Disappearing Working Capital:
Implications for Accounting Research

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Disappearing Working Capital: Implications for Accounting Research

ABSTRACT: This paper examines the implications of the technological advances on the net working capital balance of U.S. firms over the past five decades. I find that the annual mean value of the net working capital balance of U.S. firms has sharply declined, from 28.9% of average total assets in the 1970s to 6.5% in the 2010s. I also show evidence suggesting that an increase in IT spending is associated with a reduction in net working capital balance, after controlling for potential alternative explanations. This real (vis-à-vis accounting) change in net working capital balance has several accounting implications. Specifically, I show that the declining working capital balance reduces current accruals from 18.8% to 5.4% of earnings, reduces the explanatory power of the Jones (1991) model from 23.7% to 3.7%, and increases the correlation between earnings and cash flows from 0.689 to 0.947 over time.

Keywords: information technology; working capital; accruals; accruals model; earnings quality

JEL Classifications: M15, M40, M41

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I. INTRODUCTION

Net working capital (noncash current assets less current liabilities other than short-term debt) is an important source of financing and investment. For example, firms finance major portions of their capital needs through accounts receivables and payables. Ng, Smith, and Smith (1999) show that vendor financing in the U.S. is approximately 2.5 times the combined value of all new public debt and equity issues in the 1990s. Inventories are firms' essential short-term investments that enable future sales to occur, but these short-term investments increase firms' financing needs. Therefore, managers optimize their inventory level to avoid over- or under-investment problems as a part of their strategic decision. Together, firms' net working capital choices reflect the efficiency of firm-specific strategic decisions which vary cross-sectionally across firms, industries and countries.[1] For example, Shin and Soenen (1998) compare the case of Walmart and K-mart. Beginning with similar levels of net working capital balance in 1994, Walmart and K-mart have each evolved to carry divergent cash conversion cycles (CCCs) of 40 days and 61 days, respectively. Consequently, they argue that K-mart faced an additional \$198.3 million in financing expenses per year, which contributed to their bankruptcy in 2002 (Shin and Soenen, 1998, p. 37). Given the severity of failure to manage working capital, it is not surprising that chief financial officers rank working capital management as one of their top three priorities in day-to-day operations (2016 Finance Priorities Survey) and that popular press such as *CFO Magazine* annually ranks the top 1,000 companies based on their respective efficiency in working capital management.

In this paper, I hypothesize that the net working capital balance of U.S. firms declined concurrently with technological advances over the past half a century. The latter half of the 20th

[1] Summary statistics reported in Rajan and Zinagles (1995) show that the amount of net working capital differs among G7 countries from 10.7% of total assets in Canada to 29.9% in Italy.

century is often characterized by unprecedented technological development in human history. Computing technology is now at the center of virtually every economic transaction in the developed world, changing the way information is transmitted, collected and analyzed (Varian, 2016). For example, advances in information technology have changed the way business-to-business (B2B) and business-to-customer (B2C) payments are made. Most companies no longer send their invoices via paper mail. Payments are made electronically and instantaneously, thereby reducing lag time and expediting the payment cycle. The share of consumer payments made by paper checks fell from 77% in 1995 to 36% in 2006, while the share of automated clearing houses increased substantially (Schuh and Stavins, 2010). Similarly, B2B procurement processes have been electronically integrated over the past decades (Mukhopadhyay and Kekre, 2002), and U.S. manufacturing firms invest over $5 billion a year on new information technology in their plants (Banker, Bardhan, Chang and Lin, 2006). Evolving information technology and advancements in logistics have also changed the way inventories are handled. Online sales now account for up to 14% of all U.S. retail sales. It has become a common practice for suppliers and buyers to share information on inventories (Cachon and Fisher, 2000) and jointly manage production. Today, the Just-in-Time (JIT) strategy is considered an old rubric from the 1980s. At every corner of U.S. industry, artificial intelligence (AI) personalizes advertisement, chats with real customers, manages inventories, and automates logistics. According to CBS News, "AI-powered supply chain and pricing solutions are often the decisive differentiator between profit and loss, and are eminently important to survive in a competitive market."[2] High-tech inventory management, advanced logistics, and individually tailored advertisements reduce the amount of inventory sitting in company warehouses.

[2] Layne, Rachel. "AI is taking retailing to new dimensions." CBS News, CBS Interactive, 28 Nov. 2017.

This study contains two segments. In the first segment, I document a striking decline in the net working capital balance of U.S. firms over the past five decades and explore potential explanations for this temporal trend. Specifically, I shows that, concurrent with advances in information and communication technology, the annual mean value of net working capital balance for U.S. firms has sharply declined from 28.9% of average total assets in the 1970s to 6.5% in the 2010s. Then, I examine potential explanations towards this trends including industry specificity, sample composition change, changes in accounting practice, working capital outsourcing, and the development in information technology. The results are generally in favor of the view that the real improvement in information technology is associated with an intertemporal decline in the net working capital balance of U.S. firms over the past five decades, after controlling for potential alternative explanations. Specifically, using business spending data on information and communication technology (ICT) equipment and computer software from the U.S. Census Bureau, I show that the development in information technology is associated with a decline in the net working capital balance over the sample period. Moreover, I use a sample of international firms and show that the intertemporal decline in the net working capital balance is prevalent among 17 OECD countries and varies predictably with each country's respective investment into information and communications technology.

In the second, and perhaps more important, segment, I demonstrate that the intertemporal reduction in net working capital balance has a few notable accounting impacts. Specifically, I point out that there are at least three accounting implications from the real changes in the net working capital balance over time. First, the change in net working capital balance leads to a change in working capital *accruals* (i.e., current accruals)[3] over time. Under clean surplus accounting, the

[3] I use the term *working capital accruals* and *current accruals* interchangeably in this paper.

balance sheet and income statement must articulate (e.g., Barton and Simko, 2002; Baber, Kang and Li, 2011). That is, the first difference in net working capital balance *is* current accruals. As a result, decreasing net working capital *balance* leads to decreasing current *accruals* over time. Consistently, I show that the mean value of current accruals reduced from 3.0% of average total assets in the 1970s to 0.3% in the 2010s.

Second, current accruals as a proportion of earnings, change in sales, or change in expense have all declined from 18.8%, 18.3% and 17.7% in the 1970s to only 5.4%, 3.5% and 6.7%, respectively, in the 2010s. These trends suggest a significant shift in the 'normal' accruals-generating process. Note that accounting literature typically models accruals as a function of change in the scale of operations (e.g., Jones, 1991; Dechow, Kothari, and Watts, 1998; McNichols, 2002). As the net working capital declines over time with the development of information technology, but not by the concurrent decline in the scale of operations (e.g., sales), the 'normal' accruals-generating process is not appropriately captured by the change in scale of the operations in recent periods. Consistently, I show that the explanatory power (R^2) of the Jones (1991) model for current accruals declined significantly from 23.7% in the 1970s to only 3.7% in the 2010s. That is, more than 96% of the variation in current accruals is classified as 'abnormal' or 'discretionary' in recent periods when using Jones (1991) model.

Third, the reduction in current accruals alters the relationship between earnings and cash flows. Because earnings[4] is the sum of accruals and cash flows, the decline in the magnitude of current accruals narrows the gap between earnings and cash flows, which in turn leads to a high correlation between earnings and cash flows. Consistently, I show that the Pearson (Spearman) correlation between earnings and cash flows increased from 0.689 (0.679) in the 1970s to 0.947

[4] I use the terms *operating income* and *earnings* interchangeably in this paper.

(0.877) in the 2010s. Notice that practitioners often consider the high correlation between earnings and cash flows as a characteristic of high-quality earnings (Dichev, Graham, Harvey and Rajgopal, 2013).[5] However, the small magnitude of current accruals and the high correlation between earnings and cash flows merely indicate that most earnings are cash-based earnings in recent periods. Hence, the seemingly apparent improvement in earnings quality could have arisen not because of an improvement in the financial reporting system but from greater ability to generate cash flows from operations. As a result, it is rather inappropriate to designate the higher earnings–cash flows correlation as a *de facto* indication of improvement in earnings quality.

This paper contributes to accounting literature in several ways. This paper identifies a previously undiscovered yet potentially relevant accounting phenomenon and explores possible explanations. The information revolution in the 21st century is arguably one of the most important economic events in human history[6]. Yet, to the best of my knowledge, no prior studies investigate whether and how developments in information technology have changed accounting over time. For example, Hunton (2002) points out that "there is little doubt that ICT has contributed immensely to the magnitude, speed, and acceleration of change in business practice over the past three decades" (p. 56) and calls for a future work that blends information and communication technology with accounting research. In this paper, I show that real (vis-à-vis accounting) improvement in information technology has fundamentally reshaped the asset structure (i.e., working capital balance) and accruals accounting practice of U.S. firms over the past five decades.

[5] Anecdotal evidence suggests similar perception. For example, the 2018 CFA Program Level II Curriculum Book states that "the analysts' most pressing concerns include the following: Are Nestle's operating earnings backed by cash flow?" (E25), naming a high earnings-cash flows correlation as the first of an analyst's concerns.

[6] For example, there are only a few other systemic shift in human history comparable to that of the digital or information revolution in the 21st century: the agricultural revolution in circa 10,000 BC, the scientific revolution in the 16-17th century, and the industrial revolution in the 19th century (Harari, 2014).

Moreover, this paper also provides several important accounting and economic implications stemming from the phenomenon. However, I also acknowledge the caveat. Despite the consideration of alternative explanations and the use of an exogenous proxy, the evidence is still susceptible to endogeneity concerns. In many time-series analyses, the passage of time itself is often highly correlated with the causal variable that precipitates various socio-economic changes over time. Thus, in this paper, some unknown variable associated with the passage of time may still be the underlying variable that causes both the development of information technology and more efficient use of working capital. In an ideal research setting, firm-specific capital expenditures and labor costs directed toward information technology associated with working capital management can be used as causal variables of interest. However, due to the unavailability of such an ideal dataset, I use the industry-specific data and supplement the main analysis with an additional analysis using an international sample.

The rest of this paper is organized as follows. In Section 2, I explain the sample-selection procedure, define variables, and show that the net working capital balance of U.S. firms has significantly declined over the past five decades. I also explore potential explanations and show that the temporal decline in net working capital balance is associated with the development in information technology over time. In Section 3, I consider three implications for accounting research. Specifically, I show that the current accruals decline over time, the explanatory power of the Jones (1991) model declines over time, and the correlation between earnings and cash flow increases over time. Section 4 concludes and discusses future research avenues.

II. INTERTEMPORAL TRENDS IN NET WORKING CAPITAL BALANCE

Since the first computer ENIAC (Electronic Numerical Integrator and Computer) was built in 1946, the computing power in human possession has doubled approximately every two years (i.e., Moore's Law). The UCLA Business and Information Technology (BIT) survey shows that information technology deployment has changed business structure, organization and practice across industries, as well as the way companies interact with their customers and trading partners (Karmakar and Mangal, 2007).

Anecdotal evidence also suggests that the real improvement in information technology is to potentially improve business efficiencies associated with working capital management. For example, information technology improves the way companies exchange billing information and manage payment cycles. A survey from Paystream Advisors shows that the top three invoice management pains an accounting department faces are the paper receipt of invoices, manual data entry, and manual approval of invoices (Paystream Advisors, 2017). The survey respondents also indicate that the adoption of a computerized invoice system has resulted in a quicker approval of invoices (72%), increased employee productivity (57%), and lower processing costs (46%).

It is well-known that integrated supply chain system, such as JIT technology, improves inventory management. Today, U.S. companies improve their inventory cycle and reduce the inventory level by leveraging the power of artificial intelligence (AI). For example, Amazon embraces over 100,000 warehouse robots to manage warehouse inventories (Forbes, 2019). Amazon's AI-driven product recommendations account for up to 30% of the company's revenue (DHL Trend Research, 2018). General Electric's AI-powered Brilliant Factory program reduces unplanned downtime on the shop floor by 20% and improves inventory cycle (GE Aviation, 2019). A computer-vision-based AI can now identify and manage individual inventory items at a store shelf level (Qopius, 2019). Consistent with these trends, more than 60% of business leaders responded to a survey stating that they plan to use AI to improve operational efficiency (Source Global Research, 2017).

Together, this anecdotal evidence suggests that developments in information technology at U.S. firms potentially has a consequence on their net working capital balance, such as accounts receivable, inventory and accounts payable. For example, if developments in electronic payment systems reduce the payment cycle of average U.S. firms, it is likely to also reduce the amount of accounts receivable and payable on the balance sheet. Similarly, sophisticated supply chain management and a computerized inventory system are likely to reduce the amount of inventory on the balance sheet. However, no prior studies show whether and how developments in information technology have changed the working capital balance over time, nor identify their accounting impacts. In this paper, I hypothesize that the net working capital balance of U.S. firms declined concurrently with technological advances over the past half a century.

Sample Selection and Variable Definition

To examine intertemporal trends in the net working capital balance over the past five decades, I first download all firm-year observations from the Compustat database over the period from 1970 to 2017. Out of 409,716 firm-year observations in the Compustat universe, I drop foreign firms (30,115); non-NYSE, AMEX, or NASDAQ firms (160,991); financial and public administration firms (60,312); and observations with missing variables to calculate net working capital (24,478). Net working capital (*NWC*) is defined as the difference between current operating assets (*COA*) and current operating liabilities (*COL*) divided by average total assets, following Richardson, Sloan, Soliman, and Tuna (RSST hereafter, 2005). *COA* is defined as noncash current assets (Compustat ACT less CHE). *COL* is defined as current liabilities other than short-term debt (Compustat LCT less DLC). Consistently, working capital accruals (*CACC*) is defined as the change in net working capital. Earnings (*E*) is defined as operating income before depreciation divided by average total assets.[7] Cash flow from operation (*CFO*) is defined as the difference between earnings and working capital accruals. My final sample consists of 133,820 firm-year observations (9,883 unique firms) between the year 1970 and 2017, as described in Panel A of Table 1.

[Insert Table 1 Here]

Panel B of Table 1 provides summary statistics of main variables. All variables in summary statistics are scaled by average total assets and winsorized at a 1% level on both tails. The mean value of cross-sectional and time-series average of U.S. firms' net working capital balance (*NWC*) is 16.3% of average total assets, which is similar to the figure reported by RSST (2005). The mean values of current operating assets (*COA*) and current operating liabilities (*COL*) are 37.3% and 21.0% of average total assets, respectively. Looking closely into each of the components of net working capital, account receivable (*AR*) is 18.3% of average total assets, inventory (*INVT*) is 15.8% of average total assets, and accounts payable (*AP*) is 9.1% of average total assets. The mean value of earnings (*E*) is 0.104, showing that U.S.-listed firms are profitable on average. Working capital accruals (*CACC*) is 0.015, and cash flows from operations (*CFO*) is 0.088. Since these summary statistics are cross-sectional and time-series averaged, I explore whether there has been any change in their annual values over time in the following tables.

Intertemporal Trends in New Working Capital Balance

Panel A of Table 2 shows the annual mean values of *NWC* and its components over the period from 1970 to 2017. For brevity in presentation, I average the annual mean value by 10-year intervals. Column 1 shows that the annual mean value of *NWC* has declined by approximately

[7] I define earnings as operating income to exclude the effect from non-operating profit and loss and below-the-line items such as special items or non-recurring items. In this paper, I use the terms *earnings* and *operating income* interchangeably.

77.4% over the past five decades, consistent with my prior expectation. Specifically, for average U.S. firms, the net working capital balance has dropped from 28.9% of average total assets in the 1970s to only 6.5% of average total assets in the 2010s. The time-trend coefficient shows that *NWC* has declined by approximately 0.6% of average total assets every year, with a highly significant t-statistic of -45.71 and adjusted R^2 of 0.98. Time-trends estimates are from a regression of annual mean values of *NWC* on *Time*, where *Time* is the number of years since 1970. Columns 2 and 3 show the annual mean value of *COA* and *COL*, respectively, by 10-year intervals. The annual mean values for *COA* sharply declined from 49.4% of average total assets in the 1970s to 27.4% in the 2010s, while there is little evidence of a deterministic trend for *COL*.

[Insert Table 2 Here]

Columns 4-10 show the annual mean values of *NWC* components. Columns 4-7 show that the decline in *COA* over time is accompanied by declines in accounts receivable (*AR*) and inventory (*INVT*). Specifically, *AR* (column 4) declined from 21.8% of average total assets in the 1970s to 13.4% in the 2010s. *INVT* (column 6) declined from 25.7% of average total assets in the 1970s to 10.1% in the 2010s. The t-statistics and R^2 associated with the time trends are also high. Columns 8-10 show components of *COL* over time. Column 8 shows that *AP* declined from 10.6% of average total assets in the 1970s to 7.7% in the 2010s. However, the reduction in *AP* is offset by an increase in other current liabilities (*LCO* in Column 10), which increased from 7.5% of average total assets in the 1970s to 12.7% in the 2010s.[8] Together, these time trends show that all three major components (i.e., accounts receivable, inventory, and accounts payable) of net working capital balance have declined over time, contributing to the overall decline in net working capital

[8] It is an interesting question to ask what increases other current liabilities over time. I find that both accrued expenses (Compustat XACC) and deferred revenue (Compustat DRC) have increased over time. However, I leave the detailed investigation to future work.

balance at U.S. firms. Panels B visually present the intertemporal trends in the annual mean, median, 1st quartile, and the 3rd quartile of *NWC*. It shows that the entire distribution trends downward over time, suggesting that the declining trend is not concentrated in a small sub-set of firms but is global across all sample firms. Panels C and D are included to visually present the intertemporal trends in the components of *NWC*.

IT Spending and Net Working Capital Balance

The preceding time-trend analysis shows that the net working capital balance of U.S. firms has declined over the past five decades, concurrently with advances in information technology. Nevertheless, the evidence does not lend itself to an inference that technological advances, such as JIT, artificial intelligence (AI) and computerized transactions, lead to more efficient working capital management. Therefore, in this section, I use an exogenous proxy that measures investment into information technology to examine the association between information technology and net working capital balance.

Since 2003, the Information & Communication Technology Survey of the U.S. Census Bureau has annually surveyed all private, nonfarm, domestic companies about their business spending for ICT equipment and computer software[9]. The U.S. Census Bureau annually reports[10] the estimated total spending on ICT by 2-digit NAICS industry. This is a useful proxy because it links the aggregate industry-level IT investment to individual firms' net working capital balance. Specifically, I estimate the following OLS regression to estimate the effect of information technology on the net working capital balance of U.S. firms:[11]

$$NWC_{i,t} = \alpha_0 + \alpha_1 \cdot Time_t + \alpha_2 \cdot IT\_Spending_{m,t} + \sum \alpha_k \cdot Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

[9] Detailed sampling and estimation methodology can be found on Census website.
[10] The survey is suspended for the year 2012 and permanently after the year 2014 due to lack of funding.
[11] Although the Census Information & Communication Technology Survey data is an industry-based measure and it limits the available sample year, it is the best available proxy yet known.

where $NWC_{i,t}$ is the firms' net working capital balance as defined previously; $Time_t$ is the number of years since 1970; and $IT\_Spending_{m,t}$ is defined as the dollar amount of total ICT spending in a given industry deflated by the dollar amount of gross output of respective industries. The gross output data is obtained from the Bureau of Economic Analysis (BEA). Control variables include *AQ*, *Matching*, *Loss*, *Size*, *Growth*, *Leverage*, *Interest_Cover*, *HHI*, and *Goodwill*. *AQ* is an indicator variable that is equal to 1 if auditor opinion is unqualified, and zero otherwise, and controls for the effect of opportunistic accounting practice. *Matching* is the adjusted R^2 from a cross-sectional estimation of the Dichev and Tang (2008) model by year and SIC 2-digit industry and controls for the possibility that better matching results in increased cash flows. *AcctLoss* is an indicator variable that equals to one if income before extraordinary items (Compustat IB) is negative but operating cash flows is positive, and zero otherwise. *CFO* is defined as operating income (Compustat OIBDP) less the change in net working capital (ΔNWC). *Interest_Cover* is defined as interest expense (Compustat XINT) divided by income before extraordinary items (Compustat IB). *AcctLoss*, *CFO*, and *Interest_Cover* are included as control variables because financially constrained firms may have large current operating liabilities balances. *Size* is defined as the natural logarithm of market value of equity and is included to control for the scale economy in net working capital management. *Growth* is defined as the market-to-book ratio (Compustat CSHO*PRCC_F/CEQ) and controls for the effect of life-cycle or growth firm effects. *Leverage* is defined as the interest-bearing debt (Compustat DLT and DLTT) divided by average total asset. *HHI* is Herfindahl-Hirschman Index calculated within 2-digit SIC industry-year and controls for the possibility that large firms with strong market power may outsource their working capital requirements to smaller suppliers. Lastly, *Goodwill* is the proportion of goodwill (Compustat GDWL) divided by average total assets and controls for the joint effect of the elimination of pooling accounting for mergers and the increases in mergers and acquisition activities over time. I also include the SIC two-digit industry-fixed effect, cohort-fixed effect, and year-fixed effect[12] to control for the effect of industry membership, sample firm composition and any unobservable economy-wide shock each year. Consistent with my hypothesis, I expect to find a negative α_2 coefficient, representing that the development in information technology is associated with a reduction in net working capital balance at U.S. firms.

[Insert Table 3 Here]

Panel A of Table 3 provides the results of OLS regression of equation (1). Column 1 shows that *NWC* decreased by approximately 0.2% of average total assets per year during the sample period, which is smaller than the overall trend of 0.6% between 1970 and 2017[13]. Column 2 shows that *IT_Spending* is significantly and negatively associated with *NWC*, suggesting that the development in information technology is associated with decreases in *NWC*. In column 3, I include both *Time* and *IT_Spending*, which both continue to be statistically significant and negative. In column 4, I include all control variables, industry fixed effect, cohort fixed effect, and year fixed effect[14]. Again, *IT_Spending* is statistically significant and negative. The coefficient estimate on *IT_Spending* is -2.425 after controls, suggesting that a 1% increase in ITC spending out of the gross industry output is associated with a reduction of *NWC* by approximately 2.4% of average total assets. The results are consistent with the characterization that development in information technology has an effect on U.S. firms' working capital management after controlling for other factors. As a robustness check, I also use an alternative specification (untabulated) at the industry level. That is, I examine the association between industry-level net working capital balance (*NWC*)

[12] In an untabulated specification, I include *TBill* (annual average 3-month Treasury bill rate obtained directly from the Federal Reserve Bank of St. Louis) instead of year fixed effects. Results are similar.
[13] Most significant decline in the net working capital balance occurred during the 1980s and 1990s.
[14] Since *IT_Spending* variable is measured at industry level, I do not include firm fixed effect.

and industry level spending for ICT investment (*IT_Spending*). The results are robust to this alternative specification with all previously introduced control variables.

As indicated in the introduction, however, such an outcome must be interpreted with an important caveat of endogeneity. Also, it should also be noted that the information technology is not the only factor that affects the net working capital balance. For example, many control variables are statistically significant in column (4) as suggested by prior literature. Firms with high accounting quality (*AQ*) tend to have greater net working capital balance. Better matching between revenue and expenses (*Matching*) results in greater net working capital balance. Poor firm performance as measured by both accounting loss (*AcctLoss*) and cash flows from operations (*CFO*) is associated with lower level of net working capital balance. Larger firms (*Size*) and growth firms (*Growth*) have greater working capital balance. Firms in competitive industry (*HHI*) tend to have greater level of net working capital balance. Together, the development in information technology is one of many factors that affect the net working capital balance of U.S. firms.

In Panel B, I examine the association between the information technology and individual components of net working capital. On the current asset side, account receivables (*AR*) and inventory (*INVT*) is significantly and negatively associated with *IT_Spending*; however, income tax refunds (*TXR*) and other current operating assets (*ACO*) are not. The result is consistent with prior expectation that the development in information technology potentially reduces payment cycle and inventory stocking. On the current liabilities side, only accounts payable (*AP*) is significantly and negatively associated with *IT_Spending* consistent with prior expectation. In contrary, other current liabilities (*LCO*) is positively associated with *IT_Spending*.[15] Together, the

[15] Again, I only speculate, but do not have a conclusive evidence, that the information technology increases deferred revenue. A detailed investigation is beyond the scope of this paper and left to future work.

relationships between the information technology and individual components of net working capital are consistent with prior expectation.

Alternative Explanations

In this section, I explore potential alternative explanations that may explain the intertemporal trends in net working capital balance. First, I examine whether there exist any differences in the observed temporal trends across different industries. For example, firms in service industries are likely to have smaller working capital requirements than firms in manufacturing or trading industries. Given that the U.S. has shifted from a manufacturing to a knowledge-based economy over the past half a century (Srivastava, 2014), it is possible that a surge in service industries has contributed to the decline in the net working capital balance over time. Therefore, I repeat the preceding analyses by sub-samples based on the Fama-French 10 industry classification. A detailed industry definition is provided in Appendix B.

[Insert Table 4 Here]

Panel A of Table 4 provides the annual mean value of net working capital balance from 1970 to 2017, whereas Panel B visually presents the intertemporal trends in *NWC*, both delineated by Fama-French 10 industry classification. Again, for brevity in presentation, I average the annual mean value by 10-year intervals. Throughout columns 1 to 10, there is strong evidence of a decline in the annual mean value of net working capital balance across all Fama-French 10 industries. Observe that the annual mean value of net working capital declines in both consumer non-durable (column 1) and durable goods (column 2) industries, from 35.5% and 38.6% of average total assets in the 1970s to 14.4% and 16.9% in the 2010s, respectively. The most significant decline is observed in the business equipment industry (column 5), where the annual mean value of net working capital declined from 39.6% of average total assets in the 1970s to a mere 2.9% in the

2010s. This trend translates to an annual decline of net working capital balance by approximately 1.0% of average total assets. The utilities industry (column 9) is characterized by the least significant decline. The annual mean value of net working capital balances declined from 2.2% of average total assets in the 1970s to 1.5% in the 2010s. Together, these results show that the decline in the net working capital balance is not concentrated in a specific subset of the industry. Rather, it is a systemic phenomenon across all industries. Therefore, industry membership does not fully explain the intertemporal decline in net working capital balance over time.[16]

Second, Fama and French (2004) argue that the characteristics of firms listed after 1980 are fundamentally different from those that existed before. Specifically, using the annual cross-section of all firms listed in U.S. stock markets, they show that the profitability of newly listed firms drifts down in the left tail and that growth becomes more right skewed. Similarly, Srivastava (2014) reports that changes in sample firm composition over the period from 1970 to 2009 contribute to changes in earnings quality over time. Moreover, if the change in sample composition is correlated with industry membership, it is possible that newly emerging service firms may contribute to the intertemporal trends in net working capital balance. Therefore, it is possible that the observed decline in the net working capital balance is attributable to changes in sample firm composition over the past five decades.

[Insert Table 5 Here]

Panel A of Table 5 investigates the extent to which changes in sample composition affect the observed trends in net working capital balance. Despite concerns for survivorship bias, one way to account for the change in sample composition is to hold sample firms constant over time.

[16] I also repeat the analyses by 2-digit SIC Industry classification. Out of 63 SIC 2-digit industries, I find negative time-trends in 59 industries (93.7%). I also find statistically significant (t-statistics stronger than -2.58) negative time trends in 55 industries (87.3%).

Therefore, I first look at intertemporal trends using only the 277 firms surviving continuously over the sample period from 1970 to 2017. Column 1 in Panel A of Table 5 provides intertemporal trends in the annual mean value of net working capital of the 277 surviving firms. Similar to the aggregate trends, the annual mean value of net working capital balance for survivors declined from around 29.3% of average total assets in the 1970s to 12.4% in the 2010s. The coefficient estimated from the time-trends estimate is -0.004, and is significant, with a t-statistic of -30.39 and an adjusted R^2 of 95.2%. These results from surviving firms show that the overall decline in net working capital balance is not attributable to a change in sample firm composition over time. Panel B visually presents the intertemporal trends in *NWC* of the 277 surviving firms.

Another way to examine the effect of sample composition change is to analyze samples based on groups of cohort firms. Specifically, I assign firms into different cohort groups based on their first year of appearance in the Compustat database. For example, firms that first appeared in the database before the year 1970 are assigned to the cohort group "<1970s firms," firms that first appear in the database from 1970 to 1979 are assigned to the cohort group "1970s firms," and so on. Columns 2 through 6 of Panel A report the annual mean value of net working capital balance by different cohort groups. Columns 2, 3, and 4 show that groups of firms in the <1970s, 1970s, 1980s, 1990s and 2000s cohorts all experienced significant decline in their net working capital balance. An exception is the firms that appear in the sample during the 2010s, who do not exhibit declining time trends. Rather, they increase their net working capital balance over time, which is *against* the overall declining time trend. However, note that their net working capital balance is already low when compared to older firms. This is consistent with prior research on the firm life cycle (Quinn and Cameron, 1983; Dickinson, 2011; Hribar and Yehuda, 2015), where firms in the introduction or growth stage make significant investments in net working capital. At the same time, the very fact that the newly emerging firms appear in the sample with already low levels of net working capital balance suggests that the net working capital balance is affected by macroeconomic forces that shape the working capital management technology at average firms. Together, these findings suggest that the newly emerging firms contribute to the overall lower level of net working capital balance, but the change in sample firm composition does not explain the declining time trends. Panel C visually presents the intertemporal trends in *NWC* by different cohort groups.

Third, it is possible that the observed decline in net working capital balance is due to outsourcing of working capital by large firms with strong market power. For example, a recent article in the New York Times argue that the big companies have become more dominant over the past 15 years (Leonhardt, 2018). If large companies can assume a dominant market position over time that permit them to force suppliers into holding working capital for them, it is possible that the observed downward trends in net working capital may represent the increasing off-balance-sheet arrangements made by large firms. On the other hand, academic literature show that U.S. economy has become more intense in competition (Irvine and Pontiff, 2008; Thomas and D'Aveni, 2009) and that the downfall of previous leaders due to the new entrant has become much more frequent (Comin and Philippon, 2005) over the past five decades. Hence, it is an empirical question whether intertemporal trends in the market power is associated with the intertemporal trends in net working capital balance. I use three proxies to examine the relative market power of the sample firms: firm size (*Size*), Herfindahl-Hirschman Indes (*HHI*) and the number of major customers (*Customers*). *Size* is defined as the natural logarithm of market value of equity. *HHI* is the sum of squares of the market shares of the firms within 2-digit SIC industry-year. *Customers* is the number of major customers disclosed by the firm and is obtained from Compustat industry segment files.

If increasing working capital outsourcing by large firms with strong market power is the reason for intertemporal reduction in the net working capital balance, I would find greater reduction in larger firms, firms in less competitive industries, and firms with smaller number of major customers.

[Insert Table 6 Here]

Table 6 provides the annual mean value of net working capital balance from 1970 to 2017 delineated by 5 portfolios based on *Size* (Panel A), *HHI* (Panel B) and *Customers* (Panel C). Panel A shows that the net working capital balance declines in all 5 portfolios delineated by firm size. Larger firms, in general, have lower net working capital balance throughout the sample period suggesting the economies-of-scale in managing working capital. However, I do not find evidence that the intertemporal trends is more pronounced in the larger firms. In Panel B, I find that the net working capital balance declines in all 5 portfolios delineated by Herfindahl-Hirschman Index. Note that lower HHI indicates more competitive industry. In contrary to working capital outsourcing hypothesis, I find that the net working capital balance tends to be lower in more competitive industries. I interpret this as an indication of firms managing working capital more rigorously when industry competition is high. Lastly, Panel C shows that the net working capital balance declines in all 5 portfolios delineated by the number of customers. Again, I do not find that the intertemporal trend is more pronounced at firms with smaller number of major customers. Together, these results show that the decline in the net working capital balance is not concentrated in firms with greater market power. That is, the intertemporal reduction in net working capital balance is not a zero-sum-game where larger firms with stronger market power benefit at the cost of weaker firms. Panels D, E, and F visually present the intertemporal trends in *NWC* by 5 portfolios based on *Size*, *HHI* and *Customers*, respectively.

Lastly, I examine whether the change in accounting practice and opportunistic earnings management affect the net working capital balance over time. First, the elimination of pooling of interests method could explain the temporal reduction in net working capital balance, given that there are increasing mergers and acquisition activities over time. For example, FASB Statement No. 141[17] eliminates the use of pooling methods and requires purchase methods for all business combinations. Under the purchase method, any premium paid over the market value of the assets is reflected on the acquirer's balance sheet as goodwill. Hence, it is possible that the increasing proportion of goodwill on the balance sheet makes the relative portion of working capital smaller. Therefore, I repeat the analyses by deflating net working capital by average total assets *less* goodwill. For brevity, I do not report the results in table format. However, the results are similar to previous analyses. Specifically, the net working capital balance declined from 28.9% of average total assets less goodwill in the 1970s to 7.3% in the 2010s. The time trend is also significant, with a t-statistic of -47.17 and R^2 of 97.9%. Also, the coefficient estimate on *IT_Spending* from OLS regressions of equation (1) continue to be significant when using total assets less goodwill as deflator. Together, the evidence shows that the change in accounting methods for business combinations do not explain the intertemporal trends in net working capital balance.

Second, both accruals-based earnings management (Healy, 1985; McNicnols and Wilson, 1988) and real activities manipulation (Roychowdhury, 2006) can potentially deviate net working capital balance from its optimal level. A manager can make a choice with respect to the provisioning of bad debt to influence the amount of accounts receivables reported (McNichols and Wilson, 1988). Similarly, a manager may overproduce or overpurchase to reduce the cost of goods

[17] Yet, FASB Statement No. 141 is effective to business combinations initiated after June 30, 2001. Hence, it is unlikely that the purchase method or the prevalence of mergers and acquisition activities explain the temporal trends in net working capital balance in the pre-2001 periods.

sold and inflate earnings (Roychowdhury, 2006). In this case, the level of inventory will be affected. However, it is noteworthy that any accruals-based or real activities manipulation in one period must reverse in another period (Baber, Kang, and Li, 2011; Dechow, Hutton, Kim, and Sloan, 2012; Larson, Sloan, and Zha Giedt, 2018). Therefore, it is unlikely that such an opportunistic accounting treatment reflects a long-term trend in net working capital balance over the period of half a century. Nevertheless, I repeat the analysis by examining firm-by-firm five-year rolling average values of net working capital balance. Any opportunistic components should reverse over the selected time period.[18] For brevity, I do not report the results in table format. However, the results are almost identical to previous analyses. On the 5-year rolling basis, the net working capital balance declined from 28.7% of average total assets in the 1970s to 6.5% in the 2010s. The time trend is also significant, with a t-statistic of -53.68 and R^2 of 98.4%.

Additional Analysis – International Evidence

In this section, I supplement my main finding with an additional analysis using international firms in 17 different OECD countries, excluding the United States.[19] Although there are differences in industry composition, accounting practices and institutional environment across different countries, I expect to find similar intertemporal trends in the net working capital balance in the international firms because the development in information and communications technology (ICT) has been a global phenomenon over the past five decades. Hence, it would serve as a useful falsification test for my main finding to examine whether the intertemporal reduction in the net working capital balance is an isolated phenomenon among U.S. firms or extends to the broader international sample. Moreover, countries also differ in their relative development in information

[18] For example, Dechow, Hutton, Kim, and Sloan (2012) model the reversal period to be three years. Larson, Sloan and Zha Giedt (2018) model the reversal period to be five years.
[19] All results are similar (and stronger) when I include the United States.

technology. For example, among OECD countries with available statistics, the United Kingdom and Sweden invest 22.7% and 21.8%, respectively,[20] of total non-residential gross fixed capital formation into ICT equipment and software. On the other hand, Ireland and Italy spend only 8.8% and 12.4%, respectively. If development in information technology indeed precipitates temporal reduction in net working capital balance, the net working capital balance across countries should also vary with their differences in the development of information technology.

I use two datasets in this additional analysis. First, I obtain ICT investment data from the Organization for Economic Cooperation and Development (OECD). ICT investment (*ICTINVST*) is defined as the acquisition of information technology equipment, communications equipment, and computer software that is used in production for more than one year, deflated by total non-residential gross fixed capital formation, and is available mostly from 1985 to 2010 for 17 countries[21]. Second, I obtain variables to calculate the net working capital balance from the Thomson Reuter Worldscope database. All variable definitions are consistent with my main analysis. Specifically, I define net working capital balance (*NWC*) as the difference between current operating assets (*COA*) and current operating liabilities (*COL*), divided by average total assets. *COA* is defined as noncash current assets (Worldscope item 2201 less 2001). *COL* is defined as current liabilities other than short-term debt (Worldscope item 3101 less 3051). Total asset is Worldscope item 2999. The final sample consists of 200,480 firm-year observations from 17 countries (excluding the United States), spanning the period from 1985 to 2010.

[Insert Table 7 Here]

[20] On average between 1985 and 2010.

[21] Countries included in the dataset are Australia, Austria, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, the United Kingdom, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Sweden and the United States.

Panel A of Table 7 shows the annual mean values of *NWC* of 17 OECD countries from 1985 to 2010. Column 1 shows that the annual mean value of *NWC* has declined by approximately 77.0% over the past five decades, similar to the decline observed from the U.S. sample. Specifically, for average OECD firms, the net working capital balance dropped from 21.7% of average total assets in 1985 to only 5.0% of average total assets in 2010. The time-trend coefficient shows that *NWC* has declined by approximately 0.5% of average total assets every year, with a significant t-statistic of -16.35 and adjusted R^2 of 0.918. Together, the evidence indicates that the intertemporal decline in the net working capital balance is not an isolated phenomenon of U.S. firms but is global across all OECD countries.

In columns 2 and 3, I show the annual mean value of *NWC*, delineated by high and low level of ICT investment each year. Specifically, I define *Low ICT Investment Countries* (column 2) as the countries with below the median value of *ICTINVST* each year. Similarly, I define *High ICT Investment Countries* (column 3) as the countries with above the median value of *ICTINVST* each year. Column 2 shows that the annual mean value of *NWC* of *Low ICT Investment Countries* declined from 22.6% of average total assets in 1985 to 9.0% in 2010. Conversely, column 3 shows that the annual mean value of *NWC* of *High ICT Investment Countries* declined from 20.9% of average total assets in 1985 to 1.9% in 2010. Comparing the time-trends coefficient estimate and the adjusted R^2 between columns 2 and 3, I find that the decline in *NWC* over time is greater in countries with a high level of ICT investment. The z-statistics (untabulated) comparing the time-trend coefficient estimate in columns 2 and 3 is also a significant 4.79, indicating that the decline in *NWC* is more significant in countries with high level of ICT investment.

[Insert Table 8 Here]

Next, I run an OLS regression similar to equation (1) to examine whether the annual mean value of net working capital balance across countries varies with each country's respective level of ICT investment in a given year. Table 8 provides the results of OLS regression for 17 OECD countries over the period from 1985 to 2010. Column 1 shows that the annual mean value of *NWC* decreased by approximately 0.5% of average total assets per year during the sample period in the 17 OECD countries. Column 2 shows that *ICTINVST* is significantly and negatively associated with *NWC*, suggesting that the decreases *NWC* are associated with the development in information technology at the country-level. In column 3, I include both *Time* and *ICTINVST*, where both variables remain statistically significant and negative. In columns 4 and 5, I include country- and year-fixed effects to control for all time-invariant country characteristics and global shocks in a given year. Again, *ICTINVST* is statistically significant and negative in both columns 4 and 5. Specifically, column 5 shows that the coefficient estimate on *ICTINVST* is -0.004, with a significant t-statistic of -3.51 and adjusted R^2 of 0.688. Together, these additional analyses provide a robust falsification test and confirm that the development in information technology is indeed associated with the decline in net working capital balance over time.

III. ACCOUNTING IMPACTS

In this section, I investigate the accounting implications of the intertemporal decline in the net working capital balance of U.S. firms. Specifically, I point out that there are at least three accounting-related impacts from the intertemporal change in net working capital balance. First, the intertemporal reduction in net working capital balance is likely to reduce working capital *accruals* (i.e., current accruals) of average U.S. firms over time. A distinct feature of accruals accounting is that the income statement and the balance sheet articulate under clean surplus accounting (e.g., Barton and Simko, 2002; Baber, Kang, and Li, 2011). That is, any changes in the working capital accounts on the balance sheet precipitate corresponding changes in accruals on the income statement, and vice versa. For example, the adoption of JIT technology reduces the amount of inventory on firms' balance sheets, which subsequently affects accruals on the income statements (e.g., current $accruals_t$ ≡ change in net working $capital_t$ ≡ net working $capital_t$ – net working $capital_{t-1}$). Therefore, I expect a corresponding decline in current *accruals* over time, contemporaneous with the reduction in net working capital balance.

Second, the intertemporal reduction in net working capital balance is likely to change the commonly modeled accruals-generating-process over time. For example, accounting literature typically models the accruals process as a function of the change in the scale of operations. Specifically, accounts receivable is often modeled as some proportion α of sales, accounts payable as some proportion β of sales, and inventory as some proportion γ of sales (Jones, 1991; Dechow, Kothari, Watts, 1998). If the intertemporal reduction in net working capital balance is precipitated by an exogenous improvement in information technology over time, it is possible that the 'normal' accruals-generating-process may not be appropriately explained by the change in scale of operations (e.g., change in sales). Therefore, I examine whether there exist any changes in the explanatory power of the state-of-the-art Jones (1991) model over time.

Lastly, the intertemporal reduction in net working capital balance is likely to alter the relationship among earnings, accruals and cash flows over time. Note that, under the basic accounting equation, earnings equals the sum of accruals and cash flows (i.e., earnings ≡ accruals + cash flows). Assuming that real economic return represented by earnings is constant, the intertemporal reduction in accruals suggests an increasing proportion of cash flows over time. Moreover, an increasing proportion of cash-based earnings suggests that earnings and cash flows become more closely related. Therefore, I examine whether the correlation between earnings and cash flows has increased over time.

Evidence on the Change in Working Capital Accruals

First, I explore intertemporal trends in current *accruals* as a proportion of total assets on the balance sheet as well as a component of earnings on the income statement.

[Insert Table 9 Here]

Panel A of Table 9 shows the annual mean values of current accruals (*CACC*), defined as the change in net working capital balance divided by different scalars in each column, over the period from 1970 to 2017. Column 1 shows that the annual mean value of current accruals declined from 3.0% of average total assets in the 1970s to only 0.3% of average total assets in the 2010s, representing a 90% reduction. The time-trend coefficient shows that current accruals has declined by approximately 0.1% of average total assets every year, with a highly significant t-statistic of -6.14 and adjusted R^2 of 0.44. Panel B visually presents the intertemporal trends in *CACC/AT*.

Similarly, column 2 shows that the annual mean value current accruals divided by earnings sharply declined from 18.8% of earnings in the 1970s to only 5.4% in the 2010s. The time-trend coefficient shows that current accruals has declined by approximately 0.4% of earnings every year, with a significant t-statistic of -4.59 and adjusted R^2 of 0.20. Together, these trends indicate that the temporal decline in the net working capital balance has precipitated a corresponding decline in current accruals over the past five decades.

A potential alternative explanation is that the decline in current accruals is attributable to accruals' proportionate change to change in sales or expenses as is commonly modeled in the accounting literature. For example, accounting literature typically models accruals as a function of change in sales and expenses (e.g., Jones, 1991; Dechow, Kothari and Watts, 1998). The intuition is straightforward, given the revenue recognition and matching principle of accruals accounting. Since a sales contract determines the timing and the amount of economic benefits and associated sacrifices, current accruals such as changes in accounts payable, inventory, and accounts payable are expected to be a certain proportion of the change in sales.

Accordingly, I also examine the intertemporal trends in current accruals divided by change in sales (column 3) and change in expenses (column 4). However, current accruals as a proportion of change in sales also declined over the sample period, from 18.3% in the 1970s to around 3.5% in the 2010s. With respect to change in expense, the proportion of accruals declined from around 17.7% in the 1970s to around 6.7% in 2010s. That is, during the 1970s, current accruals comprised 18.3 (17.7) cents of any given dollar of change in sales (expenses). However, during the 2010s, current accruals comprised only 3.5 (6.7) cents for every dollar of change in sales (expenses). These time trends are also statistically significant, with t-statistics of –4.59 and –4.14, respectively. Together, these trends show that the decline in the net working capital balance precipitates a corresponding decline in current accruals over time. Panel C visually presents the intertemporal trends in *CACC/E*, *CACC/*Δ*Sales*, and *CACC/*Δ*Expenses*.

Evidence on the Accruals-Generating Process

The preceding time trend shows that working capital accruals has not only declined as a proportion of total assets but also as a proportion of change in sales, change in expenses and earnings. This suggests a significant change in the way accounting literature models the 'normal' accruals-generating-process, as in Jones (1991) type models. That is, the change in the size of accruals as an outcome of more efficient working capital management on the balance sheet is disproportionate to change in the scale of operations as measured by the change in sales on the income statement. Therefore, I expect the coefficient estimate and explanatory power of Jones

(1991) model to decline over time, contemporaneously with the exogenous decline in working capital accruals over time.

[Insert Table 10 Here]

Panel A of Table 10 shows coefficient estimates and adjusted R^2 from Jones (1991) model over the past five decades. Specifically, I estimate the following regression in annual cross-section (coefficient estimate and adjusted R^2 reported in columns 1 and 2) as well as by SIC 2-digit industry-year (coefficient estimate and adjusted R^2 reported in columns 3 and 4):

$$CACC_{i,t} = \beta_0 \cdot 1/Avg\_AT_t + \beta_1 \cdot Sale/Avg\_AT_t + \beta_2 \cdot PPEGT/Avg\_AT_{i,t} + \varepsilon_{i,t} \qquad (2)$$

where *CACC* is working capital accruals; *Avg_AT* is average total assets; *Sale* is sales; and *PPEGT* is gross property, plants and equipment. For industry-year regression, I exclude industries with less than 20 observations each year.

Column 1 and 2 show coefficient estimates and adjusted R^2 of annual cross-sectional regression of model (2) over the past five decades. Consistent with the expectation, I find that the coefficient estimate (β_1) declined from 0.11 in the 1970s to 0.05 in the 2010s (Column 1). Similarly, the adjusted R^2 in column 2 also declined from 23.7% in the 1970s to only 3.7% in the 2010s. That is, only 3.7% of variations in working capital accruals is explained by the commonly used Jones (1991) model. The results are similar when model (2) is estimated within SIC 2-digit industry-year. Column 3 shows that the coefficient estimate declined from 0.12 in the 1970s to 0.06 in the 2010s. Column 4 shows that the adjusted R^2 declined from 29.7% in the 1970s to only 11.8% in the 2010s. Together, these results indicate that the conventional accruals models are becoming less effective at mapping the underlying accruals-generating process not by the deficiency in the model but by the sheer reduction in the magnitude of accruals. Panels B and C visually present the coefficient estimates and the adjusted R^2 of the Jones (1991) model over time.

Evidence on the Earning–Cashflows Relationship

The observed intertemporal decline in working capital accruals also implies intertemporal changes in the relationship between earnings and cash flows. Observe that working capital accruals account for only 5.4% of earnings in the 2010s, suggesting that approximately 95% of earnings is cash-based earnings in recent periods. Because earnings equal the sum of accruals and cash flows, a reduction in the magnitude of working capital accruals implies a narrowing difference between earnings and cash flows, which, in turn, leads to a higher correlation between earnings and cash flows. Note that practitioners typically consider high correlations between earnings and cash flows as an indication of high-quality earnings (Dichev, Graham, Harvey and Rajgopal, 2003). From this perspective, the increasing earnings–cash flow correlation may indicate that earnings quality has been increasing over the last 53 years. However, extant accounting literature documents the contrary: that earnings quality has declined over the past five decades due to an increase in intangible-intensive industry (Collins, Maydew and Weiss, 1997), changes in generally accepted accounting principles (Donelson, Jennings and McInnis, 2011), poor matching between revenue and expense (Dichev and Tang, 2008), and changes in sample firm composition (Srivastava, 2014).

Therefore, I investigate whether the declining accruals are attributable to an increase in earnings– cash flows correlation. Let "E," "CFO," "Accr," and "a" denote earnings, operating cash flows, working capital accruals, and accruals-to-earnings ratio, respectively. Then, I denote working capital accruals and operating cash flows as "a" and "1–a" percent of operating income,[22] respectively, since earnings equals the sum of working capital accruals and operating cash flows ($E \equiv Accr + CFO$). Next, I re-write the correlation between operating income and operating cash flows as follows:

[22] That is, $Accr \equiv a*E$ and $CFO \equiv (1\text{-}a)*E$, respectively.

$$Corr(E, CFO) = \frac{Cov(E,CFO)}{Std(E)*Std(CFO)} = \frac{Cov(E,(1-a)*E)}{Std(E)*Std(CFO)} \quad (3)$$

Supposing that "a" and "E" are both random variables, the numerator can be written as:

$$\begin{aligned} Cov\left(\tilde{E}, (1-\tilde{a}) * \tilde{E}\right) &= Var\left(\tilde{E}\right) - Cov\left(\tilde{E}, \tilde{a} * \tilde{E}\right) \\ &= Var\left(\tilde{E}\right) - E(\tilde{a}) * Var(\tilde{E}) \\ &= \{1 - E(\tilde{a})\} * Var(\tilde{E}) \end{aligned} \quad (4)$$

Replacing the numerator in equation (3) with equation (4) and simplifying the expectation term, I can re-write the earnings–cash flows correlation as:

$$Corr(E, CFO) = \frac{(1-a)*Var(E)}{Std(E)*Std(CFO)} = (1-a) * \frac{Std(E)}{Std(CFO)} \quad (5)$$

Two points are worth noting from equation (5). First, Corr(E, CFO) is a function of (i) the accruals-to-earnings ratio "a" and (ii) the standard deviation of operating income relative to that of operating cash flows ($\frac{Std(E)}{Std(CFO)}$). Second, by taking the derivative[23] with respect to "a," Corr(E, CFO) strictly decreases (increases) with increases (decreases) in "a."[24] In other words, a decrease in the accruals portion of operating income strictly increases the correlations between earnings and cash flows. The intuition behind the algebraic result is simple: earnings and cash flows are more correlated when the distance between the two is smaller. Then, I explore whether the correlation between earnings and cash flows has indeed increased over time because a number of simplifying assumptions[25] in the preceding algebra may not hold in our sample firms.

[Insert Table 11 Here]

[23] $\frac{\partial \mathrm{Corr(E,CFO)}}{\partial \mathrm{a}} = -\frac{Std(E)}{Std(CFO)} < 0$, since Std(E) > 0 and Std(CFO) > 0.

[24] A third point to note is that an increase (decrease) in $\frac{Std(E)}{Std(CFO)}$ strictly increases (decreases) earnings–cash flows correlation as long as 0 < a < 1. However, the extent to which $\frac{Std(E)}{Std(CFO)}$ increases or decreases the earnings-cash flows correlation is beyond the scope of this paper and is studied extensively in a concurrent paper by Kang and Na (2018).

[25] For example, I assume that 0 < a < 1 and that $E(\tilde{a})$=a.

Column 1 (column 2) of Panel A of Table 11 presents intertemporal trends in Pearson (Spearman) earnings–cash flows correlations. Consistent with the expectation, the Pearson (Spearman) correlation between earnings and cash flows rose from 0.678 (0.679) in the 1970s to 0.947 (0.877) in the 2010s. The increase is also statistically significant, with a coefficient estimate of 0.007 (0.005), t-statistic of 25.49 (18.65) and R^2 of 0.93 (0.88). In the untabulated results, I also regress *Corr(E, CFO)* on accruals-to-earnings ratio "a" to test the proposition that the decrease in working capital accruals contributes to the increase in the earnings–cash flows correlation over time. The results indicate that a 1% reduction in accruals-to-earnings ratio "a" is associated with an increase in the Pearson (Spearman) correlation between earnings and cash flows by 0.006 (0.005). Panel B visually presents the intertemporal trends in *Corr(E, CFO)*.

Together, these results indicate that the reduction in working capital accruals contributes to increasing correlation between operating income and cash flows. As noted before, practitioners typically consider a high earnings–cash flows correlation to be an indication of high earnings quality (Dichev et al., 2013). However, the results show that the recent increase in the earnings–cash flows correlation is an outcome of the declining working capital accruals and is not a *de facto* indicator for higher earnings quality. Stated differently, the apparent increase in earnings quality may not have come from an improvement in financial reporting but from real improvement in efficiency in working capital management. If any, the increase in the earnings–cash flows correlation rather indicates that *cash flows* (vis-à-vis earnings) has become a relatively better measure of firm performance (i.e., became closer to earnings) over time (e.g., Dechow, 1994).

IV. CONCLUSION AND DISCUSSION

In this paper, I postulate that the evolution of information technology over the past five decades precipitated more efficient working capital management at average U.S. firms between

1970 and 2017. Consistent with this expectation, I document that the levels of net working capital accounts on the balance sheet and their size relative to the income statement (e.g., working capital accruals) have all declined significantly over the past five decades. Specifically, the annual mean values of net working capital *balance* and working capital *accruals* declined from 28.9% and 3.0% of average total assets in the 1970s to around 6.5% and 0.3% of average total assets in the 2010s, respectively. That is, overall, U.S. firms have become more efficient managers of working capital over the past five decades. I also show that the reduction in the net working capital balance can be explained by development in information technology, as proxied by the IT spending data provided from the U.S. Census Bureau. In additional analyses, I examine several alternative explanations such as the industry membership, sample firm composition, working capital outsourcing, earnings management, and accounting rule change. Lastly, I use a sample of international firms and show that the intertemporal decline in the net working capital balance is a global phenomenon across OECD countries and varies predictably with each country's respective investment into information and communication technology. Together, this paper shows that the development in information technology is a previously undiscovered yet independent force, among others, that shapes working capital behavior of U.S. firms and contributes to the intertemporal reduction of net working capital balance.

I also highlight that these changes have potentially important implications for accounting research. As a result of the decline in working capital accruals, there has been a significant change in the 'normal' accruals-generating process over time. Specifically, change in the scale of operations does not appropriately explain the 'normal' accruals any longer. Consistently, the adjusted R^2 from the widely used Jones (1991) model declined from 23.7% in the 1970s to a mere 3.7% in the 2010s. That is, more than 95% of accruals are classified as 'abnormal' or 'discretionary' accruals using conventional technology to map accruals with the change in scale of operations. I also show that the decline in working capital accruals increases the correlation between earnings and cash flows over time and that approximately 95% of earnings are cash-based earnings in recent periods. Hence, I advise caution when practitioners and researchers interpret high correlation between earnings and cash flows as a *de facto* indicator of high earnings quality.

I conclude this paper with the following discussions and suggest some future research avenues. First, reduction in the size of accruals implies less ability to manage earnings using accruals. If the level of net working capital on the balance sheet is a limit to which accruals-based earnings management is constrained (e.g., Barton and Simko, 2002; Baber, Kang and Li, 2011), the reduction in the level of net working capital balance indicates a reduction in the *ability* to manage earnings via accruals. Therefore, an interesting question is whether the small magnitude of accruals affects accruals-based earnings management. Follow-up research can answer whether this leads to a more transparent financial reporting regime in more recent periods or simply a substitution among accruals-based earnings management, real earnings management, cash flows management, classification shifting and/or others.

Second, the observed intertemporal decline in accruals also makes us reconsider the role of accruals accounting. It is well-known that accruals convey information about expected future cash flows, and for that reason, accruals is a superior measure of firm performance than cash flows (Ball and Brown, 1968; Rayburn, 1986; Dechow, 1994). Accruals also contain private information and managers' expectations about future cash flows (e.g., Subramanyam, 1996; Bradshaw, Richardson and Sloan, 2001; Louis and Robinson, 2005). From such a viewpoint, the intertemporal decline in accruals is important for two reasons. First, information technology and efficiency gain have reduced informational uncertainty for managers and accountants. With lower inventory level and faster collection cycle, there is a reduced need to make assumptions and forecasts and thus a reduced amount of private information contained in earnings incremental to operating cash flows (i.e., accruals). Therefore, an interesting avenue for future research may address whether the informational role of accruals earnings is reduced in the capital market in more recent periods.

Lastly, what will be the role of accrual accounting be when information technology can (more) perfectly predict customers' credit risk, forecast bad debts, optimize inventory level, and determine precisely how much PPE was used to generate revenue, and so on? Will there be room for accounting assumptions and judgment? The reason accountants rely on either the FIFO or LIFO assumption is because it is cost-inefficient for humans to track down individual inventory flows. Similarly, various depreciation methods are used because of our limited capacity to cost-efficiently measure the use of PPE for a given sale amount. Today, global accounting firms like Ernst & Young use natural language processing AI to extract critical information from millions of invoices and identify anomalous or fraudulent invoices at a 97% accuracy rate (Zhou, 207). In this case, how much incremental benefit do accounting assumptions like percentage-of-sales or aging-of-receivables methods add to forecasting and managing bad debts? That said, if true economic figures (e.g., the true amounts of inventory, cost of goods sold, assets used, etc.) can be revealed by advanced information technology (e.g., AI), will accrual accounting remain useful information system to approximate an economic transaction? Will managers be able to manipulate earnings? Do we need auditors or data inspectors? Shall we continue to teach our students debits and credits? These are, of course, hypothetical questions. However, these technological changes already here and the disappearing working capital is just one facet of it. I believe that these questions merit the attention of academics, educators, managers, auditors, investors, and regulatory agencies to reconsider the role of accrual accounting as a form of information system.

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Table 1. Sample Selection and Descriptive Statistics

Panel A of Table 1 explains sample selection process. Out of 409,7167 firm-year observations in the Compustat universe, I drop foreign firms (30,115), non-NYSE, AMEX, or NASDAQ firm (160,991), financial and public administration firms (60,312), and observations with missing variables to calculate working capital (24,478). My final sample consists of 133,820 firm-year observations between the year 1970 and 2017. Panel B shows descriptive statistics of main variables. Net working capital (*NWC*) is defined as the difference between current operating assets (*COA*) and current operating liabilities (*COL*), divided by average total assets, following Richardson, Sloan, Soliman, and Tuna (RSST hereafter, 2005). *COA* is defined as noncash current assets (Compustat ACT less CHE). *COL* is defined as current liabilities other than short-term debt (Compustat LCT less DLC). Consistently, working capital accruals (*CACC*) is defined as the change in net working capital. Earnings (*E*) is defined as operating income before depreciation divided by average total assets. Cash flow from operation (*CFO*) is defined as the difference between earnings and working capital accruals.

Panel A. Sample Selection

	#Obs
All Compustat firm-year observations between 1970-2017	409,716
Drop foreign firms	30,115
Drop non-NYSE, AMEX, NASDAQ firms	160,991
Drop financial and public administration firms	60,312
Drop observations with missing core variables	24,478
Final firm-year observations	133,820

Panel B. Descriptive Statistics

Variables	N	Mean	StdDev	Median	1st Pctl	99th Pctl
NWC	133,820	0.163	0.207	0.134	-0.309	0.662
COA	133,820	0.373	0.232	0.352	0.019	0.928
COL	133,820	0.210	0.129	0.184	0.034	0.673
AR	133,820	0.183	0.134	0.161	0.000	0.624
INVT	133,820	0.158	0.158	0.116	0.000	0.618
AP	133,820	0.091	0.079	0.070	0.005	0.417
CACC	133,820	0.015	0.086	0.008	-0.244	0.295
E	133,820	0.104	0.198	0.132	-0.772	0.447
CFO	133,820	0.088	0.202	0.119	-0.780	0.462

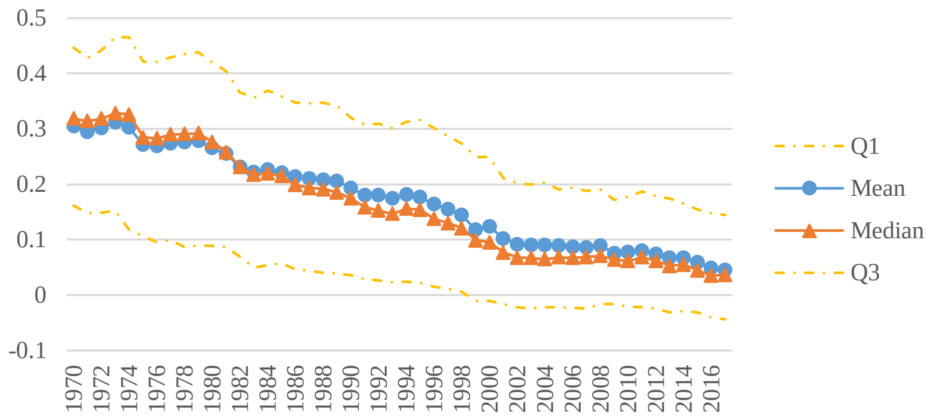
Table 2. Net Working Capital Balance over Time (1970-2017)

Table 2 shows intertemporal trends in net working capital balance and its components over time. *NWC* is net working capital balance. *COA* is current operating asset. *COL* is current operating liabilities. *AR* is accounts receivable. *TXR* is income tax refund. *INVT* is inventory. *ACO* is other current operating assets. *AP* is accounts payable. *TXP* is income taxes payable. *LCO* is other current liabilities. All variables are deflated by average total assets. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

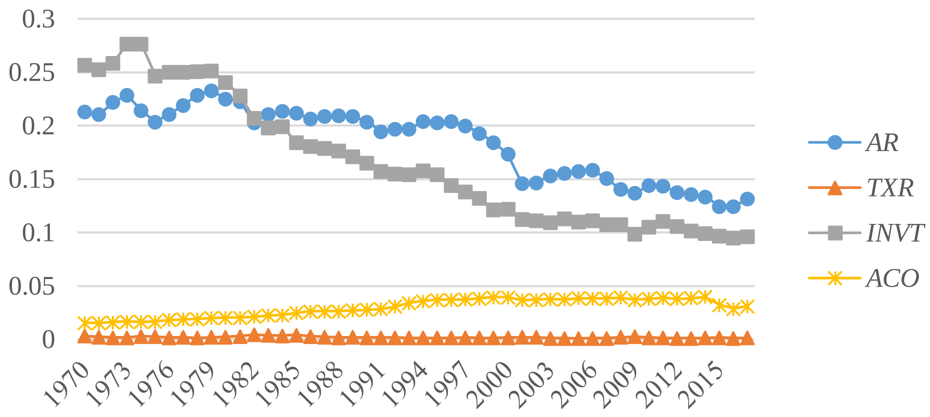
Panel A. Mean NWC and its components over time

	NWC	*COA*	*COL*	*AR*	*TXR*	*INVT*	*ACO*	*AP*	*TXP*	*LCO*
1970s	0.289	0.494	0.205	0.218	0.002	0.257	0.017	0.106	0.024	0.074
1980s	0.226	0.434	0.208	0.212	0.003	0.196	0.024	0.100	0.015	0.092
1990s	0.167	0.382	0.215	0.198	0.001	0.148	0.035	0.096	0.009	0.110
2000s	0.093	0.302	0.210	0.152	0.001	0.110	0.038	0.079	0.006	0.123
2010s	0.065	0.274	0.209	0.134	0.001	0.101	0.036	0.077	0.003	0.127
Time-trends										
Coefficient	-0.006***	-0.006***	0.000	-0.002***	0.000***	-0.004***	0.001***	-0.001***	0.000***	0.001***
(t-statistic)	*(-45.71)*	*(-31.42)*	*(1.29)*	*(-16.42)*	*(-4.40)*	*(-24.97)*	*(12.40)*	*(-13.96)*	*(-17.87)*	*(23.56)*
R^2	0.978	0.955	0.014	0.851	0.281	0.930	0.765	0.805	0.871	0.922

Panel B. *NWC* (mean, median, Q1, and Q3) over time



Panel C. Components of *COA* over time



Panel C. Components of *COL* over time

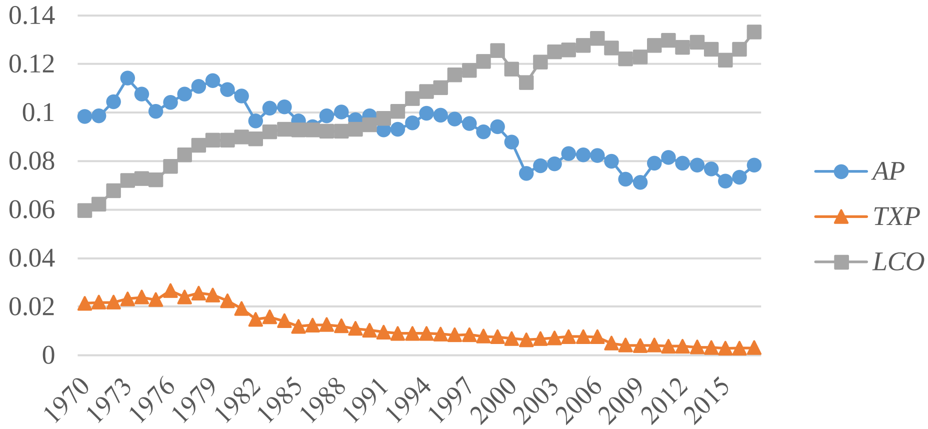


Table 3. IT Spending and Net Working Capital Balance

Table 3 examines the impact of the development of information technology on net working capital balance (Panel A) and its components (Panel B). The dependent variable in Panel A, *NWC,* is net working capital balance. In Panel B, dependent variables are current operating asset (*COA*), current operating liabilities (*COL*), accounts receivable (*AR*), income tax refund (*TXR*), inventory (*INVT*), other current operating assets (*ACO*), accounts payable (*AP*), income taxes payable (*TXP*), other current liabilities (*LCO*). *Time* is the number of years since 1970. *IT_Spending* is the dollar amount of total ICT spending in a given industry deflated by the dollar amount of gross output of respective industries. *AQ* is an indicator variable that equals to one if auditor opinion is unqualified, and zero otherwise. *Matching* is the adjusted R^2 from cross-sectional estimation of Dichev and Tang (2008) model by year and SIC 2-digit industry. *AcctLoss* is an indicator variable that equals to one if income before extraordinary items (Compustat IB) is negative but operating cash flows is positive, and zero otherwise. *CFO* is defined as operating income (Compustat OIBDP) less the change in net working capital (ΔNWC). *Size* is defined as the natural logarithm of market value of equity. *Growth* is defined as market-to-book ratio (Compustat CSHO*PRCC_F/CEQ). *Leverage* is defined as interest-bearing debt (Compustat DLTT and DLC) divided by average total assets. *Interest_Cover* is defined as interest expense (Compustat XINT) divided by income before extraordinary items (Compustat IB). *HHI* is Herfindahl-Hirschman Index calculated within 2-digit SIC industry and year. *Goodwill* is the proportion of goodwill (Compustat GDWL) divided by average total assets. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. IT Spending and Net Working Capital Balance

	(1)	(2)	(3)	(4)
Intercept	0.164***	0.131***	0.213***	-0.067
	(11.55)	(37.10)	(15.48)	(-1.14)
Time	-0.002***		-0.002***	0.002**
	(-5.73)		(-6.10)	(2.30)
IT Spending		-3.226***	-3.227***	-2.425***
		(-25.83)	(-25.81)	(-8.48)
AQ				0.022***
				(7.55)
Matching				0.055***
				(4.10)
AcctLoss				-0.034***
				(-8.88)
CFO				-0.000***
				(-2.71)
Size				-0.012***
				(-7.56)
Growth				-0.002***
				(-5.38)
Leverage				0.001
				(0.06)
Interest Coverage				0.000
				(0.09)
HHI				-0.19***
				(2.92)
Goodwill				-0.026*
				(-1.96)
Industry, Cohort and Year FE	No	No	No	Yes
Clustered SE	Firm	Firm	Firm	Firm
#Observations	29,661	29,661	29,661	25,828
Adj. R2	0.001	0.086	0.087	0.360

Panel B. IT Spending and Components of Net Working Capital

	COA	*COL*	*AR*	*TXR*	*INVT*	*ACO*	*AP*	*TXP*	*LCO*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	0.486***	0.561***	0.336***	0.004**	0.078***	0.057***	0.203***	0.014***	0.357***
	(8.09)	(10.07)	(8.81)	(2.07)	(2.42)	(4.01)	(7.56)	(3.70)	(8.04)
Time	-0.001	-0.004***	-0.001	0.000	0.000	0.000	-0.001***	0.000***	-0.002***
	(-0.63)	(-3.30)	(-0.93)	(-1.61)	(0.03)	(-0.45)	(-2.55)	(-4.33)	(-2.50)
IT Spending	-2.260***	0.182	-1.909***	-0.014*	-0.287***	0.000	-0.579***	0.003	0.773***
	(-7.74)	(0.73)	(-7.47)	(-1.86)	(-2.58)	(0.00)	(-4.02)	(0.15)	(3.58)
AQ	0.006**	-0.017***	0.004*	0.000	0.005***	-0.003***	-0.007***	0.000	-0.010***
	(2.14)	(-6.72)	(1.95)	(1.27)	(2.99)	(-4.74)	(-4.94)	(-0.21)	(-5.71)
Matching	0.027**	-0.035***	0.014*	0.000	0.010	0.000	0.001	0.000	-0.037***
	(2.08)	(-2.93)	(1.81)	(0.73)	(1.36)	(0.15)	(0.10)	(0.08)	(-3.80)
AcctLoss	-0.040***	-0.006*	-0.021***	0.001***	-0.017***	-0.002***	-0.009***	-0.001***	0.002
	(-10.42)	(-1.82)	(-8.21)	(5.34)	(-7.26)	(-2.91)	(-4.63)	(-5.33)	(0.79)
CFO	0.000	0.000***	0.000	0.000**	0.000	0.000***	0.000***	0.000	0.000
	(0.58)	(4.27)	(1.51)	(-2.45)	(0.08)	(-2.55)	(5.26)	(1.90)	(1.46)
Size	-0.017***	-0.005***	-0.008***	0.000**	-0.009***	0.001**	-0.006***	0.001***	0.000
	(-10.58)	(-3.99)	(-8.15)	(-2.29)	(-8.92)	(2.36)	(-8.45)	(11.21)	(-0.31)
Growth	0.000	0.002***	0.001***	0.000	-0.001***	0.000**	0.000***	0.000	0.002***
	(0.39)	(6.30)	(2.63)	(-1.49)	(-3.61)	(2.25)	(2.52)	(1.50)	(5.67)
Leverage	0.000	-0.001	-0.006	-0.001***	0.006	0.000	0.011**	-0.002***	-0.002
	(-0.03)	(-0.06)	(-1.01)	(-5.10)	(0.96)	(0.09)	(2.42)	(-4.70)	(-0.28)
Interest Coverage	-0.002**	-0.002***	-0.001***	0.000	0.000	0.000	-0.001***	0.000***	-0.001**
	(-2.48)	(-3.40)	(-2.88)	(1.03)	(-0.73)	(-1.31)	(-3.04)	(-3.93)	(-2.31)
HHI	-0.166**	0.024	-0.008	0.002	-0.179***	0.006	-0.016	-0.002	0.036
	(-2.30)	(0.56)	(-0.18)	(0.93)	(-3.60)	(0.51)	(-0.55)	(-0.46)	(1.27)
Goodwill	-0.147***	-0.120***	-0.037***	-0.001**	-0.077***	-0.025***	-0.043***	-0.003***	-0.073***
	(-10.57)	(-10.78)	(-3.85)	(-2.14)	(-9.42)	(-10.61)	(-7.12)	(-4.09)	(-8.29)
Industry, Cohort and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
#Observations	25,828	25,828	25,828	24,630	25,828	25,828	25,828	25,260	25,828
Adj. R2	0.424	0.212	0.315	0.037	0.513	0.079	0.251	0.104	0.240

Table 4. Net Working Capital Balance over Time by Fama-French 10 Industry (1970-2017)

Table 4 shows intertemporal trends in net working capital balance over time by Fama-French 10 industry. *NWC* is net working capital balance, deflated by average total assets. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Fama-French 10 industry classification is detailed in Appendix B. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. Mean *NWC* over time by Fama-French 10 industry

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FF9	FF10
1970s	0.355	0.386	0.337	0.082	0.396	0.067	0.325	0.307	0.022	0.147
1980s	0.292	0.324	0.287	0.047	0.315	0.027	0.271	0.226	0.017	0.124
1990s	0.248	0.289	0.243	0.026	0.188	0.014	0.229	0.140	0.016	0.088
2000s	0.179	0.199	0.197	0.018	0.060	-0.024	0.159	0.059	0.019	0.040
2010s	0.144	0.169	0.165	0.008	0.029	-0.012	0.135	0.003	0.015	0.030
Time Trends										
Coefficient	-0.005***	-0.006***	-0.004***	-0.002***	-0.010***	-0.002***	-0.005***	-0.008***	-0.000***	-0.003***
(t-statistics)	(-38.83)	(-27.09)	(-33.10)	(-13.09)	(-28.73)	(-15.06)	(-34.13)	(-40.93)	(-2.68)	(-29.23)
R^2	0.970	0.940	0.959	0.784	0.946	0.828	0.961	0.973	0.116	0.948

Panel B. Mean *NWC* over time by Fama-French 10 industry

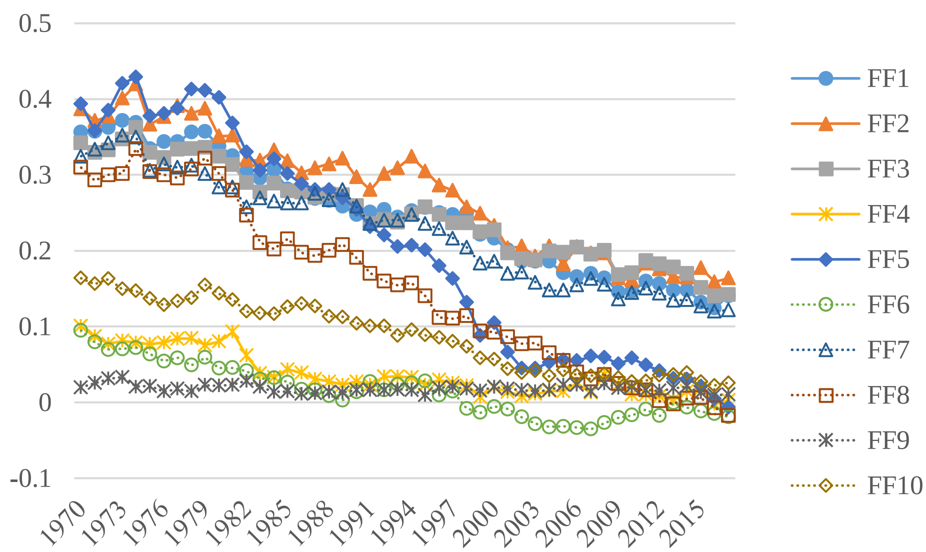


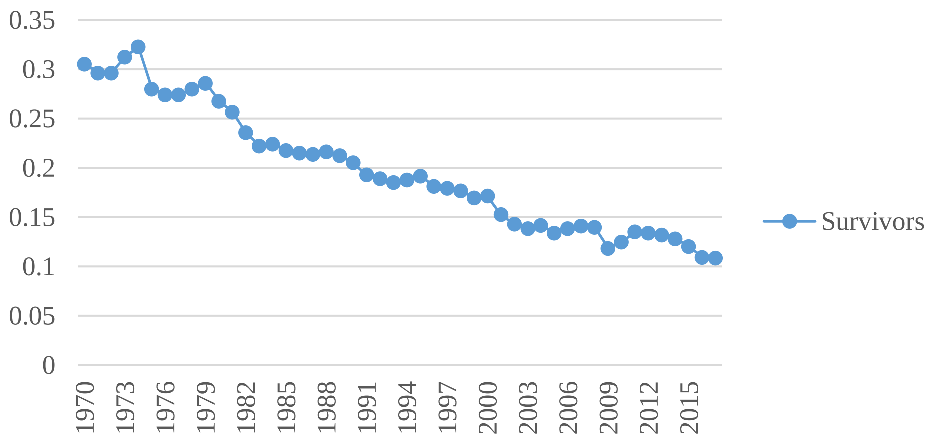
Table 5. Net Working Capital Balance over Time by Cohort Firms (1970-2017)

Table 5 shows intertemporal trends in net working capital balance over time for surviving firms and by cohort of firms. *NWC* is net working capital balance, deflated by average total assets. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Survivors are the subset of firms that survive continuously through 1970-2017. Cohort firms are assigned to their respective groups based on the year of first appearance on Compustat database. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. Mean *NWC* of surviving firms and by cohort firms over time (1970-2017)

	Survivors	<1970s	1970s	1980s	1990s	2000s	2010s
1970s	0.293	0.285	0.302				
1980s	0.229	0.215	0.250	0.212			
1990s	0.186	0.161	0.210	0.177	0.139		
2000s	0.142	0.124	0.149	0.128	0.072	0.050	
2010s	0.124	0.105	0.122	0.109	0.080	0.032	-0.035
Time Trends							
Coefficient	-0.004***	-0.005***	-0.005***	-0.004***	-0.003***	-0.002***	0.006*
(t-statistics)	(-30.39)	(-28.40)	(-34.21)	(-19.31)	(-5.27)	(-4.08)	(1.77)
R^2	0.952	0.945	0.962	0.912	0.507	0.494	0.263

Panel B. Mean *NWC* of surviving firms over time (1970-2017)



Panel C. Mean *NWC* by cohort firms over time (1970-2017)

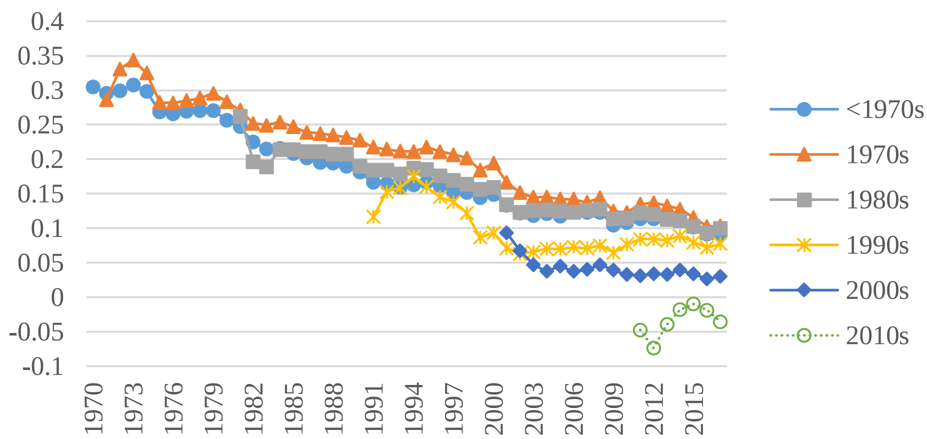


Table 6. Net Working Capital Balance over Time by Market Power Portfolios (1970-2017)

Table 6 shows intertemporal trends in net working capital balance (*NWC*) over time by 5 portfolios delineated by *Size* (Panel A), *HHI* (Panel B), and *Customer* (Panel C). *NWC* is net working capital balance, deflated by average total assets. *Size* is defined as the natural logarithm of market value of equity. *HHI* is the sum of squares of the market shares of the firms within 2-digit SIC industry-year. *Customers* is the number of major customers disclosed by the firm and is obtained from Compustat industry segment files. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. Mean *NWC* by *Size* portfolio over time (1970-2017)

	Size Rank 1	Size Rank 2	Size Rank 3	Size Rank 4	Size Rank 5
1970s	0.309	0.305	0.295	0.283	0.255
1980s	0.249	0.251	0.241	0.218	0.181
1990s	0.202	0.189	0.175	0.161	0.128
2000s	0.130	0.109	0.093	0.081	0.063
2010s	0.102	0.075	0.067	0.065	0.041
Time Trends					
Coefficient	-0.005***	-0.006***	-0.006***	-0.006***	-0.006***
(t-statistics)	(-40.96)	(-39.23)	(-38.82)	(-35.60)	(-35.49)
R^2	0.973	0.970	0.970	0.964	0.964

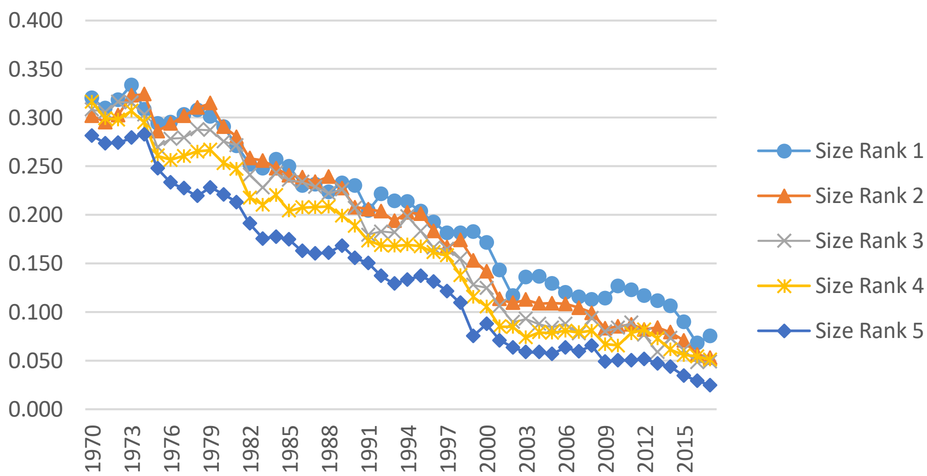
Panel B. Mean *NWC* by *HHI* portfolio over time (1970-2017)

	HHI Rank 1	HHI Rank 2	HHI Rank 3	HHI Rank 4	HHI Rank 5
1970s	0.248	0.405	0.266	0.234	0.278
1980s	0.155	0.304	0.221	0.230	0.223
1990s	0.091	0.211	0.160	0.181	0.187
2000s	0.021	0.076	0.137	0.119	0.123
2010s	0.001	0.009	0.122	0.093	0.110
Time Trends					
Coefficient	-0.007***	-0.010***	-0.004***	-0.004***	-0.004***
(t-statistics)	(-23.09)	(-26.85)	(-8.18)	(-13.09)	(-14.79)
R^2	0.919	0.939	0.584	0.784	0.823

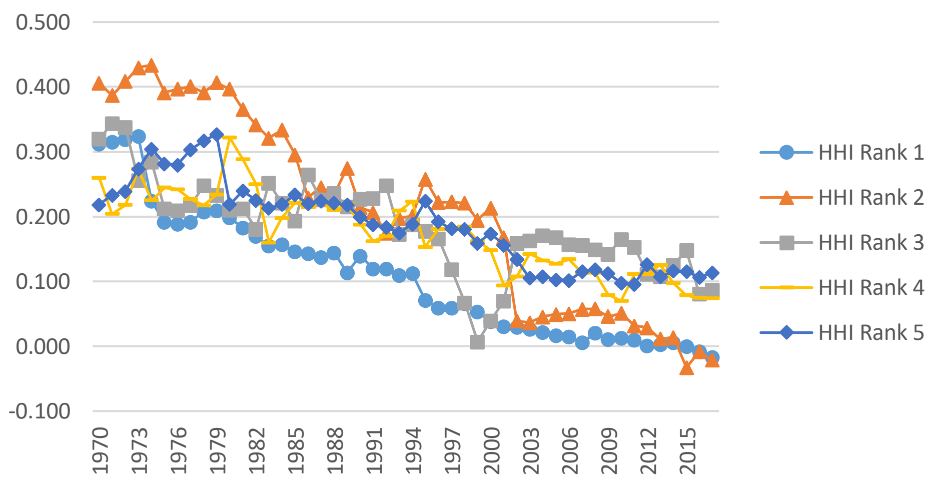
Panel C. Mean *NWC* by *Customer* portfolio over time (1978-2017)

	Customer Rank 1	Customer Rank 2	Customer Rank 3	Customer Rank 4	Customer Rank 5
1970s	0.230	0.326	0.220	0.319	0.310
1980s	0.156	0.264	0.216	0.237	0.236
1990s	0.183	0.184	0.180	0.188	0.182
2000s	0.097	0.122	0.110	0.107	0.119
2010s	0.056	0.071	0.077	0.090	0.106
Time Trends					
Coefficient	-0.004***	-0.007***	-0.005***	-0.006***	-0.006***
(t-statistics)	(-7.83)	(-27.62)	(-19.63)	(-18.45)	(-12.52)
R^2	0.601	0.949	0.904	0.892	0.792

Panel D. Mean *NWC* by *Size* portfolio over time (1970-2017)



Panel E. Mean *NWC* by *HHI* portfolio over time (1970-2017)



Panel F. Mean *NWC* by *Customer* portfolio over time (1978-2017)

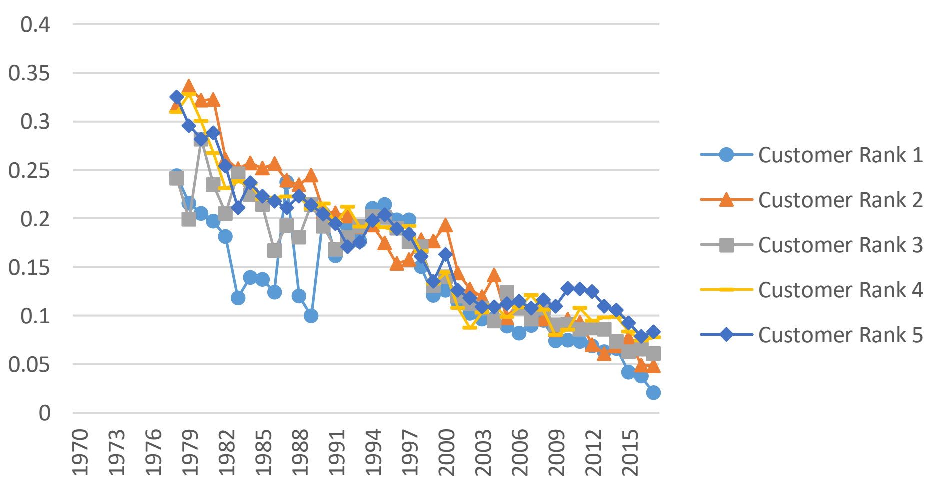


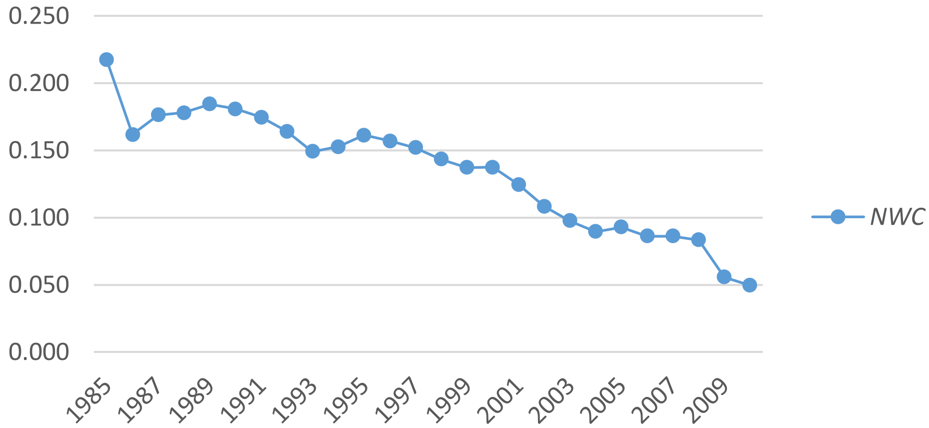
Table 7. Net Working Capital Balance over Time (1985-2010) – International Evidence

Table 7 shows intertemporal trends in net working capital balance over the period 1985-2010 in 17 OECD countries with ICT investment data available from OECD. *NWC* is net working capital balance defined as current operating assets (*COA*) less current operating liabilities (*COL*). *COA* is current operating asset defined as noncash current assets (Worldscope item 2201 less 2001) divided by average total assets (Worldscope item 2999). *COL* is current operating liabilities defined as current liabilities other than short-term debt (Worldscope item 3101 less 3051) divided by average total assets. *High ICT Investment Countries* are defined as the countries with above the mean value of *ICTINVST* each year. Similarly, *Low ICT Investment Countries* are defined as the countries with below the mean value of *ICTINVST* each year. *ICTINVST* is directly obtained from OECD Data and is defined as the acquisition of information technology equipment, communications equipment, and computer software that is used in production for more than one year, deflated by total non-residential gross fixed capital formation. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1985. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. Mean *NWC* of 17 OECD Countries

	NWC		
Year	Full Sample (17 OECD Countries excluding the US)	*Low ICT Investment Countries*	*High ICT Investment Countries*
1985	0.217	0.226	0.209
1986	0.162	0.148	0.174
1987	0.176	0.183	0.171
1988	0.178	0.167	0.188
1989	0.184	0.181	0.187
1990	0.181	0.176	0.185
1991	0.175	0.172	0.177
1992	0.164	0.166	0.163
1993	0.149	0.151	0.147
1994	0.153	0.166	0.141
1995	0.161	0.178	0.147
1996	0.157	0.166	0.149
1997	0.152	0.166	0.139
1998	0.143	0.154	0.134
1999	0.137	0.145	0.130
2000	0.137	0.147	0.129
2001	0.125	0.132	0.118
2002	0.108	0.125	0.093
2003	0.098	0.116	0.081
2004	0.090	0.104	0.076
2005	0.093	0.088	0.077
2006	0.086	0.089	0.056
2007	0.086	0.091	0.056
2008	0.083	0.115	0.017
2009	0.056	0.090	-0.017
2010	0.050	0.090	0.019
Time Trends			
Coefficient	-0.005***	-0.004***	-0.007***
(t-statistic)	*(-16.35)*	*(-10.01)*	*(-15.24)*
Adjusted R^2	0.918	0.799	0.902

Panel B. Mean *NWC* of 17 OECD Countries over Time



Panel C. Mean *NWC* of High and Low ICT Investment Countries over Time

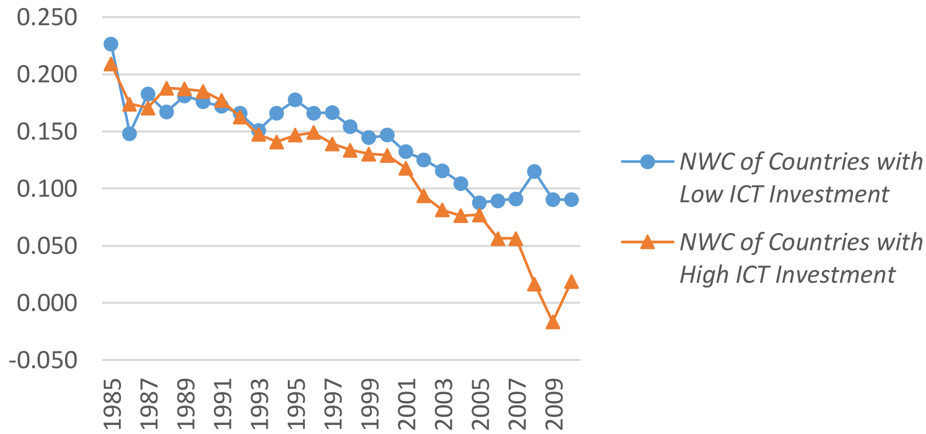


Table 8. ICT Investment and Net Working Capital Balance – International Evidence

Table 8 examines the impact of the development of information technology on net working capital balance with international sample of 17 OECD countries excluding the U.S. The dependent variable throughout the columns is the annual mean value of each country's net working capital balance (*NWC*) defined as current operating assets (*COA*) less current operating liabilities (*COL*). *COA* is current operating asset defined as noncash current assets (Worldscope item 2201 less 2001) divided by average total assets (Worldscope item 2999). *COL* is current operating liabilities defined as current liabilities other than short-term debt (Worldscope item 3101 less 3051) divided by average total assets. *ICTINVST* is directly obtained from OECD Data and is defined as the acquisition of information technology equipment, communications equipment, and computer software that is used in production for more than one year, deflated by total non-residential gross fixed capital formation. *Time* is the number of years since 1985. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.201***	0.194***	0.218***	0.149***	0.311
	(32.81)	(16.74)	(20.83)	(4.64)	(0.64)
$Time_t$	-0.005***		-0.005***		-0.007
	(-12.13)		(-10.89)		(-0.33)
$ICTINVST_{c,t}$		-0.004***	-0.001***	-0.004***	-0.004***
		(-5.11)	(-4.86)	(-3.51)	(-3.51)
Country Fixed Effect	No	No	No	Yes	Yes
Year Fixed Effect	No	No	No	Yes	Yes
#Observations	422	422	422	422	422
Adj. R^2	0.258	0.056	0.263	0.688	0.688

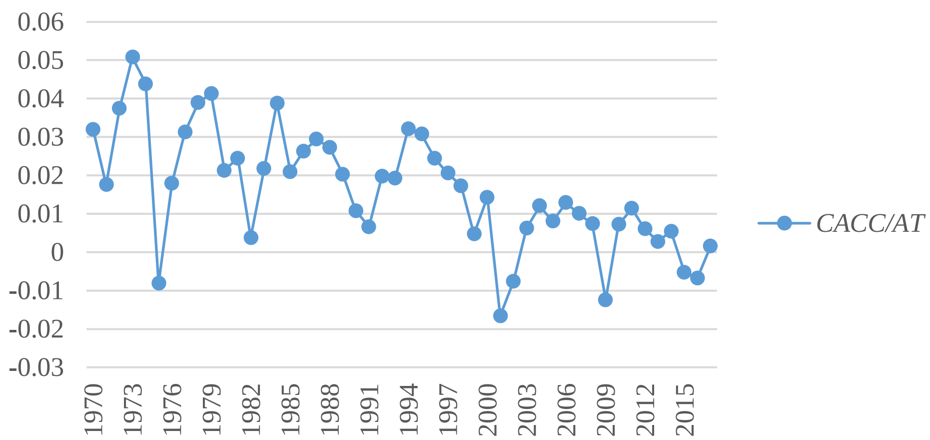
Table 9. Intertemporal Trends in Working Capital Accruals

Table 9 shows the intertemporal trends in working capital accruals (*CACC*) as a proportion of total assets (*CACC/AT*), earnings (*CACC/E*), change in sales (*CACC/ΔSales*), and change in expenses (*CACC/ΔExpense*). *CACC* is defined as change in net working capital balance. *E* is defined as operating income before depreciation. *Sales* is sales. *Expense* is *Sales* less operating income before depreciation. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. *CACC* over time

	CACC/AT	*CACC/E*	*CACC/ΔSales*	*CACC/ΔExpense*
1970s	0.030	0.188	0.183	0.177
1980s	0.023	0.205	0.125	0.175
1990s	0.019	0.178	0.113	0.147
2000s	0.003	0.074	0.062	0.068
2010s	0.003	0.054	0.035	0.067
Time Trends				
Coefficient	-0.001***	-0.004***	-0.004***	-0.003***
(t-statistics)	(-6.14)	(-4.59)	(-4.59)	(-4.14)
R^2	0.438	0.300	0.299	0.256

Panel B. *CACC* as a proportion of total assets over time (1970-2017)



Panel C. *CACC* as a proportion of *E*, Δ*Sale*, and Δ*Expense* over time (1970-2017)

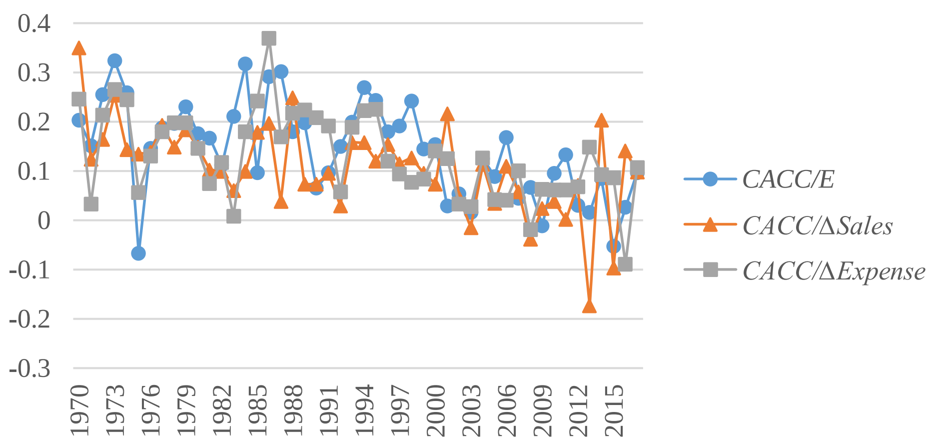


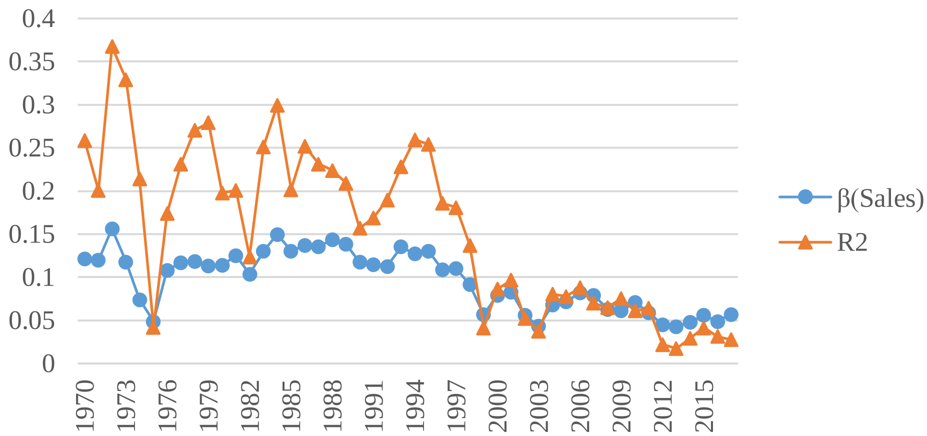
Table 10. Intertemporal Trends in Jones (1991) Model Estimates

Table 10 shows the intertemporal trends in Jones (1991) model estimates over time. For columns 1 and 2, I estimate Jones (1991) model annually and report coefficient estimates and the adjusted R^2. For columns 3 and 4, I estimate Jones (1991) model by SIC 2-digit industry and year, and report coefficient estimates and the adjusted R^2. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. *CACC* over time

	Cross-sectional by Year		*Cross-sectional by Industry/Year*	
	β(Sales)	R^2	*β(Sales)*	R^2
1970s	0.109	0.237	0.121	0.297
1980s	0.131	0.219	0.131	0.250
1990s	0.110	0.180	0.111	0.216
2000s	0.069	0.073	0.071	0.135
2010s	0.053	0.037	0.055	0.118
Time Trends				
Coefficient	-0.002***	-0.005***	-0.002***	-0.005***
(t-statistics)	(-6.78)	(-8.93)	(-9.11)	(-9.02)
R^2	0.489	0.626	0.636	0.631

Panel B. Jones (1991) model estimates over time (1970-2017) – Annual Estimation



Panel C. Jones (1991) model estimates over time (1970-2017) – Industry/Year Estimation

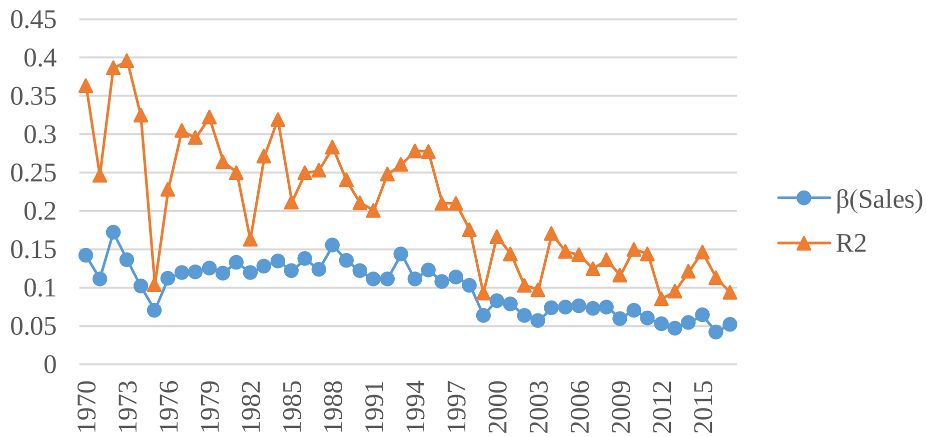


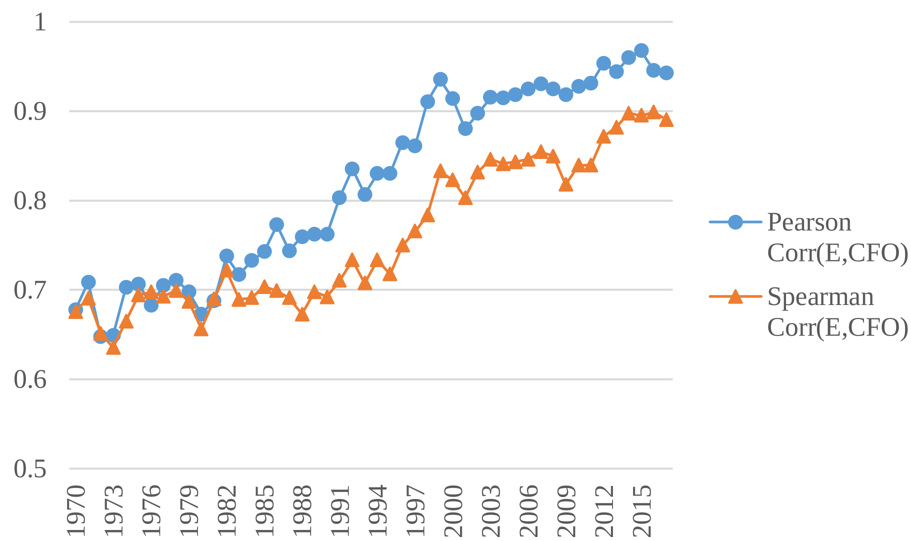
Table 11. Intertemporal Trends in Earnings-Cash Flows Correlations

Table 11 shows the intertemporal trends in the Pearson and Spearman correlation (*Corr(E,CFO)*) between earnings (*E*) and cash flows (*CFO*). *E* is defined as operating income before depreciation divided by average total asset. *CFO* is defined as the difference between earnings and working capital accruals (*CACC*). *CACC* is defined as the change in net working capital balance. Time-trends estimates are from a regression of annual mean values of respective variables on *Time*. *Time* is the number of years since 1970. Asterisks *, **, and *** denote two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A. Pearson and Spearman correlation between earnings and cash flows over time

	Pearson *Corr(E,CFO)*	Spearman *Corr(E,CFO)*
1970s	0.689	0.679
1980s	0.733	0.691
1990s	0.844	0.743
2000s	0.914	0.836
2010s	0.947	0.877
Time Trends		
Coefficient	0.007***	0.005***
(t-statistics)	(25.49)	(18.65)
R^2	0.932	0.881

Panel B. Pearson and Spearman *Corr(E,CFO)* over time (1970-2017)



Appendix A.

Variable Definition

Variable	Definition
ACO	*ACO* is other current operating assets, divided by average total assets.
AP	*AP* is accounts payable, divided by average total assets.
AR	*AR* is accounts receivable, divided by average total assets.
AQ	*AQ* is an indicator variable that equals to one if auditor opinion is unqualified, and zero otherwise.
CACC	Working capital accruals (*CACC*) is the change in net working capital (*NWC*).
Cash	*Cash* is defined as the amount of cash balance (Compustat CH).
COA	*COA* is noncash current assets (Compustat ACT less CHE), divided by average total assets.
COL	*COL* is current liabilities other than short-term debt (Compustat LCT less DLC), divided by average total assets.
CFO	Cash flow from operation (*CFO*) is the difference between earnings (*E*) and working capital accruals (*CACC*).
E	Earnings (*E*) is operating income before depreciation divided by average total assets.
Expense	*Expense* is *Sales* less operating income before depreciation.
Financing	*Financing* is defined as financial investments (Compustat IVST and IVAO) less current and long-term debt (Compustat DLC and DLTT).
Goodwill	*Goodwill* is the proportion of goodwill (Compustat GDWL) divided by average total assets.
Growth	*Growth* is defined as market-to-book ratio (Compustat CSHO*PRCC_F/CEQ).
HHI	*HHI* is Herfindahl-Hirschman Index calculated within 2-digit SIC industry and year.
Interest_Cover	*Interest_Cover* is defined as interest expense (Compustat XINT) divided by income before extraordinary items (Compustat IB).
Investment	*Investment* is defined as net investments into non-current operating assets (Compustat PPEGT, INTAN, AO, IVAEQA less DPACT) less non-current operating liabilities (Compustat TXDB, ITCB and LO).
INVT	*INVT* is inventory, divided by average total assets.
IT Spending	*IT_Spending* is the percentage increase in ICT spending as provided by the Census Bureau.
LCO	*LCO* is other current liabilities, divided by average total assets.
Leverage	*Leverage* is interest-bearing debt (Compustat DLTT and DLC) divided by average total assets.
Loss	*Loss* is an indicator variable that equals to one if income before extraordinary items (Compustat IB) is negative, and zero otherwise.

Matching	*Matching* is the adjusted R^2 from cross-sectional estimation of Dichev and Tang (2008) model by year and SIC 2-digit industry.
NWC	Net working capital (*NWC*) is the difference between current operating assets (*COA*) and current operating liabilities (*COL*), divided by average total assets.
ROA	*ROA* is the operating income before depreciation divided by average total assets.
Sales	Sales is sales (Compustat SALE).
Size	*Size* is the natural logarithm of market value of equity.
Tbill	*TBill* is annual average 3-month Treasury bill rate obtained directly from the Federal Reserve Bank of St. Louis.
Time	*Time* is the number of years since 1970.
TXP	*TXP* is income taxes payable, divided by average total assets.
TXR	*TXR* is income tax refund, divided by average total assets.
VolCFO	*VolCFO* is the trailing 5 year standard deviation of operating cash flows divided by average total assets.

Appendix B.
Fama-French 10 Industry Classification

Industry Code	Industry Name
1	Consumer non-Durables (Food, Tobacco, Textiles, Apparel, Leather, Toy)
2	Consumer Durables (Cars, TVs, Furniture, Household Appliances)
3	Manufacturing (Machinery, Trucks, Planes, Chemicals, Office Furniture, Paper, Computer Printing)
4	Energy (Oil, Gas, and Coal Extraction and Products)
5	Computer Equipment (Computers, Software, and Electronic Equipment)
6	Telephone and Television Transmission
7	Shops (Wholesale, Retail, Laundries, and Repair Shops)
8	Healthcare, Medical Equipment, and Drugs
9	Utilities
10	Other (Mines, Construction, Building, Transportation, Hotels, Bus Services, Entertainment, Finance)