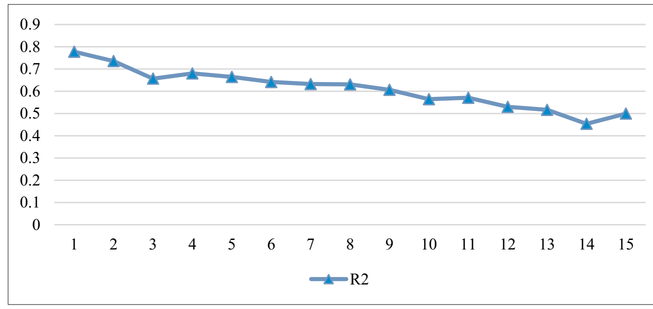

Fig. 3. Percentage variation in working capital allocations explained by the cross-sections k-years apart.

Notes: This figure identifies the correlation between the cross-sectional distributions of working capital allocations at time t and t + k, where k is the time difference between the two cross-sections. We estimate these correlations for the time difference ranging from one to 15 years. For example, we estimate the correlation between working capital allocations one year apart for the years 1984 and 1985, 1985 and 1986 and so on and then average these correlations to represent the 1-year correlation. Similarly, we use the average of the correlations between years 1984 and 1984 + k, 1985 and 1985 + k and so on to represent k-year correlation. Subsequently, we square these average correlations to reflect R-squared (R2) between two cross-sections k-years apart. These R-squares represent the percentage variation explained by the cross-section k-years apart. Figure III plots these R-squares for cross-sections up to 15 years apart, i.e., k = [1, 15], for the constant sample of 228 firms surviving throughout analysis.

We conduct our first parametric analysis by investigating the role of initial working capital allocations in determining their current allocations amidst several cross-sectional determinants using the following model:

$$NWCR_{i,t} = \alpha + \beta_1 .\ NWCR_{i,0} + \beta_j .\ X\,(fs)_{i,t-1} + \beta_l .\ X\,(me)_{i,t-1} + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where $NWCR_{i,t}$ represents the firms' relative working capital allocations measured as the ratio of net operating working capital to total net assets scaled by the median of this ratio for respective industries in a given year. We chose to scale working capital allocations by their industry median rather than using an industry-fixed effect to simultaneously control for unobserved heterogeneity at the firm level later in this paper. Gormley and Matsa (2013) suggest that fixed-effect estimation is computationally difficult while controlling heterogeneity at industry and firm-level simultaneously. Further, scaling by industry median is particularly worrisome only when the medians themselves correlate with explanatory variables. We find that such is not the case in our dataset. Appendix D shows that industry median working capital allocation (MED) does not significantly correlate with any other explanatory variable.

Since we find systematic differences in working capital allocations across industries, the scaling by the industry median ensures that the working capital allocations are comparable for firms across industries while retaining the firms' relative positions within these industries. That is, such scaling reduces the between-industry variation while not affecting the within-industry variation. Further, such scaling also ensures that we control for the possible exogenous systematic decline in working capital allocations within industries.[10] This is important given our focus is to explore endogenous changes in firms' relative working

[9] As a proportion of the total available firm-year observations for the non-financial firms, we lose approximately 4.2%, 3.2%, 7.6%, 9.7%, and 5.3% respectively on account of threshold sales, extreme proportions of net fixed assets, extreme debt to asset ratios, negative ratio of operating income to net assets and negative growth in fixed assets respectively.

[10] Consistent with Aktas et al. (2015), we notice a systematic decline in working capital allocations across industries and for all four quartiles in Section 3.1. Importantly, systematic decline in working capital allocations can be due to improvement in firms' asset utilization, such as due to the systematic use of just-in-time inventory management techniques. Since the objective in this paper is to study firms' relative working capital allocations within industries, we specifically control for such exogenous decline in working capital allocations independent of firm-specific developments.

Table 1
Working capital levels across industries.

Panel A	
Total industries in the sample	43
Total number of years in the sample	31
Average number of years spent in a predominant quartile	26.18
% duration in a predominant quartile	84.45%

% range/duration in a predominant quartile	No. of industries	Fraction of total (43)
0–25	0	0.000
25–50	1	0.023
50–75	10	0.233
75–100	32	0.744
90–100	23	0.535
100	14	0.326

Panel B

	Average duration in quartile (years)			
Predominant quartile	1	2	3	4
1	29.7	1.3	0.0	0.0
2	1.1	24.2	5.7	0.1
3	0.0	3.5	22.8	4.7
4	0.0	0.0	2.2	28.8

Panel C

No. of observations	(2)-(1)	(3)-(2)	(4)-(3)
Positive	1130	1150	1155
Total available	1316	1303	1263
Fraction	0.86	0.88	0.91

Notes: This table (Panels A and B) observe the movement in the relative rankings of working capital allocations across industries each year from 1984 to 2014. For each year we sort industries based on their median working capital allocations and assign them respective quartile numbers. Subsequently, we observe the change in these numbers for the industries over time. Panel A shows average number of years and percentage duration spent in a predominant quartile. Panel B shows the average number of years spent in specific quartiles by industries based on their existence in a predominant quartile. For example, industries predominantly appearing in quartile 1 spend 29.7 years, on average, in quartile 1 out of the 31 total years of data analyzed. Panel C observes the persistence within industries. For each industry, we sort the firms in four quartiles based on their ratio of net operating working capital to total net assets in the representative year 2000. We then calculate the medians of the ratio of net operating working capital to total net assets for all the years from 1984 to 2014 while keeping the same set of firms in the four quartiles. We then take the difference of the median ratio of net operating working capital to total net assets between adjacent quartiles in each industry for each year. Subsequently, we estimate the fraction of observations greater than zero for each group of differences.

capital allocations within industries over time. Thus,

$$NWCR_{i,t} = \frac{NWC_{i,t}/NTA_{i,t}}{Med(NWC_{i,t}/NTA_{i,t})} \tag{2}$$

where $NWC_{i,t}$ represents firms' net operating working capital measured as accounts receivable plus inventories minus accounts payable for firm i at time t; $NTA_{i,t}$ represents firms' total net assets measured as total assets minus accounts payable. The denominator in Eq. (2) is the industry median ratio of net operating working capital to total net assets for the year t. Since negative values in the denominator of Eq. (2) would create conflict in interpreting working capital allocations with positive and negative signs in the numerator,[11] we limit our exposition to industries with positive median net operating working capital to total net asset ratio only. This ensures that relative working capital allocations measured through Eq. (2) are comparable across industries.

$NWCR_{i,0}$ in Eq. (1) represents the firms' first non-missing median adjusted working capital allocation — calculated by Eq. (2); $X(fs)_{i,t-1}$ and $X(me)_{i,t-1}$ are the lagged values of the sets of firm-specific and macroeconomic control variables respectively; λ_t represents the year-fixed effect and $\varepsilon_{i,t}$ represents the stochastic error term, which is possibly heteroscedastic and correlated within firms. We use lagged values of all the control variables to alleviate any endogeneity concerns in the estimation. While using the initial working capital allocation as an explanatory variable, we drop the first observation for each firm that is concurrent with the initial allocation. Further, we use cluster-robust standard errors, clustered at the firm level, to adjust for the possible heteroscedastic error terms.

Results reported in Table 3 suggest the dominant impact of initial working capital allocations in determining the current allocations both in statistical and economic terms. We also report the economic significance of each variable of interest for the sake of comparison of their marginal effects. Economic significance is estimated as the change in working capital allocations due to one standard deviation change in the subject variable. Panel A shows results using the full sample of firms. The results in Column 1, using initial working capital allocations as the sole determinant, suggest that one standard deviation change in initial

[11] The relative magnitude of working capital allocations could be affected even if we take absolute values of median net operating working capital to total net asset ratio in the denominator of Eq. (2). Our results, therefore, have limited inference to this extent. Due to the elimination of the firm-year observations with negative values of median net operating working capital to total net asset ratio and other exclusions, the median value of NWCR calculated through Eq. (3) is not centered on unity (Appendix C). Importantly, we lose only less than three percent of the total firm-year observations by excluding negative values of median net operating working capital to total net asset ratio.

Table 2
Working capital levels within industries.

Panel A

Sample	Constant		At least 15 years		At least 5 years		Full	
Minimum % duration in a predominant quartile	No. of firms	Fraction of total	No. of firms	Fraction of total	No. of firms	Fraction of total	No. of firms	Fraction of total
90	25	0.110	231	0.118	897	0.142	1492	0.156
80	58	0.254	425	0.217	1604	0.254	2663	0.278
75	62	0.272	532	0.272	1985	0.315	3215	0.336
50	190	0.833	1529	0.781	5010	0.795	7740	0.808
40	218	0.956	1822	0.931	5872	0.931	8996	0.939
30	227	0.996	1947	0.995	6276	0.996	9539	0.996
25	228	1.000	1957	1.000	6304	1.000	9582	1.000
Average fractional duration in a predominant quartile	0.663		0.641		0.653		0.662	

Panel B

Sample	Constant		At least 15 years		At least 5 years		Full	
Minimum % duration in a predominant half	No. of firms	Fraction of total	No. of firms	Fraction of total	No. of firms	Fraction of total	No. of firms	Fraction of total
90	133	0.583	907	0.463	2900	0.460	4364	0.455
80	163	0.715	1183	0.604	3854	0.611	5944	0.620
75	167	0.732	1300	0.664	4257	0.675	6532	0.682
70	192	0.842	1444	0.738	4660	0.739	7114	0.742
60	211	0.925	1708	0.873	5516	0.875	8459	0.883
50	228	1.000	1957	1.000	6304	1.000	9582	1.000

Average duration in quartile (years)

		1	2	3	4		1	2	3	4
		Constant sample					At least 5 years sample			
Predominant quartile	1	19.05	8.55	2.61	0.66	1	11.45	3.81	1.70	0.88
	2	5.39	19.59	5.17	0.85	2	2.69	10.84	3.67	0.82
	3	0.57	4.28	20.14	6.01	3	0.88	3.27	11.19	3.30
	4	0.60	1.16	6.21	23.04	4	0.75	1.06	3.25	13.12
		At least 15 years sample					Full sample			
Predominant quartile	1	16.19	6.20	2.74	0.88	1	9.24	2.88	1.31	0.82
	2	3.96	15.47	5.55	1.12	2	2.22	8.94	2.97	0.72
	3	1.09	4.51	15.60	4.61	3	0.77	2.70	9.32	2.69
	4	0.84	1.39	4.95	18.49	4	0.69	0.90	2.63	11.01

Notes: This table observes the movement in respective quartile numbers assigned to the firms within each industry based on their ratio of net operating working capital to total net assets for each year. Panel A and B show the percentage of time spent in a predominant quartile and half respectively. Panel C shows the average number of years spent in different quartiles based on their predominant quartiles. For example, for the constant sample, firms predominantly in quartile 1 spend about 19 years in quartile 1 and only about 8.5 years in quartile 2. Results for all the four samples described in the data (Section 3.2) are shown.

working capital allocations changes the current working capital allocations by 1.46 units, which is approximately half of the unconditional variation (3.17 units) of the current allocation (Appendix C). Columns 2 and 3 show the results using all other controls and suggest that while the marginal impact of the initial working capital allocation is unchanged, the impact of all other variables is quite small. The marginal impact of the next-best explanatory variable is only one-fifth of that of the initial working capital allocations.

Since initial working capital allocations can serve as a proxy for allocations lagging behind the current allocations by only a few years, this can lead to an overestimation of their explanatory power or suggest an overstated measure of persistence in general. Therefore, we repeat the analysis using the constant sample of firms surviving throughout the analysis. If initial working capital allocations serve as the proxy for short-term persistence only, their marginal impact will diminish in the constant sample. This is because the constant sample has observations for 30 years, so the initial working capital level has a mean lag of 15 years for these observations.[12] Results in Panel B of Table 3 confirm the dominant impact of initial allocations and rather suggest a further increase in the economic impact of the initial working capital allocations. One standard deviation change in these allocations changes the dependent variable by about 1.5 units, which now represents about 63% of the unconditional variation of the current allocation (2.36 units). Further, although the relative marginal impact of some of the control variables is larger than in the full sample, the marginal impact of the next-best explanatory variable is still less than half that of

[12] Although the constant sample has data for working capital allocations for 228 firms for all the years from 1984 to 2014, some data is missing for these firms for other relevant variables. Some firm-year observations are, therefore, lost due to the use of lagged control variables in Eq. (1). Results are qualitatively similar for the sample of firms surviving for at least 5 and 15 years and hence are not reported here for the sake of brevity.

Table 3
The role of initial working capital allocation and long-term impact of cross-sectional determinants.

Panel A: Full sample

	1			2			3			4		
	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance
$NWCR_{i,0}$	0.589	21.060	1.468	0.584	20.770	1.456	0.584	20.770	1.457	0.679	15.030	1.693
SIZE				−0.077	−5.030	−0.173	−0.074	−4.830	−0.166	−0.109	−4.280	−0.243
TAN				−0.371	−2.400	−0.084	−0.376	−2.430	−0.085	−0.343	−1.240	−0.078
LEV				−0.230	−1.940	−0.042	−0.221	−1.860	−0.040	0.034	0.140	0.006
AGE				0.161	4.000	0.107	0.159	3.770	0.106	−0.071	−1.630	−0.047
RND				1.848	5.630	0.146	1.865	5.670	0.147	4.138	5.720	0.327
RSK				−0.118	−2.690	−0.046	−0.076	−1.680	−0.030	−0.016	−0.090	−0.006
CASH				−0.873	−6.300	−0.148	−0.877	−6.320	−0.148	−1.151	−4.350	−0.195
SV				0.046	1.660	0.055	0.046	1.660	0.055	0.053	1.500	0.063
SG				0.154	4.330	0.070	0.144	4.040	0.065	0.752	2.500	0.341
ALTZ				−0.005	−0.250	−0.012	−0.002	−0.120	−0.006	−0.003	−0.100	−0.009
STA				0.023	0.680	0.019	0.021	0.610	0.017	−0.037	−0.620	−0.030
MSHR				−0.934	−0.930	−0.024	−0.995	−0.990	−0.025	−1.096	−0.880	−0.028
PRF				1.098	6.790	0.219	1.079	6.730	0.215	2.347	5.090	0.468
CPX				−0.136	−0.470	−0.011	−0.092	−0.320	−0.008	−0.868	−0.890	−0.073
ACQ				−0.409	−3.310	−0.041	−0.370	−2.980	−0.037	−2.665	−4.540	−0.269
LIBOR				−0.105	−8.550	−0.264						
TSPR				−0.120	−5.690	−0.121						
CSPR				0.239	4.990	0.077						
GDPG				0.064	7.040	0.105						
MKT				−0.205	−3.990	−0.036						
Const	0.872	24.390		1.354	6.960		0.274	2.830		29.010	1.690	
Year FE	No			No			Yes			Yes		
N	74,767			74,767			74,767			35,409		
Adj. R2	0.21			0.23			0.23			0.25		

Panel B: Constant sample

	1			2			3			4		
	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance	Coeff.	*t*-stat	Eco. significance
$NWCR_{i,0}$	0.665	8.220	1.502	0.670	9.180	1.512	0.670	9.210	1.512	0.680	6.980	1.535
SIZE				0.006	0.150	0.013	0.010	0.240	0.021	0.014	0.300	0.029
TAN				0.062	0.110	0.012	0.067	0.120	0.013	0.011	0.010	0.002
LEV				1.083	2.320	0.140	1.161	2.450	0.150	1.545	2.160	0.200
AGE				−0.061	−0.770	−0.039	−0.891	−1.400	−0.559	28.623	1.040	−0.063
RND				7.632	2.940	0.269	7.693	2.960	0.271	8.264	2.150	0.291
RSK				0.115	0.620	0.022	0.288	1.410	0.054	0.460	0.950	0.086
CASH				0.519	0.800	0.047	0.404	0.620	0.037	1.213	1.170	0.111
SV				0.147	2.000	0.273	0.147	2.010	0.274	0.103	1.350	0.192
SG				0.147	0.820	0.031	0.062	0.340	0.013	−0.508	−0.530	−0.109
ALTZ				0.647	4.420	0.642	0.661	4.430	0.655	0.835	4.130	0.828
STA				−0.578	−3.160	−0.409	−0.594	−3.210	−0.421	−0.778	−3.260	−0.552
MSHR				−4.136	−1.530	−0.153	−4.145	−1.530	−0.153	−3.154	−1.150	−0.117
PRF				−1.583	−1.570	−0.111	−1.522	−1.500	−0.107	−2.774	−1.590	−0.195
CPX				−0.183	−0.170	−0.011	−0.140	−0.130	−0.009	1.900	0.650	0.118
ACQ				−0.588	−2.060	−0.052	−0.468	−1.680	−0.041	−2.305	−1.660	−0.202
LIBOR				−0.146	−4.420	−0.383						
TSPR				−0.255	−4.000	−0.255						
CSPR				0.142	1.370	0.046						
GDPG				0.029	1.370	0.048						
MKT				−0.009	−0.160	−0.002						
Const	0.614	5.590		0.371	0.560		−0.020	−0.020		−135.814	−1.140	
Year FE	No			No			Yes			Yes		
N	5836			5836			5836			4536		
Adj. R2	0.40			0.45			0.46			0.44		

Notes: This table shows the results of investigating the role of initial working capital allocations in determining their current allocations amidst several cross-sectional determinants. The variables of interest are defined in Appendix B. Panels A and B show results for the full and the constant sample of firms respectively. Column 1 shows results using initial working capital allocations as the sole determinant. Columns 2 and 3 show the results using all other controls while ignoring and using year-fixed effects respectively. Column 4 estimates the longer-term marginal contributions of cross-sectional determinants and compare them with the marginal contribution of initial working capital allocations using a distributed lag model where we report results by adding up all the coefficients up to five years of lag for each variable. Economic significance is estimated as the change in working capital allocations due to one standard deviation change in the subject variable.

initial working capital allocations. Increase in the marginal impact of the explanatory variables is duly reflected in the increase in adjusted R-squared in Panel B. Interestingly, R-squared using the constant sample for estimating Eq. (1) is quite close to the R-squared of the two cross-sections that are 15 years apart in Fig. 3. The minor difference in the R-squares possibly accounts for the fact that Eq. (1) generally estimates the cross-sectional similarity of any cross-section and its initial distribution, which can be less than or more than 15 years apart. In sum, the results in Table 3 help us to reliably conclude that firms' working capital allocations persist even after a long span of 15 years.

4.4. Longer-term impact of cross-sectional determinants

In the previous sub-section, we find relatively insignificant marginal contributions of cross-sectional determinants of working capital allocations. However, considering the infrequent changes in relative working capital allocations, it is possible that managers take a longer-term perspective on working capital allocations and adjust them only gradually to the changes in firm-specific characteristics. Therefore, the true contribution of the cross-sectional determinants may surface only after some time. We, therefore, estimate longer-term marginal contributions of cross-sectional determinants and compare them with the marginal contribution of initial working capital allocations using a distributed lag model as follows:

$$NWCR_{i,t} = \alpha + \beta_1 .\ NWCR_{i,0} + \sum_{\tau=1}^{n} \beta_j .\ X(fs)_{i,t-\tau} + \lambda_t + \varepsilon_{i,t} \quad (3)$$

where the summation term includes 1 to n years of lagged variables. We use the Akaike information criteria (AIC) and Bayesian information criteria (BIC) to identify an optimal lag up to five years but do not find much statistical difference from three to five years of lag.[13] We, therefore, report our results for the model including all five years of lag. To compare the marginal impact in the longer run, we add up all the coefficients up to five years of lag for each variable and report their longer-term economic significance, along with these coefficients, in Column 4 of Table 3. We estimate the standard errors for the joint coefficient of each variable using a linear transformation of coefficients and report their statistical significance.

The results in Column 4, when compared to those in Column 2, suggest that, although the marginal impact of several variables has increased, their relative contribution is still quite insignificant when compared to that of initial working capital allocations. In fact, the marginal contribution for initial working capital allocations in Column 4 has increased when compared to Column 2, especially for the full sample. This is probably because initial working capital explains more of the variation in current allocations in the sample where between-firm variation is reduced substantially due to the inclusion of several lags.

Since the slope coefficients in Column 4 are estimated using unrestricted lag distributions, while for some variables the long-run effect is always greater than that of the short run, the marginal impact of some variables has decreased or did not change substantially in the longer run. For example, the marginal impact of firms' leverage in the full sample is reduced substantially in the long run along with the change in sign for the coefficient. This suggests that the impact of the cross-sectional determinants in the short run is quite different from their impact in the long run. Further, the coefficients and marginal impacts of these variables are quite different for the full sample versus the constant sample.

In sum, the impact of initial working capital allocations in determining current allocations is far greater than the impact of any other cross-sectional variables. Further, its effect is dominant regardless of taking a short-term or a long-term perspective on the movement of cross-sectional variables. Although the analysis in this section suggests that model specifications with appropriate lags and sample composition affect the coefficient stability of the cross-sectional variables, the marginal impact of these variables is far too small when compared to a time-invariant component. This is important given that the cross-sectional determinants are allowed to change every period.

[13] Since firms' working capital typically turn over several times in a year, we use five years of lag to reflect long-term management of working capital.

4.5. Variance decomposition of working capital allocations

Even though the individual economic impact of each time-varying factor is small, their collective contribution can be significant in determining current working capital allocations. Thus, we estimate the precise contribution of time-varying factors, including the cross-sectional determinants, when compared to time-invariant factors to explain working capital allocations. This analysis also helps us gauge to what extent we can afford to go wrong in model specifications while predicting working capital allocations using time-varying factors.

We begin by reporting non-parametric measures of variance decomposition of working capital allocations for different sample compositions. We calculate within- and between-firm variation in working capital allocations averaged for all firms and years. Panels A and B of Table 4 report these average variations unadjusted and adjusted, respectively, for their industry medians. We find that within-firm variation is significantly lower than between-firm variation, irrespective of the sample composition and adjustment to median industry allocations. This is consistent with the strong persistence that we identified previously. However, at least a part of the unadjusted between-firm variation is due to the systematic differences in the median industry working capital allocations, which we identify in Section 3. Similarly, at least a part of the unadjusted within-firm variation is due to the systematic decline in industry-wide working capital allocations identified in Fig. 2.

Since we are interested in studying firms' working capital allocations that are comparable within and across industries over time, such undue (unadjusted) variation could cause impaired inferences. It is, therefore, imperative that we adjust for systematic differences in median industry allocations. We accomplish this using the ratio of net operating working capital to total net assets scaled by the median of this ratio for respective industries, calculated using Eq. (2). Table 4 shows that average within- and between-firm variations as a proportion of their respective mean allocations (i.e., the coefficient of variation, CV) are relatively stable for the adjusted working capital allocations (Panel B) as compared to their unadjusted counterparts (Panel A). Similarly, the within-firm variation as a proportion of between-firm variation is also largely independent of the sample composition for the adjusted working capital allocations. Thus, by scaling the working capital allocations with their respective industry medians, we ensure adequate adjustments for the undue within- and between-firm variations.

We next turn to parameterize the contributions of the variance in time-varying and time-invariant factors using analysis of covariance (ANCOVA). Specifically, we use the following model for this analysis:

$$NWCR_{i,t} = \alpha + \beta_j .\ X(fs)_{i,t-1} + \eta_i + \lambda_t + \varepsilon_{i,t} \quad (4)$$

where η_i, λ_t and $\varepsilon_{i,t}$ represent the firm-fixed effect, year-fixed effect, and stochastic error term respectively. We control for firm-fixed and year-fixed effect through their respective dummies.

Following Scheffe (1959), we estimate the type III partial sum of squares for the firm-fixed effect, year-fixed effect and the set of control variables for different model specifications and different sample compositions. We estimate the partial sum of squares for each effect as the difference between the residual sum of squares of the model excluding that effect and the full model including all the effects. For different sample compositions, the results in Panel A of Table 5 show the relative contributions of these effects estimated as the respective partial sum of

Table 4
Within- and between-firm variation in working capital levels.

Panel A: NWC/NTA	Within	Between	Within/between	Panel B: Median adjusted NWC/NTA	Within	Between	Within/between
Constant sample (N = 228)				Constant sample (N = 228)			
Mean (a)	0.29	0.29		Mean (a)	1.66	1.66	
Avg. Stdev (b)	0.08	0.18	0.44	Avg. Stdev (b)	0.75	2.28	0.33
CV (b)/(a)	0.28	0.62		CV (b)/(a)	0.45	1.37	
At least 15 years sample (N = 1957)				At least 15 years sample (N = 1957)			
Mean (a)	0.28	0.28		Mean (a)	1.75	1.74	
Avg. Stdev (b)	0.11	0.29	0.38	Avg. Stdev (b)	1.00	2.81	0.36
CV (b)/(a)	0.39	1.04		CV (b)/(a)	0.57	1.61	
Full sample (N = 9582)				Full sample (N = 9582)			
Mean (a)	0.25	0.25		Mean (a)	1.63	1.71	
Avg. Stdev (b)	0.22	1.29	0.17	Avg. Stdev (b)	1.06	3.19	0.33
CV (b)/(a)	0.88	5.16		CV (b)/(a)	0.65	1.87	

Notes: This table shows within- and between-firm variation in working capital allocations averaged for all firms and years for different samples. Panels A and B report these average variations unadjusted and adjusted, respectively, for their industry medians.

squares as a fraction of the total partial sum of squares of all the effects in a particular model. Results suggest the dominance of firm-fixed effect such that while it contributes almost all the explained variation, both the year-fixed effect and the cross-sectional control variables contribute little.

Even though relative proportions of the partial sum of squares suggest an insignificant contribution on the part of the set of cross-sectional determinants, we may not conclude that they are worthless in explaining the variation in working capital allocations. This is because the relative contributions are estimated as a fraction of the sum of each partial sum of squares that prevent the estimation of the common contributions between different effects. This suggests a potential drawback in inferring relative contributions using the type III partial sum of squares. Thus, if most of the contributions of the cross-sectional determinants come from their cross-sectional rather than time-varying attribute, the firm-fixed effect would simply overshadow such contributions when used in conjunction with them, as in model 5 shown in Panel A of Table 5. Further, since the partial sum of squares is not adjusted for degrees of freedom, it tends to inflate the relative contribution of the constituent set of factors similar to an unadjusted R-squared would do. However, since the sole explanatory power of cross-sectional determinants (model 3) is much lower than that of the fixed-effect (model 1), such pitfalls in estimating relative contributions using the partial sum of squares may not be worrisome in our analysis here.

Adjusted R-squares can be used to assess the exclusive contributions of each effect when they influence the dependent variable simultaneously. Importantly, such an assessment would accommodate both the concerns mentioned above for estimating relative contributions using the partial sum of squares. For example, in the constant sample case, the exclusive contribution of cross-sectional determinants is merely 0.016, estimated as the difference in adjusted R-squares of models using both firm-fixed effects and cross-sectional variables simultaneously (model 5) and the model using only the firm-fixed effect (model 1). Similarly, while the exclusive contribution of the firm-fixed effect is 0.573, the common effect — estimated as the residual contribution — is 0.072. As a fraction of their total explained variation jointly, these effects are 2.46%, 86.60%, and 10.94% respectively.[14] Since adjusted R-squares adjust for degrees of freedom these contributions are not inflated and represent the true marginal contributions. Thus, even when we find significant common variation between the firm-fixed effect and the cross-sectional determinants, the sole explanatory power of cross-sectional determinants is far too small to account for anything close to what is exclusively contributed by the firm-fixed effect in our analysis here. Similarly, the exclusive contribution of the year-fixed effect is further lower than that of cross-sectional determinants.

DeAngelo and Roll (2015), in the context of persistence in corporate leverage, suggest the relatively important contribution of the year-fixed effect when the firm-fixed effect could change with time. Responding to the results of variance decomposition analysis in Lemmon et al. (2008), DeAngelo and Roll (2015) estimate relative contributions using the type III partial sum of squares and show the significant time-varying effect that is contributed by the interaction of time- and firm-fixed effects. Thus, if the firm-fixed effect is not really time-invariant but changes slowly, we may expect such interaction also to be a significant contributor to the explained variation of working capital allocations.

We assess this possibility by allowing for the interaction between firm- and time-fixed effects. While DeAngelo and Roll (2015) allow the firm-fixed effect to change over the interval of a decade, we use a more conservative interval of a half-decade. This is done partly to preserve degrees of freedom, and also because of the shorter span of our sample (starting in 1984 as compared to DeAngelo and Roll's (2015), which starts in 1950), along with the shorter-term turnaround of working capital as compared to firms' leverage.

The results using a half-decade interval as the time frame are shown in Panel B of Table 5 for the constant sample of surviving firms. Importantly, similar to DeAngelo and Roll (2015), we find a significant contribution by the firm-half-decade interaction term in models 5 and 7 that exclude cross-sectional control variables and models 8 and 11 that include them. The type III partial sum of squares suggests that a firm-half-decade interaction term contributes more than half of the total explained variation. However, the contribution of the firm-half-decade interaction is not statistically different than the firm-fixed effect. Specifically, the Fischer statistics suggest that models 1 and 3, 4 and 6, and 9 and 10, which use these effects separately, are statistically indistinguishable. This is because the two terms have a lot in common such that they measure the same effect to a large extent.

We identify the relative contribution of the constituent effects in model 5 (Panel B, Table 5) that estimates the joint impact of the firm-fixed and firm-half-decade interaction effects, allowing for their common contributions to be duly acknowledged. Using the adjusted R-squares of models 1, 3 and 5, we find that the exclusive fractional

[14] The contributions of each effect using models 4, 5, 6 and 7 are 1.64%, 1.19%, 85.95%, and 1.12% respectively for cross-sectional control variables, year fixed-effect, firm fixed effect, and the common effect.

Table 5
Variance decomposition of working capital levels.

Panel A: Relative contribution of different effects

	1	2	3	4	5	6	7
Constant sample							
Firm-fixed effect	1.000			0.979	0.972		0.966
Year-fixed effect		1.000		0.021		0.897	0.014
Controls			1.000		0.027	0.102	0.019
Adj-R2	0.645	0.011	0.089	0.658	0.661	0.094	0.669
N	6048	6048	6048	6048	6048	6048	6048
At least 15 years sample							
Firm-fixed effect	1.000			0.984	0.976		0.974
Year-fixed effect		1.000		0.016		0.748	0.009
Controls			1.000		0.024	0.251	0.017
Adj-R2	0.552	0.008	0.019	0.561	0.566	0.024	0.571
N	38,968	38,968	38,968	38,968	38,968	38,968	38,968
Full sample							
Firm-fixed effect	1.000			0.991	0.983		0.987
Year-fixed effect		1.000		0.009		0.686	0.004
Controls			1.000		0.017	0.314	0.009
Adj-R2	0.491	0.006	0.011	0.512	0.523	0.019	0.546
N	85,881	85,881	85,881	85,881	85,881	85,881	85,881

Panel B: Relative contribution of different effects including firm-time interaction effect

Constant sample	1	2	3	4	5	6	7	8	9	10	11
Firm-fixed effect	1.000			0.989	0.441		0.392	0.378	0.965		0.337
Half-decade fixed effect		1.000		0.011		0.067	0.025	0.023	0.003	0.017	
Firm-half decade interaction			1.000		0.559	0.933	0.584	0.554		0.941	0.562
Controls								0.045	0.032	0.042	0.101
Adj-R2	0.634	0.006	0.606	0.641	0.718	0.632	0.725	0.744	0.671	0.659	0.738
N	6612	6612	6612	6612	6612	6612	6612	6048	6048	6048	6048

F-statistics between models	
(1) and (3)	0.506
(4) and (6)	0.836
(9) and (10)	0.761

Notes: This table, Panel A, shows the relative contributions of the firm-fixed effect, year-fixed effect and the set of control variables estimated through the respective type III partial sum of squares. The relative contributions of these effects are estimated as a fraction of the total partial sum of squares of all the effects in a particular model. Panel B allows for the interaction between firm- and time-fixed effects for the constant sample of surviving firms, where the firm-fixed effect change over the interval of a half-decade.

contributions of the firm-fixed effect and the interaction effect are 0.112 (0.718–0.606) and 0.085 (0.718–0.633) respectively, while their common effect is 0.521 (0.718–0.112-0.085). In percentage terms, these effects are 15.64%, 11.78% and 72.59% of the total explained variation respectively. Such strong commonality between the models using the firm-fixed effect and the firm-half-decade interaction effect confirms that they are not statistically distinguishable from each other. This implies largely time-invariant or extremely slow changing firm-fixed effect. Thus, there is no statistical evidence that the nature of firm-fixed effect changes with time for our dataset. To a large extent, the firm-half-decade interaction term essentially measures the firm-fixed effect only that remains as the primary contributor to the explained variation in working capital allocations.

In sum, the variance decomposition suggests that working capital allocations are truly persistent and that such persistence is primarily due to time-invariant firm-fixed effects. The usual cross-sectional determinants could not explain much of the variation in relative working capital allocations. Model mis-specifications in determining firms' working capital allocations in the presence of the firm-fixed effect, therefore, are not quite consequential.

5. Discussion and implications for future research

Even though we find quite persistent working capital allocations, our findings do not necessarily contradict with their empirically observed systematic decline over time. This is because our focus is to investigate endogenous changes in firms' *relative* working capital allocations. To accomplish this, we control for any systematic industry-wide changes by scaling the firms' working capital allocations by their respective industry medians. Importantly, systematic decline in working capital allocations may reflect exogenous changes due to the industry-wide improvements in firms' asset utilization or the difference in the accounting of short-term and long-term assets.

Although a thorough investigation is required to explore an exhaustive list of reasons leading to the observed persistence in working capital allocations, we suggest some possible contenders here. First, firms may be choosing their working capital allocations strategically such that these strategic considerations are, at best, very slow to change over time. Firms may follow specific business models suited to their comparative advantages, such as firms' control over their resources, including management, or the adoption of a specific technology in their respective industries. For example, a firm may choose to keep very low inventory allocations, owing to the adoption of technology which allows the firm to produce just-in-time, while another firm in the same industry may choose to outsource its production so as to work with minimal fixed assets while keeping a buffer stock of finished goods in its inventory at all times. Importantly, the choice of technology or the decision to outsource may be the strategic consideration that changes only infrequently over a long period. While highlighting the importance of such strategic considerations, past literature has identified persistence in several corporate aspects, such as leverage (Lemmon et al., 2008), investments (Kuh, 1963) and production functions (Mundlak, 1961). To what extent firms' strategic considerations determine their working capital allocations could be a fruitful future research agenda.

Second, there could be little value addition from changing working capital allocations over time. Although past literature identifies a statistically significant relationship between firm value and working capital allocations, the economic significance of such a relationship is indeed marginal. For example, while Aktas et al. (2015) suggest that firm value increases (decreases) with working capital allocation for firms underinvesting (overinvesting) in working capital, the impact of one standard deviation change in excess working capital allocation is merely 0.35% of the unconditional variation in firm value.[15] Similarly, while Kieschnick et al. (2013) suggest that every incremental addition in working capital is value destructive, the impact of one standard deviation change in working capital allocation is only 5.37% change in the unconditional variation in firm value.[16] Insignificant value addition using working capital may not necessarily be inconsistent with slow-changing firms' strategic considerations in explaining persistence in working capital allocations. If most of the incremental firm value stems from firms' strategy, business context and competitive position within their industries, the marginal contribution of working capital to influence firm value could certainly be inconsequential.

Finally, a less persuasive reason may also lead to the observed persistence. Persistence in working capital allocations may surface if firms face stiff adjustment costs in changing their working capital allocations. However, such adjustment costs, if any, should not deter firms from changing their allocations over time. If these adjustment costs are exclusive of firms' strategic considerations, they should subside over time, and firms may find it relatively easy to make the desired transitions. Leary and Roberts (2005) suggest that the presence of adjustment costs could prevent firms from rebalancing their capital structure, but only in the short run; firms tend to rebalance over time.

Persistence in working capital allocations that we find in this paper does not suggest firms' tactical use of working capital as a tool for value creation. Contrary to the past literature, since we find that time-invariant factors primarily drive working capital allocations, it is quite possible that these factors represent firms' specific business contexts and comparative advantages rather than concerns over improving intertemporal cash flows and sales. Relative persistence in working capital allocations within industries also contradicts with the findings in the past literature of an industry-wide optimal allocation for the constituent firms and the notion that firms could be better-off by moving toward such optimal. Such optimal becomes all the more irrelevant when there is little value added by changing working capital allocations over time. Further, such persistence also poses a challenge to conceive a trade-off between firms' working capital investments and capital expenditures to accommodate any exogenous shocks to the latter. Future research may shed more light on these aspects.

Frankel et al. (2017) in the past have used quarterly data to show that firms tend to manage their year-end working capital levels to increase their year-end operating cash flows. Since our objective in this paper is to focus on long-term persistence in working capital allocations and the fact that several variables of interest were not available with quarterly frequency, we use annual data. Although firms could modulate their working capital allocations within a year to conform to industry best practices or standards, our analysis in Section 3 suggests a significant spread of these allocations within industries in a given year. Results reported in Panel C of Table 1 suggest almost equally distributed firms across all the four quartiles within industries. Thus, the seasonal modulation of working capital may not affect our main findings significantly.[17]

6. Conclusion

Working capital decisions are often perceived to be flexible and short-term in nature. Presumably, in the pursuit of value creation, firms can modulate their working capital allocations relatively easily and in a short notice. However, such modulations in working capital allocations are not empirically observed in the data.

In this paper, we find that there is a wide distribution of firms' working capital allocations within industries. Further, these allocations and their differences across firms tend to persist for a very long time, often exceeding 15 years. Such persistence is confirmed by an economically significant role of time-invariant factors influencing the firms' relative working capital allocations.

Persistence in working capital allocations precludes the use of working capital as a tactical tool for value creation. Contrary to the past literature, it appears that firms' specific business contexts and comparative advantages, rather than concerns over improving intertemporal cash flows and sales, drive their working capital allocations. Relative persistence in working capital allocations within industries contradicts with the findings in the past literature of an industry-wide optimal allocation for the constituent firms and the notion that firms could be better-off by moving toward such optimal.

Declarations of interest

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[15] Aktas et al. (2015) measured excess net operating working capital (NWC) as the difference between actual NWC and the industry median NWC. The study reports a coefficient of −0.0095 (Table 5) and a standard deviation of 24.75% (Table 3) for excess NWC. However, since the variation in firm value (measured as excess returns over benchmark Fama-French 25 portfolio) is 66.31% (Table 3), the impact of one standard deviation change in excess NWC is only 0.35% of this variation.

[16] While Kieschnick et al. (2013) also measured firm value similar to Aktas et al. (2015), the study reports a coefficient of 0.282 (Table 3) and a standard deviation of 18.30% (Table 1) for NWC. Given that the variation in firm value is 96.10% (Table 1), the impact of one standard deviation change in NWC is 5.37% of this variation.

[17] We thank an anonymous referee for suggesting highlighting these issues in the paper.

Appendix A. Cross-sectional determinants of working capital

We discuss the potential impact of the following important firm-specific attributes that could influence the working capital allocations.

A. Asset profile

Since we note significant differences in working capital allocations for firms across and within industries, it is imperative that these firms also have a definite positioning of their other tangible and intangible assets. Persistence in working capital further suggests the strategic nature of such relative positioning. Lesser allocation to long term assets would mean more allocation to working capital as a proportion of their total assets. Similarly, firms could make an active trade-off in their investments into these assets (see, e.g., Fazzari & Petersen, 1993 and Kieschnick et al., 2006). We expect firms to spend less in their capital and intangible assets but more in working capital investments to increase the extent of working capital deployed.

We use asset tangibility, capital expenditure, acquisitions, research and development expenses (as a proxy for investments into intangible assets) to capture the asset profiles of the firms deploying the varying level of working capital.

B. Sales profile

Past literature suggests higher sales growth as the prime motivation for firms to deploy higher allocations of working capital (see, e.g., Hill et al., 2010). This is because higher sales growth may need inter-temporal relaxation in credit policies and a larger inventory base. Sales volatility is another aspect which could influence firms to carry on more or less working capital (see, e.g., Ng et al., 1999). Since larger fixed-asset base would lead to higher operating leverage for firms, higher sales volatility may aggravate the effect of ensuing fixed costs. Thus, higher sales volatility may lead firms to choose more of proportionate allocations of working capital as against the fixed assets. Finally, overall sales influence the relative market share of the firms in an industry which determines the relative bargaining power of the firms with their customers and suppliers. Accordingly, we use market share as a proxy for market power which can influence the extent of working capital deployed by the firms (see, e.g., Hill et al., 2010).

We capture the effect of firms' sales profile on varying working capital deployment through sales growth, sales volatility and firms' market share in its respective industry.

C. Asset utilization

Due to the relatively short turnover time of working capital components, higher working capital allocations may provide ensuing flexibility in managing the firms' overall assets. Thus, firms with better asset utilization may have relatively higher working capital allocations. Similarly, firms with higher proportionate allocations of working capital may be in a better position to modulate the profit margins across varying economic cycles. This may result in overall better profitability of these firms. Further, since managing working capital is relatively more flexible than managing other long-term assets, firms with relatively higher working capital allocations may operate with relatively lesser cash holdings.

We study the effect of relative asset utilization for firms with varying working capital allocations through asset turnover, profitability, and cash holdings.

D. Financing constraints

Past literature suggests an important role of working capital in managing financing constraints. Firms with more of these constraints may use their working capital more effectively (see, e.g., Fazzari & Petersen, 1993 and Kieschnick et al., 2013). However, tactical use of working capital to mitigate financing constraints does not concur with the persistent differences in working capital allocations for the firms within and across industries, that we have identified in Section 3. Firms' age and size have been traditionally used as a measure of its financing constraints (see, e.g., Faulkender & Wang, 2006; Niskanen & Niskanen, 2006). Financial distress and firms' leverage are other measures that often capture the effect of financial constraints (see, e.g., Molina & Preve, 2009; Baños-Caballero et al., 2014).

We study the effect of financing constraints through firms' size, age, financial soundness (as measured by modified Altman Z score) and debt to asset ratio.

E. Perceived risk

Since operating leverage is positively related to firms' business risk, firms with proportionately higher working capital allocations may be less risky to that extent. However, since perceived risk of a firm also includes its financial risk, its marginal relationship to working capital allocations will also depend upon firms' leverage. In the case where firms could balance the increase in their business risk by offsetting their financial risk, the perceived risk may not have a significant influence on working capital deployed by the firms. We study the effect of firms' risk through stock price volatility, as has been used in Aktas et al. (2015).

Following Kieschnick et al. (2013), along with firm-specific determinants, we also control for the possible inter-temporal influence of macro-economic factors such as interest rates, term spread, credit spread, economic growth rate, and stock market performance. The measurement and definition of all the variables of interest are shown in Appendix B.

Appendix B. Measurement and definition of variables

Variable	Symbol	Description
Working capital allocations	NWCR	Firms' relative working capital allocations measured as the ratio of net operating working capital to total net assets scaled by the median of this ratio for respective industries in a given year; estimated through Eq. (2).
Initial working capital allocations	$NWCR_{i,0}$	Firms' first non-missing median-adjusted working capital allocation.
Change in working capital	ΔNWC	Change in working capital as a proportion of net operating working capital at the beginning of the year.
Median working capital allocation	MED	Industry median ratio of net operating working capital to total net assets for a given period.
Size	SIZE	Firms' size measured as log of inflation-adjusted (to 2004 dollars) total book value of assets in millions of dollars.
Asset tangibility	TAN	Asset tangibility measured as the ratio of net fixed assets to total net assets (total assets minus accounts payables).
Leverage	LEV	Leverage measured as the ratio of debt to total net assets.
Age	AGE	Age measured as the log of the number of years since the stock price is available for the firm in Compustat.
Investments into intangible assets	RND	Investments into intangible assets measured as the ratio of research and development expenditure to total net assets.
Perceived risk	RSK	Perceived risk is measured as annualized standard deviation of monthly stock returns.
Cash balances	CASH	Cash balances measured as the ratio of cash and cash equivalent to total net assets.
Sales volatility	SV	Sales volatility measured as the standard deviation of a firm's annual sales over the previous five-year period. Annual sales used in this calculation is in billions of dollars. Firm-year observations are included in the sample for a given year if the firm has at least three observations during the previous five-year period.
Sales growth	SG	Sales growth measured as growth in total sales over the previous year.
Financial soundness	ALTZ	Financial soundness is captured through the modified Altman Z score proposed by Mackie-Mason (1990) and is measured as 3.3 times EBIT (operating income) plus sales plus 1.4 times retained earnings plus 1.2 times (current assets minus current liabilities) divided by total net assets. Altman's *Z*-score measures the ex-ante probability of distress (Graham, 2000).
Asset turnover	STA	Asset turnover measured as the ratio of total sales to total net assets.
Market share	MSHR	Market share measured as the ratio of total sales of the firms to total industry sales. Industries are classified according to Fama French 49 industry classification.
Profitability	PRF	Profitability measured as the ratio of operating income before depreciation to total net assets.
Capital expenditures	CPX	Capital expenditures measured as the difference in gross fixed assets over the previous year to total net assets.
Acquisitions	ACQ	Acquisitions measured as acquisitions (obtained from the cash flow statement item no. A129) to total net assets.
Libor rate	LIBOR	Libor rate measured as an annual average of 3-month LIBOR rate; obtained from the FRED database.
Term spread	TSPR	Term spread measured as the average of the monthly term spread. The term spread is defined as the difference between the 10-year and 1-year constant maturity treasury rates; obtained from the FRED database.
Credit spread	CSPR	Credit spread measured as the spread between Moody's Aaa and Baa Corporate Bond yields as a proxy for general credit risk; obtained from the FRED database.
Real GDP growth	GDPG	Real GDP growth measured as the annual percentage change in real GDP; obtained from the FRED database.
Stock market returns	MKT	Stock market returns measured as the annualized returns on the S&P 500 index using data on monthly returns.

Appendix C. Descriptive statistics of the variables of interest

Variable	Full sample (N = 85,881)					Constant sample (N = 6048)				
	Mean	Std. Dev	Q1	Median	Q3	Mean	Std. Dev	Q1	Median	Q3
NWCR	1.707	3.173	0.663	1.128	1.779	1.633	2.364	0.734	1.155	1.651
$NWCR_{i,0}$	1.417	2.493	0.605	1.047	1.568	1.530	2.257	0.709	1.097	1.419
SIZE	5.625	2.243	3.969	5.541	7.173	7.259	2.035	5.890	7.234	8.754
TAN	0.300	0.227	0.120	0.241	0.431	0.313	0.198	0.167	0.265	0.413
LEV	0.237	0.181	0.084	0.219	0.355	0.222	0.130	0.129	0.216	0.306
AGE	2.198	0.666	1.609	2.197	2.708	2.636	0.628	2.197	2.773	3.178
RND	0.038	0.079	0.000	0.000	0.040	0.023	0.035	0.000	0.008	0.032
RSK	0.531	0.391	0.295	0.430	0.634	0.341	0.188	0.219	0.298	0.412
CAS	0.139	0.169	0.022	0.073	0.189	0.086	0.091	0.020	0.053	0.119
SV	0.372	1.204	0.009	0.040	0.192	0.888	1.863	0.047	0.186	0.737
SG	0.153	0.454	−0.024	0.081	0.219	0.090	0.213	−0.002	0.072	0.150
ALTZ	1.331	2.585	0.863	1.814	2.643	2.421	0.991	1.770	2.379	3.011
STA	1.224	0.817	0.665	1.072	1.573	1.291	0.709	0.829	1.156	1.596
MSHR	0.009	0.025	0.000	0.001	0.005	0.020	0.037	0.001	0.006	0.020
PRF	0.084	0.199	0.055	0.115	0.169	0.145	0.070	0.101	0.141	0.184
CPX	0.071	0.084	0.022	0.046	0.087	0.065	0.062	0.028	0.047	0.079
ACQ	0.033	0.101	0.000	0.000	0.011	0.033	0.088	0.000	0.000	0.023
ΔNWC	0.192	1.507	−0.111	0.058	0.256	0.086	0.815	−0.050	0.053	0.172
LBR	4.336	2.527	1.795	5.197	5.984	4.277	2.615	1.624	4.751	6.039
TSR	1.430	1.005	0.630	1.540	2.380	1.467	1.003	0.670	1.620	2.440
CSR	0.975	0.322	0.750	0.890	1.100	0.994	0.325	0.760	0.920	1.120
GDP	2.687	1.642	1.800	2.800	3.800	2.607	1.663	1.800	2.700	3.800
MKT	0.097	0.175	−0.020	0.098	0.236	0.094	0.172	0.020	0.098	0.198

Appendix D. Correlation matrix

	NWCR	ΔNWC	$NWCR_{i,0}$	MED	SIZE	TAN	LEV	AGE	RND	RSK	CAS	SV	SG	ALTZ	STA	MSHR	PRF	CPX	ACQ	LIB	TSP	CSP	GDP	MKT
NWCR	1.00																							
ΔNWC	0.08	1.00																						
$NWCR_{i,0}$	0.46	−0.02	1.00																					
MED	−0.05	−0.02	0.08	1.00																				
SIZE	−0.01	−0.04	0.01	0.27	1.00																			
TAN	−0.05	0.01	−0.03	0.39	0.20	1.00																		
LEV	−0.04	−0.01	−0.02	0.07	0.16	0.27	1.00																	
AGE	0.06	−0.04	−0.01	−0.14	0.23	−0.04	−0.05	1.00																
RND	−0.02	0.04	−0.07	−0.07	−0.23	−0.26	−0.22	−0.07	1.00															
RSK	−0.01	0.03	0.00	0.00	−0.41	−0.10	0.02	−0.12	0.18	1.00														
CASH	−0.05	0.07	−0.07	0.04	−0.17	−0.33	−0.37	−0.07	0.49	0.14	1.00													
SV	0.03	−0.02	0.05	0.08	0.52	0.06	0.03	0.16	−0.07	−0.14	−0.07	1.00												
SG	0.00	0.04	−0.03	0.34	−0.04	−0.02	0.01	−0.12	0.05	0.05	0.07	−0.02	1.00											
ALTZ	0.06	−0.07	0.07	0.15	0.28	0.03	−0.01	0.05	−0.50	−0.34	−0.37	0.08	−0.05	1.00										
STA	0.05	−0.02	0.05	−0.10	−0.18	−0.20	−0.10	0.01	−0.15	0.01	−0.21	0.00	−0.07	0.43	1.00									
MSHR	−0.02	−0.02	−0.01	0.08	0.48	0.04	0.06	0.11	−0.06	−0.16	−0.08	0.50	−0.06	0.06	−0.01	1.00								
PRF	0.06	−0.05	0.04	−0.05	0.32	0.15	0.03	0.08	−0.46	−0.29	−0.28	0.09	0.02	0.69	0.15	0.06	1.00							
CPX	−0.03	0.03	−0.03	−0.05	0.06	0.52	0.08	−0.13	−0.11	−0.04	−0.10	0.01	0.22	0.03	−0.12	−0.03	0.14	1.00						
ACQ	−0.01	0.01	0.00	−0.06	0.08	−0.07	0.13	−0.03	−0.06	−0.04	−0.10	−0.01	0.23	0.02	−0.09	0.01	0.04	0.04	1.00					
LIBOR	−0.06	0.00	0.00	0.27	−0.18	0.07	0.08	−0.46	−0.03	0.01	−0.11	−0.11	0.06	0.13	0.10	−0.03	0.03	0.12	0.02	1.00				
TSPR	0.02	0.01	0.00	0.07	0.06	0.00	−0.04	0.14	0.00	0.00	0.04	0.03	−0.06	−0.04	−0.03	0.02	0.00	−0.09	−0.07	−0.72	1.00			
CSPR	0.01	−0.01	0.01	0.22	0.08	−0.01	−0.01	0.05	0.00	0.06	0.05	0.06	−0.09	−0.04	−0.04	0.03	−0.01	−0.07	−0.04	−0.31	0.39	1.00		
GDPG	−0.01	0.02	−0.01	0.16	−0.11	0.02	0.03	−0.23	−0.01	−0.05	−0.06	−0.08	0.10	0.06	0.05	−0.03	0.02	0.09	0.05	0.43	−0.42	−0.71	1.00	
MKT	−0.01	0.02	0.00	−0.12	−0.04	0.02	0.01	−0.09	−0.02	−0.06	−0.02	−0.03	0.01	0.03	0.01	−0.01	0.02	0.03	0.01	0.08	−0.10	−0.26	0.22	1.00

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Gaurav S Chauhan is working as an Associate Professor of Finance at Indian Institute of Management (IIM) Indore. He has received his doctorate in Finance from IIM Indore in the year 2012. He has also been awarded charter for Certified Financial Analyst (CFA) from the CFA Institute, USA and Financial Risk Manager (FRM) from Global Association of Risk Professionals (GARP). His research and teaching interests deal with analyzing issues in corporate finance with a focus on corporate leverage and working capital management and also dealing with mutual fund performance measurement and attribution, portfolio management. He has published his research work in the *Journal of Corporate Finance* among others.