Is working capital management value-enhancing? Evidence from firm performance and investments

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ABSTRACT

We examine the value effect of working capital management (WCM) for a large sample of US firms between 1982-2011. Our results indicate (i) the existence of an optimal level of working capital policy; and (ii) firms that converge to that optimal level (either by increasing or decreasing their investment in working capital) improve their stock and operating performance. We also document that corporate investment is the channel through which efficient WCM translates into superior firm performance. In particular, efficient WCM allows firms to redeploy underutilized corporate resources to higher-valued use, such as the funding of cash acquisitions.

JEL classification: G31; G32

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1. Introduction

Working capital management is a notion that traditionally appears in all standard corporate finance textbooks highlighting its importance for corporations. At the end of 2011, US firms' total investment in working capital (i.e., inventories plus receivables) amounted to $4.2 trillion, which accounts for 24% of their total sales and above 18% of the book value of their assets.[1] Almost 40% of this aggregate working capital has been financed by accounts payable (i.e., supplier credit), leading to an aggregate investment in net operating working capital (NWC) of $2.5 trillion.[2]

Practitioner-oriented articles emphasize that a substantial portion of working capital investment is not necessary. Ek and Guerin (2011) argue that there is tremendous latitude for improving the efficiency of working capital management (WCM) in most companies. Ernst & Young (2012), in its WCM report devoted to the leading 1,000 US companies in year 2011, highlights that the unnecessary portion of NWC represents between $330 billion and $590 billion. This range of cash opportunity corresponds to, respectively, between 3% and 6% of their aggregate sales.[3] Buchmann et al. (2008) stress that the power of NWC as a potential source of cash to fund growth is often neglected by companies. The following anecdotal evidence from the same authors is particularly interesting: "*[…] one company cut working capital by 30 percent and used the cash to fund a major acquisition in Asia without having to take on debt and the associated interest costs*."

The aforementioned practitioner view on WCM naturally raises the following questions. Do firms indeed over-invest in working capital as claimed by practitioners? To what extent does the decrease in unnecessary cash tied up in working capital translate into higher firm performance? Do firms cut

[1] Source: Compustat database.

[2] In its simplest expression net operating working capital (NWC) corresponds to inventories plus receivables minus accounts payable. Throughout the paper, instead of considering the component of NWC in isolation, we follow Sartoris and Hill (1983) and adopt an integrated cash flow approach to working capital management (see, e.g., Hill et al. (2010) and Kieschnick et al. (2013) for a similar approach).

[3] Our own estimate of the unnecessary portion of NWC in 2011 for our sample firms (3,431 firms) amounts to an aggregate value of $790 billion. This corresponds to 4.5% of their aggregate sales in 2011. To estimate the unnecessary portion of NWC for our sample firms in 2011, we sum all the positive industry-median adjusted NWC.

excessive working capital to fund capital expenditures and acquisitions? The aim of this paper is to provide answers to these questions.

The literature proposes several theoretical arguments to understand the relation between working capital and firm performance. On the one hand, additional investment in working capital is expected to have positive effects, in particular for firms with low level of working capital. This is because working capital allows firms to growth by increasing sales and earnings. Larger inventories are known, among other issues, to reduce supply cost, provide hedge against input price fluctuations, and minimize loss of sales due to potential stock-outs (see, e.g., Blinder and Maccini (1991), Fazzari and Petersen (1993) and Corsten and Gruen (2004)). Supplying credit to customers may also affect positively firm sales because it allows for price discrimination, serves as a warranty for product quality, and fosters long-term relationship with customers (see, e.g., Brennan et al. (1988), Long et al. (1993) and Summers and Wilson (2002)). On the other hand, overinvestment in working capital may generate adverse effects and lead to value destruction for shareholders. Like any investment, increases in working capital require additional financing, which in turn involves financing and opportunity costs (see, e.g., Kieschnick et al. (2013)). Therefore, *ceteris paribus*, firms that hold high working capital on their balance sheet potentially face also high interest expenses and bankruptcy risk.[4] Moreover, too much cash tied up in NWC might also impede firms from implementing value-enhancing investment projects in the short run (see, e.g., Ek and Guerin (2011)). The existence of potential benefits and costs implies therefore *a non-linear relation between working capital level and firm performance, with the expected relation being negative for firms with high level of working capital (i.e., overinvestment in NWC) and positive for firms with low level of working capital (i.e., underinvestment in NWC).*

For firms with excessive working capital, we propose corporate investment as a possible channel through which the decrease in unnecessary working capital from one period to the next translates into

[4] Concerning the financial risk associated with holding high working capital, the illustration in Shin and Soenen (1998) is particularly relevant. In 1994, Wal-Mart and Kmart were two similar companies in terms of capital structures, but Kmart had a substantially higher NWC relative to its sales in comparison to Wal-Mart. Kmart went into financial troubles essentially due to the financial costs of its poor WCM. The company closed 110 stores in 1994, and ultimately filed for Chapter 11 bankruptcy protection in 2002.

higher firm performance. If a firm cuts working capital to redeploy underutilized resources to higher-valued uses, working capital reductions should be associated with an increase in firm performance (see, e.g., Atanassov and Kim (2009) for similar arguments on asset sales). Motivated by prior literature which suggests that working capital could be considered as a source of internal fund (Fazzari and Petersen (1993) and Eckbo and Kisser (2013)), or substitute to cash (Bates et al. (2009)), we argue in this paper that corporate investment is a potential channel through which improvement in WCM should affect firm performance. Indeed, the decrease in unnecessary NWC through time increases firm's financial flexibility in the short run thanks to the release of unnecessary cash invested in working capital, and also in the long run thanks to relatively less financing needs to fund day-to-day operating activities. Additionally, financially flexible firms have a greater ability to take investment opportunities (see, e.g., Denis and Sibilkov (2010) and Duchin et al. (2010b)). For firms with unnecessary NWC, we therefore expect *a negative relation between NWC and corporate investment* (i.e., a positive relation between the decrease in unnecessary NWC across time and corporate investment). For firms with already low level of NWC, corporate investment sourced by working capital reductions is almost impossible. We therefore do not expect a negative relation between NWC and corporate investment for firms with underinvestment in NWC.

To assess the effect of WCM on firm performance and investment, we use a sample of 15,541 unique Compustat firms with available observations between 1982 and 2011. We first document that the cross-sectional average and median NWC-to-sales ratio has decreased significantly through time between 1982 and 2011, from 24% to 17%.[5] Then, we measure the effect of improvement in WCM on stock performance. We document, using fixed effects regressions, that the relation between excess NWC and stock performance is non-linear; the relation is negative for firms with positive excess NWC (i.e., positive industry-median adjusted NWC), and positive for firms with negative excess NWC. The results indicate the existence of an optimal level of NWC, and firms that converge to that optimal level increase their stock performance. The corresponding economic effect is quite substantial: a one standard deviation

[5] It is common in the literature to relate the firm's NWC to its sales.

decrease (increase) in positive (negative) excess NWC is associated with an increase of 0.90% (0.85%) in excess stock return over the next year.[6]

We next examine for firms that have unnecessary cash tied up in working capital whether corporate investment is a potential channel through which improvement in WCM translates into superior firm performance. Following Bates et al. (2009), we consider both capital expenditures and cash outflows associated with acquisitions as measures of corporate investment. Our results strongly support our conjecture as we find for firms with positive excess NWC that the release of unnecessary cash invested in working capital is positively associated with an increase in corporate investment over the next period. The corresponding economic effect is economically meaningful. A one standard deviation decrease in excess NWC is associated with an average increase of 0.60% in the unanticipated component of corporate investment (relative to total assets) over the next year. For the average firm in our sample, this corresponds to an increase in investment of $11.8 million. Among the components of corporate investment, the negative effect of positive excess NWC on total investment is essentially driven by the impact of excess NWC on cash acquisitions (which are known in the literature to be non-value decreasing, see e.g., Travlos (1987), Fuller et al. (2002) and Betton et al. (2008)). Firms in our sample appear therefore on average to increase cash acquisitions following the reductions in unnecessary NWC.

For firms with negative excess NWC, the relation between excess NWC and change in investment is positive, indicating that firms that are able to overcome their deficiency in working capital increase also their investment in fixed asset. Firms with negative excess NWC are firms that are relatively smaller, with volatile sales, higher R&D and growth opportunities. Taken together, our performance and investment results indicate that for firms with low NWC, the increase in working capital (i.e., the building up of working capital reserves) and fixed asset investments (i.e., the development of scale economies through additional capital expenditures) are associated with increasing firm performance.

[6] The economic effects are systematically computed using the average within-firm standard deviation, which is circa half of the sample standard deviation in our sample.

Finally, we perform three additional checks in order to assess the robustness of our findings. We first perform two complementary tests in order to provide additional evidence that corporate investment is the main channel through which WCM translates into superior firm performance. The first complementary test examines the effect of WCM on operating performance. The investment channel posits that future stock performance is negatively related to positive excess NWC because the release of cash allows the firm to undertake additional efficient investment. We therefore expect that future operating performance is also negatively related to excess NWC, in particular for firms that have positive excess NWC. This is exactly what we find using the return on assets (ROA) as a measure of operating performance.[7]

Our second complementary test looks at the effect of WCM on firm risk, because an excessively aggressive WCM might increase firm risk. Therefore, the negative relation between positive excess NWC and stock performance might be due to increasing firm risk following a decrease in NWC. We document an insignificant relation between excess NWC and firm risk for firms with positive excess NWC. Our results rule out therefore the risk channel as a potential driver of the negative relation between firm performance and positive excess NWC. For firms with negative excess NWC, the relation between NWC and firm risk is negative and consistent with the performance results (i.e., additional investment in working capital is associated with lower risk and higher stock and operating performance).

As a final robustness check, instead of using the industry-median adjusted NWC, we rely on a regression-based approach to estimate the excess NWC for a given firm in a given year. To do so, we adopt a two-step procedure. We first estimate using industry/year regressions the firm's working capital needs using variables known to affect the NWC-to-sales ratio (see, e.g., Hill et al. (2010)). Then, we use in the performance and investment regressions the standardized residual from the first stage as a measure

[7] The positive effect of a decrease in NWC through time on ROA is potentially implied by the DuPont equation as emphasized by Kieschnick et al. (2013). This argument however implies that the firm is able to keep its sales unaffected while decreasing its NWC. This is only possible if the firm had initially overinvested in NWC (i.e., above the optimum level). Otherwise, future sales and cash flows are likely to be affected by any non-optimal change in NWC.

of the firm's excess NWC.[8] The performance and investment results are qualitatively the same as the ones with the industry-median adjusted NWC.

Our study is related to prior works analyzing the performance effect of WCM within the US context. Using a linear model without fixed effects, Shin and Soenen (1998) uncover a negative contemporaneous relation between NWC and corporate profitability for a sample of US firms. Kieschnick et al. (2013), relying on a valuation framework similar to Faulkender and Wang (2006), report that for the average firm the incremental dollar invested in NWC is worth less than the incremental dollar held in cash. We extend these two studies by showing that the documented negative relationship between excess NWC and firm stock performance is confined to firms with abnormally high level of NWC. For firms underinvesting in working capital, we show that the relation between working capital and stock performance is positive, suggesting that there is an optimal level of working capital, and that firms converging to the optimal level (either by cutting unnecessary working capital or by increasing the investment in working capital for firms with underinvestment in NWC) increase their stock performance. Additionally, unlike prior literature, we importantly shed light on the role played by the investment channel, which serves as a plausible candidate to understand the value effect of WCM. Further, we broaden the scope of the literature by analyzing the effect of WCM on firm risk.

Our paper is also related to several international studies assessing the performance effect of working capital management. Deloof (2003) analyze a sample of Belgian firms and report a negative linear contemporaneous relation between NWC and operating performance, with the result being only significant in a specification without firm fixed effects. Banos-Caballero et al. (2012) focus on a sample of small and medium-sized Spanish firms, and document a concave relationship between NWC and operating performance. Finally, studying a sample of UK firms, Banos-Caballero et al. (2014) document an inverted U-shape relation between NWC and stock performance. We provide comparable evidence in a major market (i.e., the US), and extend these studies by emphasizing the investment channel to

[8] The standardization allows alleviating the errors-in-variable bias in the estimation of the excess NWC.

understand the value effect of WCM for firms with unnecessary cash tied up in working capital; we also analyze the effects of WCM on firm risk.

We organize the remainder of this article as follows: Section 2 describes the sample used in the empirical analysis and the considered empirical methods. Section 3 presents the empirical analysis of the relation between improvement in working capital management and firm performance and investment. Section 4 is devoted to additional results and robustness checks. Section 5 concludes the study.

2. Sample construction and empirical methods

2.1. Sample construction

We construct a sample of listed firms from the WRDS merged CRSP/Compustat files for the period 1982 to 2011. We exclude financial institutions, defined as firms with SIC codes inside the interval 6000-6999. In total, we have 15,541 unique firms in our main sample, with 140,508 firm-year observations.

The second column of Table 1 reports the number of sample firms in each year. The number of firms per year ranges from 3,431 in 2011 to 6,295 in 1997. The number of firms increases through time during the first half of the sample period, with the wave of dot.com IPOs being clearly apparent in the second half of the 1990s. The decrease in the number of listed firms after year 2001 is consistent with the increasing frequency of going private transactions after the passage of Sarbanes-Oxley Act of 2002 (see, Engel et al. (2007)).

We also provide in Table 1 the aggregate values for total assets, sales, cash holdings, net operating working capital (NWC) and the components of NWC for each sample year. All dollar values are in billions and converted to real values in 2005 dollars using the consumer price index (CPI). It is important to note that while the aggregate cash tied up in NWC is more than three times of the aggregate cash holdings at the beginning of the sample period, cash holdings become as important as the aggregate investment in NWC towards the end of the sample period. The last row in Table 1 reports the average yearly growth rate of the corresponding variables. Between 1982 and 2011, all the considered variables display a clearly increasing trend. In particular, total assets and sales grew on average at a yearly rate of

4.5% and 3.2%, respectively. Over the same period of time, the aggregate amount held in cash has grown at a higher rate relatively to total assets (and sales), a pattern which is consistent with Bates et al. (2009). The aggregate amount invested in NWC increased less relatively to total assets, sales and cash holdings, with an annual growth rate of 2.6%. Among the three components of NWC, inventories have grown less (annual growth rate of 1.9%) in comparison to receivables and payables (annual growth rate of 4%). These patterns indicate that firms hold on average relatively less working capital through time, and in particular inventories.

[Please Insert Table 1 About Here]

Figure 1 reports the cross-sectional average and median NWC-to-sales ratio from 1982 to 2011. The average (median) NWC-to-sales ratio over this period is approximately 20% (19%). The decreasing time trends in average and median NWC-to-sales ratio are clearly apparent in Figure 1. The yearly average (median) NWC-to-sales declined from 24% (22%) in 1982 to 17% (15%) in 2011. The cross-sectional standard deviation of the NWC-to-sales ratio per year, reported also in Figure 1, also (slightly) decreases over the sample period, indicating that firm heterogeneity in terms of NWC-to-sales ratio did not increase through time.

[Please Insert Figure 1 About Here]

To analyze whether the time trend in the NWC-to-sales ratio between 1982 and 2011 is statistically significant, we regress the NWC-to-sales ratio on a constant and time measured in years (not reported in a table). The coefficient on the time trend for the average NWC-to-sales ratio corresponds to a yearly decrease of –0.32% and has a *p*-value below 0.01. The R-square of the regression is 92%. For the median, the slope coefficient represents a 0.28% yearly decrease. It also has a *p*-value below 0.01. The R-square is 95%. This indicates the existence of a significant decreasing time trend in NWC-to-sales ratio over the sample period.

To assess which one of the three components of the NWC contributed the most in the decrease of the NWC-to-sales ratio, we report in Figure 2 the evolution through time of the average inventories, receivables and payables, scaled by sales. The three components of the NWC-to-sales ratio decreased

significantly through time, but the decrease is relatively more pronounced for the average inventories-to-sales ratio. The substantial decrease in inventories though time is most commonly attributed to the widespread adoption of Just-in-Time (JIT) inventory system (see, e.g., Chen et al. (2005) and Gao (2014) for a review of the literature devoted to JIT). Unreported results indicate that the slope coefficients of the linear time trend for inventories, receivables and payables are –0.25%, –0.14% and –0.07%, respectively. The three slope coefficients are statistically significant with *p*-values below 0.01. The corresponding R-squares are 95% for inventories, 74% for receivables, and 29% for payables.

[Please Insert Figure 2 About Here]

The sample composition changes through time, due to some firms entering and others leaving the sample. Unreported results show that the time series pattern of the average and median NWC-to-sales ratio is not affected by the changing sample composition. For the subsample of 643 surviving firms (i.e., firms that are in the sample since 1982), the average NWC-to-sales ratio moves from 23% to 19% over the sample period. In comparison to firms that are entering and exiting the sample in a given year, firms that remain in the sample are not the most efficient ones in terms of WCM. Moreover, firms entering the sample in a given year do not have systematically lower working capital ratio than firms exiting the sample. So the decreasing patterns highlighted in Figure 1 cannot be attributed solely to changing sample composition.[9]

We also perform industry analyses to examine whether the decreasing pattern in NWC through time documented in Figure 1 is a common trend or just confined into a subset of specific industries. To group firms into industries, we use the Fama-French 49-industry classification. We remove the four industries related to financial activities (i.e., banking, insurance, real estate, and trading). For each industry, Table 2 reports the median and the cross-sectional standard deviation of the NWC-to-sales ratio for the first (1982) and last (2011) year of our sampling period. The distribution of the median and standard deviation indicate the existence of high heterogeneity in terms of working capital practices across industries. Using all the 30 annual observations between 1982 and 2011, we regress both the median and the standard

[9] These results are available upon request.

deviation of the NWC-to-sales ratio on a time trend with intercept for each industry. Columns 3 and 4 of Table 2 report the coefficient estimate of the time trend variable. Concerning the evolution of the median NWC-to-sales ratio through time, our regressions indicate that the time trend is negative for 41 industries (out of 45), and the slope coefficient is statistically significant for 34 of those industries.[10] Interestingly, the coefficient estimates of the time trend variable for the standard deviation is also negative for most of the industries (for 38 industries out of 45), and it is statistically significant for 26 industries (see column 4 in Table 2). These two results indicate that the decrease in NWC is a common phenomenon across a large set of industries, and the heterogeneity in terms of working capital management has also decreased through time in most industries. The industries that saw the most important decline in NWC through time are computers, pharmaceuticals, electronic equipment, medical equipment, measuring and control equipment, apparel, among others.

[Please Insert Table 2 About Here]

2.2. Variable definitions and empirical methods

2.2.1. Independent variable of interest

As highlighted in Table 2, working capital needs and practices are different from one industry to another (see, e.g., Hill et al. (2010) for similar arguments and evidence). It is therefore important to control for changing industry characteristics. To control for industry effects, we use the industry-median adjusted NWC-to-sales ratio as main variable of interest. We subtract from the NWC-to-sales ratio of a given firm the ratio of the median firm in the corresponding industry/year, and denote the corresponding variable *excess NWC* throughout the paper. For every firm in a given year, *excess NWC* measures the unnecessary cash tied up in working capital.[11] A positive excess NWC indicates that the firm is over-investing in working capital. This implies that there is room for the firm to increase the efficiency of its WCM across time by adopting a relatively more aggressive working capital policy (such as by reducing

[10] We obtain similar pattern with the industry mean NWC-to-sales ratio (unreported).

[11] In addition to the use of the industry-median adjusted NWC, we also assess the robustness of our results in Section 4 by relying on a regression-based approach in order to determine the excess NWC for a given firm in a given year.

inventories and payment delays granted to customers). A negative excess NWC indicates that the firm is currently adopting an extremely aggressive working capital policy, which potentially increases the risk of sales loss essentially due to potential stock-outs and customer dissatisfactions driven by aggressive receivable collections (see, e.g., Fazzari and Petersen (1993), Corsten and Gruen (2004) and Kieschnick et al. (2013)). In this case, additional investment in working capital is expected to be more valuable because, among others, larger inventories can prevent input shortages and interruptions in the production process (see, e.g., Blinder and Maccini (1991)); further, increasing trade credit supply can stimulate sales because it allows for price discrimination, serves as a warranty for product quality, and fosters long-term relationship with customers (see, e.g., Brennan et al. (1988), Long et al. (1993) and Summers and Wilson (2002)). We implicitly assume that the efficient NWC of the firm (i.e., the NWC level adopted by a shareholder value maximizing manager who trade-offs benefits and costs of investment in working capital) is the one which leads to the industry-median NWC level (i.e., insignificant excess NWC).

The summary statistics presented in Table 3 show that the average NWC-to-sales ratio is 19.99%, a figure which is very close to the 19.79% reported by Hill et al. (2010). Concerning the industry-median adjusted NWC-to-sales ratio (i.e., excess NWC), the mean is 1.20% and the median 0.00% by construction.

2.2.2. Dependent variables

We use excess stock return adjusted for firm size and market-to-book as a measure of stock performance. Following Barber and Lyon (1997), we define excess return for time *t* as the difference between the return of the buy-and-hold investment in the sample firm *i* less the return of the buy-and-hold investment in a benchmark portfolio:

$$(1) \qquad Excess\ return_{i,t} = \prod_{m=1}^{T}(1 + R_{i,m}) - \prod_{m=1}^{T}(1 + R_{p,m}),$$

where $R_{i,m}$ is the return for firm i, $R_{p,m}$ is the return of the benchmark portfolio for month m, and T is the investment horizon in number of months. We compute excess returns over 1-year horizon (T = 12). Following Daniel and Titman (1997), the benchmark portfolios are the twenty-five Fama-French value-

weighted portfolios constructed by independently sorting stocks on size (ME) and book-to-market (BE/ME) characteristics.[12] Each sample firm is assigned to a size and book-to-market portfolios using Fama-French ME and BE/ME breakpoints.[13]

Following Bates et al. (2009), we consider both capital expenditures (CAPEX) and cash outflows associated with acquisitions as measures of corporate investment. The investment variables are scaled by total assets at the beginning of the period. We use the change in investment as our dependent variable in the investment regressions, because in an efficient capital market only the unanticipated component of the investment is expected to be associated with superior stock performance (see, e.g., McConnell and Muscarella (1985)). Moreover, the use of the change in investment as dependent variable controls to some extent for the maintenance investment (i.e., the investment which is necessary for the firm to keep functioning at current levels of growth in a competitive environment), and allows focusing only on the part of the investment devoted to firm growth.

Some of our tests use also measures of operating performance and firm risk as dependent variables. We use the return on assets (ROA) as a measure of operating performance. Following Coles et al. (2006), our proxy for firm risk is the annualized standard deviation of daily stock returns (see also, e.g., Armstrong and Vashishtha (2012)).

Table 3 reports summary statistics for the dependent variables. The median firm has a 1-year excess stock return of –11.86%, while the mean excess return is –2.82%, consistent with the distribution of excess stock returns being positively skewed (see, e.g., Barber and Lyon, 1997).[14] The 1-year ROA has a mean value of 5.01% in our sample, while the median is 10.62%, indicating that the distribution of ROA is negatively skewed in our sample. The mean CAPEX and cash acquisition represent 7.64% and 3.10% of total assets, respectively. These two variables are positively skewed.

[Please Insert Table 3 About Here]

[12] For other applications of the 25-portfolio approach to compute excess stock returns see also Faulkender and Wang (2006) and Denis and Sibilkov (2010).
[13] ME and BE/ME breakpoints are available on Kenneth French's website.
[14] The non-zero mean excess return is mainly due to the winsorization of the variable at the 1st and 99th percentiles. The mean of the 1-year excess return before winsorization is much lower with a value of –0.003 in our sample.

2.2.3. Econometric specifications and methods

We study the impact of excess NWC on firm performance and investment using the following linear regression specification:

$$V_{i,t} = \alpha_t + \eta_i + \beta_1\, Excess\ NWC_{i,t-1} + \beta_2\, Controls_{i,t-1} + \varepsilon_{i,t}, \quad (2)$$

where, V is the dependent variable measuring either firm performance or investment, and α_t and η_i represent year and firm fixed effects, respectively. Given the panel structure of our dataset and the use of fixed effects, a negative (positive) β_1 coefficient measures the increase (decrease) in firm performance or investment associated with a one unit decrease in *excess NWC* across time. Control refers to a set of control variables known to affect firm performance or investment.

In Equation (2), all right-hand side variables are lagged by one period in order to alleviate the concern that net operating working capital, firm performance, and corporate investment may be simultaneously determined in equilibrium. To control for time-invariant firm characteristics, all regressions include firm fixed effects, which allows mitigating missing variable issues. The inclusion of year fixed effects controls for changing economic and financing conditions through time. It is also important to note that industry fixed effects are indirectly controlled for through the use of industry-median adjusted NWC. We also cluster standard errors at the firm level for the statistical tests to account for heteroskedasticity and auto-correlation at the firm level (see Petersen (2009), Thompson (2011)). Throughout the study, we winsorize all variables at the 1st and 99th percentiles to mitigate the influence of extreme values.

To examine whether the relation between excess NWC and firm performance (or investment) is nonlinear, we rely on an asymmetric model, in which we allow the slope coefficient of the considered regression model to be different for positive and negative excess NWC. The considered nonlinear specification is the following one:

$$V_{i,t} = \alpha_t + \eta_i + \gamma_1 \left[Excess\ NWC_{i,t-1} \times D \right] + \gamma_2 \left[Excess\ NWC_{i,t-1} \times (1 - D) \right] + \gamma_3\, Control_{i,t-1} + \varepsilon_{i,t}, \quad (3)$$

where, D is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., abnormally high cash tied up in net working capital), and 0 otherwise.

Our performance and investment regressions include firm-specific control variables known to determine working capital levels, and their omission could raise concerns about missing factors correlated with the main independent variable. Following Hill et al. (2010), we employ a large set of firm characteristics as control variables: sales volatility, 1-year sales growth rate, operating cash flow, and a dummy variable for financial distress. Damodaran (2012) argues that mature firms require less working capital per unit of sales. We therefore also consider firm age as an additional control variable. Bates et al. (2009) document the existence of a substitution effect between cash reserves and working capital through time. To alleviate the concern that our results might be driven by this substitution effect, we systematically use cash reserves as an additional control variable in all of our specifications.

Moreover, in the performance regressions, following the literature, we consider as additional control variables the market value of equity (as a proxy for firm size), leverage, risk, and intangible assets (see, e.g., Coles et al. (2008), Duchin et al. (2010a)). Future stock performance is also related to R&D expenses (see, e.g., Chan et al. (2001)) and asset growth (see, e.g., Cooper et al. (2008), Lipson et al. (2011)). To control for the asset growth effect, we use fixed asset growth instead of total asset growth, because the latter includes also components of the working capital. In the investment regressions, in addition to firm size, leverage, and risk, we also include variables known to be correlated with growth opportunities, such as cash flow, Tobin's Q, and sales growth (see, e.g., Lang et al. (1996)). Variable definitions are in Appendix. Summary statistics for the considered control variables can be found in Table 3.

2.3. Preliminary analysis

Table 4 reports the average and median values of our dependent and control variables for subsamples based on the sign of the excess NWC. For each variable, the last two columns display the *p*-values from a test of mean and median differences between negative and positive excess NWC subsamples, respectively.

In comparison to firms with negative excess NWC, firms with positive excess NWC have on average significantly lower stock performance. They also invest on average less in capital expenditures, but undertake slightly more cash acquisitions. Firms with negative excess NWC are smaller, younger and slightly riskier than firms with positive excess NWC. They also tend to have on average more volatile sales and R&D, and less operating cash flows, as well as higher growth opportunities (see for example the variables Tobin's Q and sales growth).

[Please Insert Table 4 About Here]

The evidence reported in Table 4 indicates that firm characteristics are significantly different between the two subsamples (positive versus negative excess NWC subsamples). It is therefore important to control for these characteristics in the multivariate analyses. To further investigate the relation between excess NWC, firm performance, and investment, in the next sub-section, we rely on a multivariate framework and control for the panel structure of our data set.

3. Empirical evidence

This section first explores the relationship between excess NWC and stock performance. Then, we assess whether corporate investment is a potential channel through which working capital management (WCM) translates into higher firm performance.

3.1. WCM and stock performance

Table 5 presents the stock performance regressions. The dependent variable is the 1-year excess return. All the independent variables are lagged by one year with respect to the dependent variables, and all specifications include firm and year fixed effects. The variable of interest is the excess NWC, a variable measuring the deviation of the firm's NWC with respect to the industry median. Columns 1 and 2 report the results for the linear model, and columns 3 and 4 for the asymmetric model. The relation between excess NWC and stock performance is negative in column 1. However, this negative relation is not robust to the inclusion of control variables in column 2.

All firms do not have the means to reduce their NWC. For firms with already low level of NWC, further reduction might increase substantially the risk of stock-outs and sales, thus affecting negatively their performance. Therefore, only the reduction of the unnecessary cash tied up in working capital (i.e., positive excess NWC) is expected to lead to superior firm performance. To capture this potential non-linearity in the relation between excess NWC and stock performance, we allow the slope coefficient to be different for positive and negative excess NWC. In columns 3 and 4, the regression specifications include two interaction variables: the first variable, *excess NWC* × *D*, interacts the excess NWC with a dummy variable identifying firms with positive excess NWC, and the second variable, *excess NWC* x (1 – *D*), interacts the excess NWC with a dummy variable identifying firms with negative excess NWC. The results in column 4 indicate that the decrease in excess NWC in the previous year is positively associated with stock performance over the subsequent year *only* for firms that have positive excess NWC. For firms with negative excess NWC, it is the increase in excess NWC that is associated with increasing stock performance. The coefficient estimates of the first interaction term (*excess NWC* × *D*) and the second interaction term (*excess NWC* × (1 – *D*)) are statistically significant with values of –0.0731 (*p*-value = 0.02) and 0.0687 (*p*-value = 0.07). The corresponding economic effects are quite substantial: a one within firm standard deviation decrease (increase) in positive (negative) excess NWC is associated with an increase (decrease) of 0.90% (0.85%) in excess stock return over the next period. The result in column 4 suggests that there is an optimal level of working capital, and firms that converge to that optimal level through time increase their stock performance by a significant amount.

[Please Insert Table 5 About Here]

Concerning the control variables, the coefficient estimates of firm size, leverage, age, R&D, risk, cash flow, and financial distress are statistically significant at conventional levels. Consistent with the literature, stock performance decreases with leverage and firm size (see, e.g., Faulkender and Wang (2006), Duchin et al. (2010a)), and increases with R&D expenses (Chan et al. (2001)). Stock performance is also negatively associated with firm age, financial distress, and positively associated with cash flow as

intuitively expected. In Table 5, we also use the variable fixed asset growth to control for the asset growth effect, but its coefficient estimate is statistically insignificant at conventional levels.

3.2. WCM and investment

The performance regressions suggest that firms that are able to reduce the level of their unnecessary NWC are increasing their stock performance. In addition, for firms with deficient investment in working capital, it is the increase in NWC which leads to superior performance. In this sub-section, our aim is to assess whether corporate investment is a potential channel through which the decrease in excess NWC across time translates into superior firm performance.

For firms with unnecessary working capital, the improvement in WCM increases firm's financial flexibility in the short run thanks to the release of unnecessary cash tied up in working capital, and also in the long run due to relatively less financing needs to fund day-to-day operating activities. Financially flexible firms have a greater ability to take investment opportunities (see, e.g., Denis and Sibilkov (2010), Duchin et al. (2010b)). Therefore, the decline in excess NWC is expected to lead to increasing corporate investment. Table 6 tests this idea relying on the asymmetric model and using the change in investment ratio as dependent variable. Column 1 considers the change in total investment, while columns 2 and 3 report on the change in CAPEX and the change in cash acquisitions as dependent variable, respectively. All the independent variables are lagged by one period with respect to the dependent variables, and all specifications include firm and year fixed effects. The dummy variable *D* identifies positive excess NWC. In column 1, the coefficient estimate of *excess NWC* × *D* is negative and statistically significant with a value of –0.0489 (*p*-value = 0.00), while the coefficient of *excess NWC* × (1 – *D*) is positive and statistically significant with a value of 0.0559 (*p*-value = 0.00). It is important to note that the asymmetric effect of excess NWC on corporate investment parallels the asymmetric effect of excess NWC on firm performance. The decrease in excess NWC in the previous year leads to increasing corporate investment over the subsequent year *only* for firms that have abnormally high investment in working capital. A one within firm standard deviation decrease in excess NWC is associated with an increase of 0.60% in the

unanticipated component of corporate investment (relative to total assets) over the next period. For the average firm in our sample, this corresponds to an increase in investment of $11.8 million. For firms with negative excess NWC, the relation between excess NWC and change in investment is positive, indicating that firms that are able to overcome their deficiency in working capital increase also their investment in fixed asset. As highlighted in Table 4, firms with negative excess NWC are firms that are relatively smaller, with volatile sales, higher R&D and growth opportunities. Taken together, the results in Tables 4 to 6 suggest that negative-excess-NWC firms that increase their NWC (i.e., building up working capital reserves), and thus the scale of their operating activities through fixed asset investment, are also the ones that increase their performance.

[Please Insert Table 6 About Here]

Concerning the component of investment, the asymmetric model provides also interesting results for CAPEX and cash acquisitions. The coefficient estimate of positive excess NWC is –0.0407 and statistically significant with a *p*-value of 0.00 in the acquisition regression (see column 3), while it is insignificant in the CAPEX regression. These results indicate that firms with unnecessary working capital cut their working capital in order to fund additional cash acquisitions, and not additional CAPEX. For firms with negative excess NWC, the coefficient estimate of excess NWC is positive and statistically significant in both CAPEX and cash acquisition regressions.

To sum-up, the results in this section indicate that the decrease in NWC for firms with abnormally high investment in working capital is associated with increasing firm performance, because firms channel the cash release from unnecessary investment in working capital towards efficient investments. For firms with low level of working capital, it is the additional investment in working capital which is associated with higher stock performance and corporate investment.

4. Additional results and robustness checks

We first assess the robustness of the investment channel as the main channel through which WCM translates into superior firm performance by performing two complementary tests. These two tests assess

the impact of WCM on operating performance and firm risk, respectively. Finally, we adopt a regression-based approach to measure excess NWC and revisit our main analyses.

4.1. WCM and operating performance

The investment channel suggests that future stock performance is negatively related to excess NWC because the release of cash allows the firm to undertake additional efficient investment. If this is the main explanation, then these additional efficient investments should also lead to increasing operating performance in the future, ruling also out concerns that our stock performance results are driven by market inefficiency. We therefore expect that operating performance is also negatively related to positive excess NWC.

Table 7 reports the regression results on operating performance. We use the same econometric approach and the same set of control variable as in Table 5. The dependent variable is the next year return on assets (ROA). Column 1 reports the estimation results of the linear model. The coefficient estimate of excess NWC is negative and statistically significant with a *p*-value of 0.07. Column 2 reports the result of the asymmetric model. For positive and negative excess NWC, the coefficient estimates are –0.1104 and 0.1007, respectively (with both *p*-values being equal to 0.00). These results parallel to a large extent the ones on stock performance and corporate investment, and indicate that a decrease in excess NWC leads to an increasing operating performance over the subsequent period *only* for firms that have unnecessary working capital. For firms that have abnormally low investment in working capital, it is the increase in excess NWC across time which is associated with superior operating performance. Hence, for those firms, overcoming deficiency in working capital allows them to also increase their operating performance. The economic effects are quite strong: for firms that have abnormally high (low) cash tied up in NWC, a one within firm standard deviation decrease (increase) in excess NWC is associated with an increase of 1.36% (1.24%) in ROA over the next year.

Overall, the operating performance results suggest also that there is an optimal level of working capital, and corporate managers that are able to get closer to this optimal level, either by reducing or

taking additional investment in working capital, increase the operating performance of their firms. With regards to the control variables, intangible assets, age, R&D, cash reserves and financial distress dummy carry a negative and significant coefficient at the 1% level, while firm size, leverage, cash flow, sales volatility and sales growth are positively associated with ROA again at the 1% significance level.

[Please Insert Table 7 About Here]

4.2. WCM and firm risk

Firm risk is a plausible alternative explanation for the increase in stock performance following a decrease in working capital. A firm adopting an excessively aggressive WCM might increase firm risk, among others, because of fluctuations in supply cost and loss of sales due to potential stock-outs (see, e.g., Blinder and Maccini (1991), Fazzari and Petersen (1993) and Corsten and Gruen (2004)). Therefore, the negative relation between NWC and firm performance might be due to increasing firm risk following a decrease in NWC. To assess whether the risk channel drives our performance results, we regress firm risk on excess NWC and a set of determinants. Table 8 reports the results. Following, Coles et al. (2006), the proxy used for firm risk is the annualized standard deviation of firm daily returns (see also, e.g., Armstrong and Vashishtha (2012)). On top of time invariant firm characteristics, the considered determinants taken from the literature are firm size, leverage, book-to-market and sales growth (see, e.g., Coles et al. (2006), Armstrong and Vashishtha (2012)). The regression controls also for year dummies and for variables known to affect working capital.

Column 1 of Table 8 shows the result of the linear model, and column 2 gives the estimation results of the asymmetric model. In the linear model, excess NWC is negatively related to firm risk, indicating that an aggressive NWC policy increases firm risk over the next period. However, the asymmetric model in column 2 of Table 8 shows that the negative relation between excess NWC and firm risk is driven by firms that have negative excess NWC. For firms with positive excess NWC, the relation between NWC and firm risk is not statistically significant. This indicates that the release of unnecessary cash tied up in working capital does not lead to increasing firm risk, a result which rules out the risk channel as a

potential driver of the negative relation between firm performance and positive excess NWC. For firms with negative excess NWC, the relation is negative and consistent with the performance results. Additional investment in working capital reduces firm risk (and increases stock and operating performance) for firms that have working capital deficiencies.

Concerning the control variables, the sign of the coefficient estimates are broadly consistent with the literature. Firm risk decreases with size, cash reserves and cash flow, and it increases with leverage, book-to-market and financial distress (see, e.g., Coles et al. (2006)).

[Please Insert Table 8 About Here]

4.3. Regression-based approach to estimate excess NWC

In Tables 5 to 8, the main variable of interest is the industry-median adjusted NWC-to-sales ratio, denoted *excess NWC*. In this sub-section, as an alternative approach, we rely on a regression-based approach to estimate the excess NWC. To do so, we first estimate the firm's normal NWC-to-sales ratio in year *t* using a linear regression with the following determinants taken mainly from Hill et al. (2010): sales volatility, 1-year sales growth rate, operating cash flow, age, and a dummy variable for financial distress (variable definitions are in Appendix). We regress the NWC-to-sales ratio on these determinants separately for each industry/year, such that our procedure controls implicitly for industry and year effects. To group firms into industries, we use the Fama-French 49-industry classification. We remove the four industries related to financial activities (i.e., banking, insurance, real estate, and trading). In total, we have 45 industries and 30 years, leading by construction to 1,350 industry/year regressions. However, for some industry/years in our sample, we do not have sufficient observations to run the corresponding regressions. The first-stage regression estimation is therefore only possible for 1,296 industry/years.[15]

For every firm in a given year, the excess NWC is the residual of the corresponding first-stage regression (i.e., NWC-to-sales ratio minus its predicted value from the regression), and measures the

[15] The first-stage regressions are not tabulated for brevity. The first-stage regressions use on average 113 observations. The average adjusted R^2 is 12.42%, which is in the same range as in Hill et al. (2010). The average Fisher-statistic is 4.15, indicating that on average the considered regression model fits the data sufficiently well.

unnecessary cash tied up in working capital. Given that observed excess NWC is derived from a first-stage statistical procedure, estimation errors at the first stage might have an impact on the validity of inferences drawn in the second stage. To alleviate this concern, we standardize the excess NWC by its standard error, and use the standardized excess NWC as independent variable in Table 9. The standardization procedure allows to put more weight on statistically significant excess NWC and to reduce the observed heteroskedasticity.

Panel A reports the results for stock performance and operating performance as dependent variables in columns 1 and 2, respectively. Panel B presents the estimation results for the investment regressions. Positive excess NWC is negatively and statistically significantly related to both stock and operating performance as well as corporate investment. The coefficient estimate of negative excess NWC is positive as expected in all regressions, but it is statistically significant only for the ROA and CAPEX regressions.

[Please Insert Table 9 About Here]

6. Conclusion

This paper provides comprehensive evidence of a relationship between WCM and firm performance using an exhaustive US sample over a 30-year period between 1982 and 2011. We document the existence of an optimal level of working capital investment. Firms that converge to that optimal level, either by increasing or decreasing their investment in working capital, improve their stock and operating performance over the subsequent period. We also uncover that corporate investment is the channel through which efficient WCM translates into superior firm performance. Our results emphasize that firms appear to redeploy underutilized working capital resources to more efficient uses, such as funding growth investment. Our study implies that efficient WCM is highly valuable, particularly in periods of expanding investment opportunity set. We also rule out the possibility that the results are driven by increasing firm risk following the adoption of aggressive working capital policy.

Our results have also important corporate policy implications. Given the magnitude of working capital as a proportion of firm assets, corporate managers should put greater emphasis on maximizing its

utility at the benefit of their shareholders. In particular, our findings imply that corporate managers should avoid holding too much cash unnecessarily tied up in working capital and target an optimal level of working capital. Such efficient management would provide a new source of internally-generated funds, which could be ultimately employed in more profitable investment opportunities at the benefit of firms' shareholders.

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Appendix: Variable Definitions

(Note: Compustat is the source of variables referred to by capital letters and italic)

NWC: Net operating working capital (inventories (*INVT*) plus receivables (*RECT*) minus accounts payable (*AP*)).

NWC-to-sales ratio: NWC divided by sales (*SALE*).

Excess NWC: NWC-to-sales ratio minus the industry median of the NWC-to-sales ratio in the corresponding year. To group firms into industries, we use the Fama-French 49-industry classification.

Sales volatility: Following Hill, Kelly, and Highfield (2010), sales volatility for a given year is the standard deviation of a firm's annual sales over the previous five-year period. Firm-year observations are included in the sample for a given year if the firm has at least three observations during the previous five-year period.

Sales growth: One-year growth rate of sales at time *t*: $(SALE_t - SALE_{t-1})/ SALE_{t-1}$.

Cash flow: Operating income before extraordinary items (*IB*) + depreciation (*DP*), scaled by lagged fixed assets (*PPENT*).

Financial distress dummy: Following Hill, Kelly, and Highfield (2010), a firm is financially distressed if two criteria are met: (1) the firm faces difficulty to cover its interest expenses and (2) the firm is overleveraged. The firm faces difficulty to cover its interest expenses if its interest coverage ratio (i.e., operating income before depreciation divided by interest expense) is below one for two consecutive years or less than 0.80 in any given year. The firm is considered to be overleveraged if it is in the top two deciles of industry leverage in a given year.

Age: Number of years since first trading date on CRSP. The regression uses the log of this variable.

Tobin's Q: The market value of equity (*PRCC* times *CSHO*) plus total assets (*AT*) minus the book value of equity (*ceq*+*txdb*), divided by total assets (*AT*).

1-year excess return: Buy-and-hold excess stock return over the calendar year defined as $\prod(1 + R_{i,m}) - \prod(1 + R_{p,m})$, where $R_{i,m}$ and $R_{p,m}$ are the return for firm *i* and the return of the benchmark portfolio for month *m*. Benchmark portfolios are the twenty-five Fama-French value-weighted portfolios based on size and book-to-market.

1-year ROA: Operating income before depreciation (*OIBDP*) divided by total assets (*AT*).

CAPEX: Capital expenditures (CAPX), scaled by total assets at the beginning of the period (*AT*).

Cash acquisition: Cash acquisitions (*AQC*), scaled by total assets at the beginning of the period (*AT*).

R&D: Research and development expenditure to total assets, computed as in Coles, Daniel, and Naveen (2008).

Investment: CAPEX plus cash acquisition, scaled by total assets at the beginning of the period.

Fixed asset growth: One-year growth rate of fixed assets (*PPENT*) at time *t*–1: $(PPENT_{t-1} - PPENT_{t-2})/ PPENT_{t-2}$.

Market value of equity: Market value of the firm's equity at the end of the corresponding year: *PRCC* x *CSHO*. The regressions use the log of the variable.

Risk: Standard deviation of daily stock returns. In the regression analyses, we use the annualized standard deviation.

Leverage: Total debt, scaled by total assets: (*DLTT* + *DLC*)/*AT*.

Intangible assets: Intangible assets (*INTAN*), scaled by total assets.

Sales growth: One-year growth rate of sales at time *t*–1: $(SALE_{t-1} - SALE_{t-2})/ SALE_{t-2}$.

Book-to-market: Book value of equity (*CEQ*) divided by market value of equity (*PRCC* times *CSHO*).

Cash reserves: Cash and cash equivalent (*CHE*), scaled by total assets.

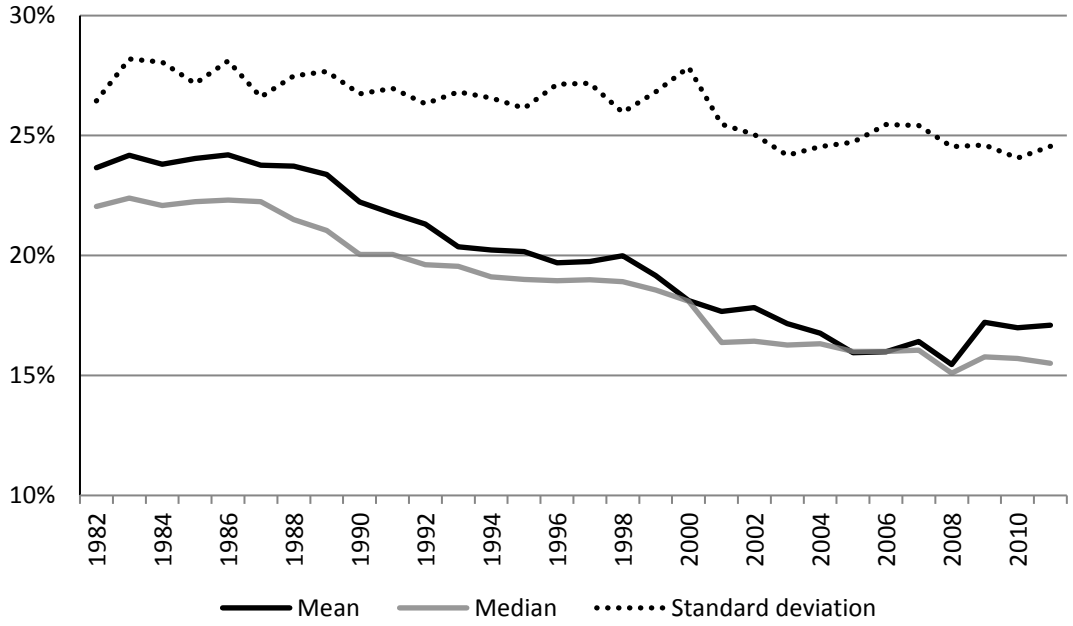

Figure 1. Time series of summary statistics for NWC-to-sales ratio. This figure plots cross-sectional summary statistics for NWC-to-sales ratio for US non-financial firms by year from 1982 to 2011. NWC corresponds to inventories plus receivables minus accounts payable.

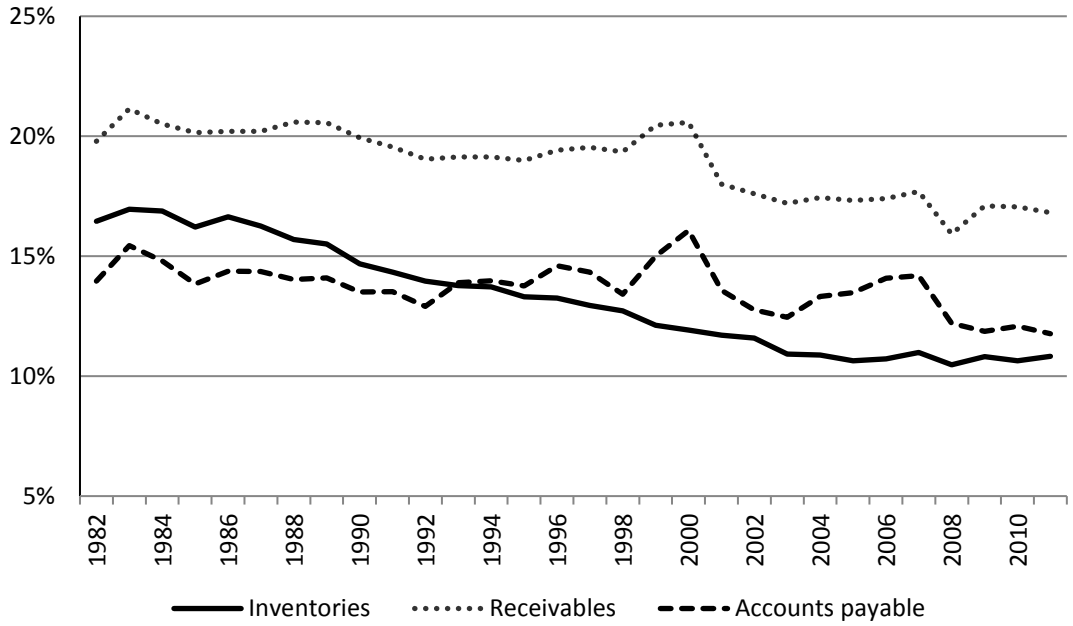

Figure 2. Yearly average inventories, receivables and accounts payable. This figure plots the cross-sectional average for inventories, receivables, and payables scaled by sales for US non-financial firms by year from 1982 to 2011.

Table 1

Aggregate Values by Year.

The table reports yearly aggregate values for total assets, sales, cash holdings, net operating working capital (NWC) and its component. NWC corresponds to inventories (INV) plus receivables (REC) minus accounts payable (AP). The sample contains listed non-financial firms from the WRDS merged CRSP/Compustat files for the period 1982 to 2011. The sample includes 140,508 observations for 15,541 unique firms. All dollar values are in billions and adjusted to 2005 dollars by the consumer price index. *N* is the number of firms. The last row displays the annual growth rate of the corresponding variables.

Year	N	Assets	Sales	Cash	NWC	INV	REC	AP
1982	3, 918	5, 243	5, 928	304	981	725	714	458
1983	4, 306	5, 380	5, 915	393	951	685	751	485
1984	4, 386	5, 497	6, 090	382	992	707	766	481
1985	4, 346	5, 687	6, 064	399	1, 004	702	800	498
1986	4, 481	5, 945	5, 845	476	1, 026	696	810	479
1987	4, 670	6, 381	6, 295	538	1, 112	747	902	537
1988	4, 585	7, 346	6, 680	548	1, 582	770	1, 464	653
1989	4, 463	7, 708	6, 892	561	1, 677	790	1, 564	677
1990	4, 439	8, 103	7, 231	563	1, 685	822	1, 589	725
1991	4, 520	8, 313	7, 220	591	1, 651	818	1, 537	703
1992	4, 701	8, 453	7, 371	623	1, 593	813	1, 468	688
1993	5, 161	8, 933	7, 673	659	1, 663	835	1, 545	717
1994	5, 459	9, 586	8, 397	718	1, 805	902	1, 667	763
1995	5, 687	10, 146	8, 985	734	1, 977	979	1, 829	832
1996	6, 191	10, 893	9, 506	808	1, 983	985	1, 895	897
1997	6, 295	11, 454	10, 037	834	2, 052	997	1, 978	923
1998	5, 961	12, 541	10, 330	944	2, 088	1, 032	2, 028	973
1999	5, 772	14, 350	10, 995	1, 091	2, 133	1, 063	2, 238	1, 168
2000	5, 648	16, 112	12, 137	1, 207	2, 162	1, 121	2, 378	1, 337
2001	5, 096	16, 074	11, 973	1, 245	2, 161	1, 054	2, 347	1, 240
2002	4, 696	16, 097	11, 809	1, 361	2, 147	1, 067	2, 369	1, 289
2003	4, 417	17, 223	12, 723	1, 661	2, 227	1, 132	2, 455	1, 359
2004	4, 377	17, 922	13, 965	1, 813	2, 442	1, 243	2, 678	1, 479
2005	4, 275	17, 627	14, 017	1, 730	2, 463	1, 234	2, 649	1, 421
2006	4, 184	18, 364	14, 827	1, 705	2, 392	1, 301	2, 577	1, 487
2007	4, 028	18, 382	14, 655	1, 655	2, 393	1, 287	2, 547	1, 441
2008	3, 810	17, 488	14, 994	1, 567	2, 255	1, 220	2, 280	1, 245
2009	3, 644	18, 114	12, 919	1, 907	2, 074	1, 145	2, 176	1, 247
2010	3, 561	19, 072	14, 168	2, 100	2, 120	1, 226	2, 284	1, 389
2011	3, 431	19, 401	15, 184	2, 025	2, 136	1, 290	2, 297	1, 452
Growth rate	N/A	4.5%	3.2%	6.5%	2.6%	1.9%	4.0%	3.9%

Table 2

Summary statistics for NWC-to-sales ratio by industry.

The sample includes listed non-financial firms from the WRDS merged CRSP/Compustat files for the period 1982 to 2011. For each industry/year in our sample period, we compute the median and standard deviation of the NWC-to-sales ratio. Columns 1-2 report the corresponding median and standard deviation for years 1982 and 2011. *N* denotes the number of observations. For each industry and using all the 30 yearly observations over the period 1982-2011, we regress the median (standard deviation) of the NWC-to-sales ratio on a linear time trend and report the slope coefficient in column 3 (column 4). Slope coefficients in bold are statistically significant at the 10% (or lower) level.

	(1) 1982			(2) 2011			(3)	(4)
	Median	St. dev.	N	Median	St. dev.	N	Slope Median	Slope St. dev.
Computers	37.3%	31.8%	119	19.6%	11.5%	79	**–0.0071**	**–0.0048**
Pharmaceutical Products	29.2%	23.0%	78	13.0%	48.1%	260	**–0.0061**	**0.0062**
Electronic Equipment	34.8%	23.6%	229	20.1%	15.2%	273	**–0.0059**	–0.0006
Computer Software	26.2%	22.0%	105	15.9%	19.8%	317	**–0.0047**	**–0.0028**
Medical Equipment	37.3%	31.7%	84	27.7%	24.3%	124	**–0.0043**	**–0.0053**
Measuring and Cont. Equip.	41.2%	17.7%	109	29.0%	16.0%	84	**–0.0042**	–0.0004
Apparel	29.9%	14.1%	78	22.1%	10.7%	48	**–0.0041**	**–0.0016**
Shipbuilding, Rail. Equip.	24.8%	10.4%	14	18.5%	5.6%	8	**–0.0038**	**–0.0019**
Recreation	34.8%	13.3%	42	25.7%	11.4%	21	**–0.0035**	–0.0013
Coal	22.6%	6.8%	6	8.1%	10.9%	17	**–0.0035**	**0.0068**
Personal Services	13.0%	22.4%	35	4.8%	13.8%	52	**–0.0033**	**–0.0059**
Machinery	34.9%	21.4%	188	26.1%	16.0%	119	**–0.0031**	**–0.0020**
Printing and Publishing	23.4%	14.7%	46	12.2%	6.7%	19	**–0.0031**	**–0.0033**
Automobiles and Trucks	24.5%	15.7%	74	15.7%	14.1%	61	**–0.0030**	–0.0005
Wholesale	21.2%	21.3%	191	14.8%	18.8%	119	**–0.0029**	**–0.0019**
Entertainment	6.0%	36.1%	62	1.5%	16.7%	43	**–0.0028**	**–0.0103**
Consumer Goods	27.7%	16.7%	115	22.7%	22.7%	48	**–0.0024**	–0.0014
Healthcare	16.2%	30.7%	41	11.4%	6.4%	63	**–0.0024**	**–0.0058**
Electrical Equipment	31.5%	19.2%	83	26.6%	16.6%	69	**–0.0023**	**0.0014**
Business Services	18.5%	25.5%	188	14.4%	23.2%	193	**–0.0022**	**–0.0017**
Communication	13.0%	21.5%	71	7.7%	14.9%	150	**–0.0021**	**–0.0055**
Shipping Containers	16.8%	8.1%	18	15.7%	7.0%	10	**–0.0021**	**–0.0018**
Retail	13.7%	12.9%	235	10.2%	14.0%	192	**–0.0017**	**–0.0017**
Construction Materials	25.1%	17.0%	164	19.8%	17.5%	57	**–0.0014**	**–0.0021**
Almost Nothing	22.6%	36.7%	79	17.3%	21.2%	48	**–0.0013**	**–0.0068**
Business Supplies	20.1%	8.9%	81	16.1%	10.8%	41	**–0.0012**	**–0.0019**
Transportation	7.2%	14.8%	108	5.1%	9.2%	129	**–0.0008**	**–0.0017**
Rubber and Plastic Prod.	21.5%	10.5%	72	18.1%	6.7%	18	**–0.0007**	**–0.0032**
Chemicals	22.5%	19.1%	82	18.9%	22.6%	85	**–0.0006**	–0.0001
Petroleum & Natural Gas	10.7%	44.2%	392	5.5%	28.2%	199	**–0.0009**	**–0.0052**
Precious Metals	28.1%	59.1%	18	12.6%	19.4%	29	**–0.0039**	**–0.0160**
Defense	30.8%	22.7%	9	18.2%	7.0%	9	**–0.0016**	–0.0003
Non-Met. & Ind. Met. Min.	21.0%	34.8%	25	16.8%	37.0%	27	**–0.0009**	0.0025
Utilities	10.6%	11.5%	210	9.8%	14.1%	114	**–0.0003**	0.0001
Tobacco Products	33.1%	14.4%	6	12.5%	10.8%	5	–0.0024	**0.0038**
Steel Works Etc	26.2%	14.4%	82	22.4%	13.8%	56	–0.0006	–0.0009
Candy & Soda	11.3%	6.2%	8	12.1%	9.8%	15	–0.0008	–0.0008
Aircraft	33.4%	15.5%	33	34.6%	16.5%	20	–0.0005	–0.0004
Textiles	26.5%	9.1%	51	29.5%	7.0%	10	–0.0004	**–0.0016**
Fabricated Products	23.4%	16.0%	31	27.6%	44.9%	9	–0.0005	–0.0024
Restaurants, Hotels, Motels	2.1%	19.7%	89	1.6%	28.3%	61	–0.0001	–0.0022
Construction	19.12%	33.00%	45	22.33%	48.46%	42	0.0000	**0.0030**
Food Products	12.9%	16.1%	90	15.7%	9.2%	58	0.0001	–0.0012
Agriculture	23.0%	21.5%	18	29.4%	42.3%	14	0.0028	**–0.0050**
Beer & Liquor	18.8%	19.9%	14	19.5%	26.8%	16	**0.0040**	**–0.0029**

Table 3

Summary Statistics.

This table provides summary statistics on our sample firms. Q1 and Q3 denote the first and third quartiles, respectively. The sample includes listed non-financial firms from the WRDS merged CRSP/Compustat files for the period 1982 to 2011. Excess NWC is the industry-median adjusted NWC-to-sales ratio. Variable definitions are provided in Appendix. All dollar values are in millions and adjusted to 2005 dollars by the consumer price index. *N* denotes the sample size.

Variable	Mean	Median	Q1	Q3	St. dev.	N
NWC-to-sales ratio	19.99%	18.59%	9.06%	29.72%	26.49%	140,508
Excess NWC	1.20%	0.00%	-6.76%	8.19%	24.75%	140,508
1-year excess return	–2.82%	–11.86%	–42.89%	22.22%	66.31%	126,825
1-year ROA	5.01%	10.62%	2.31%	16.57%	23.49%	140,115
CAPEX	7.64%	4.76%	2.24%	9.23%	9.24%	123,596
Cash acquisition	3.10%	0.00%	0.00%	0.63%	9.82%	118,957
Risk	3.89%	3.25%	2.16%	4.87%	2.42%	137,349
Total assets	1,971.92	164.88	38.73	834.89	6,096.63	140,508
Sales	1,673.88	164.46	34.19	807.91	5,030.62	140,508
Market value of equity	1,804.77	153.73	33.35	804.86	5,687.63	139,462
Tobin's Q	1.99	1.38	1.03	2.17	1.80	135,075
R&D	4.75%	0.00%	0.00%	5.14%	9.95%	140,506
Cash flow	–29.12%	24.52%	0.68%	60.84%	397.12%	128,037
Fixed asset growth	19.27%	4.51%	–6.27%	22.61%	65.45%	128,306
Sales growth	20.89%	9.05%	–2.27%	25.03%	62.27%	116,636
Intangible assets	10.00%	2.24%	0.00%	13.83%	15.46%	124,695
Leverage	23.66%	20.38%	4.10%	36.70%	21.44%	140,129
Age	12.94	8.00	3.00	18.00	14.24	140,504
Book-to-market	0.65	0.51	0.27	0.86	0.70	139,396
Cash reserves	17.72%	8.71%	2.42%	25.31%	21.25%	140,490
Sales volatility	25.88%	18.02%	9.72%	31.69%	26.90%	111,049
Financial distress dummy	6.16%	0.00%	0.00%	0.00%	24.04%	140,508

Table 4

Sample Characteristics: Negative versus Positive Excess NWC.

This table compares the sample characteristics of firms with negative and positive excess NWC. The sample includes listed non-financial firms from the WRDS merged CRSP/Compustat files for the period 1982 to 2011. Excess NWC is the industry-median adjusted NWC-to-sales ratio. Variable definitions are provided in Appendix. For each variable, the last two columns display the p-values from a test of mean differences and a test of median differences between negative and positive excess NWC subsamples, respectively.

Variable	Negative excess NWC		Positive excess NWC		*p*-value for positive – negative	
	Mean	Median	Mean	Median	Mean	Median
1-year excess return	–2.01%	–11.31%	–3.61%	–12.38%	*0.00*	*0.00*
1-year ROA	3.74%	11.00%	6.27%	10.32%	*0.00*	*0.00*
CAPEX	8.47%	5.25%	6.83%	4.35%	*0.00*	*0.00*
Cash acquisition	2.62%	0.00%	3.57%	0.00%	*0.00*	*0.00*
Risk	3.98%	3.30%	3.79%	3.21%	*0.00*	*0.00*
Total assets	1,946.56	156.42	1,997.03	172.97	*0.12*	*0.00*
Sales	1,831.99	168.98	1,517.34	160.58	*0.00*	*0.00*
Market value of equity	1,818.39	155.73	1,791.31	152.19	*0.37*	*0.14*
Tobin's Q	2.12	1.45	1.87	1.32	*0.00*	*0.00*
R&D	5.31%	0.00%	4.20%	0.00%	*0.00*	*0.00*
Cash flow	–54.07%	21.82%	–4.73%	27.52%	*0.00*	*0.00*
Fixed asset growth	17.88%	4.07%	20.63%	4.93%	*0.00*	*0.00*
Sales growth	22.68%	9.16%	19.17%	8.93%	*0.00*	*0.05*
Intangible assets	10.12%	1.91%	9.89%	2.55%	*0.01*	*0.00*
Leverage	23.66%	19.68%	23.66%	21.08%	*0.99*	*0.00*
Age	12.60	8.00	13.30	9.00	*0.00*	*0.00*
Book-to-market	0.59	0.46	0.72	0.56	*0.00*	*0.00*
Cash reserves	20.14%	10.09%	15.32%	7.59%	*0.00*	*0.00*
Sales volatility	29.51%	19.80%	22.37%	16.68%	*0.00*	*0.00*
Financial distress dummy	6.84%	0.00%	5.48%	0.00%	*0.00*	*0.00*

Table 5

Excess Net Working Capital and Stock Performance.

This table reports the fixed effects stock performance regressions. The dependent variable is the 1-year excess return in year *t*. The independent variables are lagged by one period with respect to the dependent variables. Columns 1-2 report the estimation of the linear model [see Equation (2)], and columns 3-4 the estimation of the asymmetric model [Equation (3)]. Excess NWC is the industry-median adjusted NWC. *D* is a dummy variable taking value one if the corresponding excess NWC is positive and 0 otherwise. The used proxy for firm size is the market value of equity. Variable definitions are provided in Appendix. Standard errors are robust and clustered at firm level.

Variable	(1)		(2)		(3)		(4)	
	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value
Excess NWC_{t-1}	–0.0641	*0.00*	–0.0095	*0.65*				
Excess NWC_{t-1} × D					–0.1034	*0.00*	–0.0731	*0.02*
Excess NWC_{t-1} × (1 – D)					–0.0199	*0.40*	0.0687	*0.07*
Firm size			–0.2857	*0.00*			–0.2855	*0.00*
Intangible assets			–0.0436	*0.25*			–0.0452	*0.23*
Leverage			–0.1289	*0.00*			–0.1282	*0.00*
Age			–0.0244	*0.00*			–0.0251	*0.00*
R&D			0.5678	*0.00*			0.5780	*0.00*
Risk			0.0547	*0.00*			0.0554	*0.00*
Fixed assets growth			–0.0077	*0.13*			–0.0068	*0.19*
Cash reserves			0.0263	*0.39*			0.0292	*0.35*
Sales volatility			0.0140	*0.44*			0.0128	*0.48*
Cash flow			0.0061	*0.00*			0.0058	*0.00*
Financial distress dummy			–0.0752	*0.00*			–0.0747	*0.00*
Sales growth			0.0004	*0.94*			–0.0016	*0.79*
Firm- and year-fixed effects	Yes		Yes		Yes		Yes	
Adjusted R-squared	0.036		0.146		0.037		0.146	
Fisher statistic	150.18	*0.00*	185.43	*0.00*	145.96	*0.00*	181.27	*0.00*
Number of observations	126,784		84,228		126,784		84,228	

Table 6

Excess Net Working Capital and Corporate Investment.

The table presents the fixed effects investment regressions. We define investment as the sum of capital expenditures (CAPEX) and cash acquisition, scaled by total assets at the beginning of the period. In column 1, the dependent variable is the change in investment at time *t*. In column 2, the dependent variable is the change in CAPEX at time *t*. In column 3, the dependent variable is the change in cash acquisition at time *t*. The independent variables are lagged by one period with respect to the dependent variables. Excess NWC is the industry-median adjusted NWC. *D* is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., firms with abnormally high level of cash tied up in NWC) and 0 otherwise. The used proxy for firm size is the market value of equity. Variable definitions are provided in Appendix. Standard errors are robust and clustered at firm level.

Variable	(1) Change in investment		(2) Change in CAPEX		(3) Change in acquisition	
	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value
Excess NWC_{t-1} × D	–0.0489	*0.00*	–0.0021	*0.50*	–0.0407	*0.00*
Excess NWC_{t-1} × (1 – D)	0.0559	*0.00*	0.0286	*0.00*	0.0242	*0.00*
Firm size	–0.0355	*0.00*	–0.0138	*0.00*	–0.0196	*0.00*
Leverage	–0.2343	*0.00*	–0.0576	*0.00*	–0.1572	*0.00*
Age	0.0078	*0.00*	0.0039	*0.00*	0.0037	*0.00*
Risk	–0.0089	*0.00*	–0.0009	*0.46*	–0.0080	*0.00*
Log of Tobin's Q	0.0727	*0.00*	0.0283	*0.00*	0.0395	*0.00*
Cash flow	0.0005	*0.07*	0.0002	*0.10*	0.0004	*0.08*
Sales volatility	0.0171	*0.00*	0.0084	*0.00*	0.0082	*0.00*
Cash reserves	0.1472	*0.00*	0.0329	*0.00*	0.1100	*0.00*
Financial distress dummy	0.0227	*0.00*	–0.0017	*0.33*	0.0233	*0.00*
Sales growth	–0.0474	*0.00*	–0.0156	*0.00*	–0.0299	*0.00*
Firm- and year-fixed effects	Yes		Yes		Yes	
Adjusted R-squared	0.094		0.057		0.064	
Fisher statistic	76.07	*0.00*	63.65	*0.00*	43.67	*0.00*
Number of observations	83,635		90,141		84,625	

Table 7

Excess Net Working Capital and Operating Performance.

This table reports the fixed effects operating performance regressions. The dependent variable is the return on assets (ROA) in year *t*. The independent variables are lagged by one period with respect to the dependent variables. Column 1 reports the estimation of the linear model, and column 2 the estimation of the asymmetric model. Excess NWC is the industry-median adjusted NWC. *D* is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., firms with abnormally high level of cash tied up in NWC) and 0 otherwise. The used proxy for firm size is the market value of equity. Variable definitions are provided in Appendix. Standard errors are robust and clustered at firm level.

Variable	(1)		(2)	
	Coef.	*p*-value	Coef.	*p*-value
Excess NWC_{t-1}	–0.0152	*0.07*		
Excess $NWC_{t-1} \times D$			–0.1104	*0.00*
Excess $NWC_{t-1} \times (1 - D)$			0.1007	*0.00*
Firm size	0.0176	*0.00*	0.0178	*0.00*
Intangible assets	–0.0600	*0.00*	–0.0624	*0.00*
Leverage	0.0216	*0.00*	0.0228	*0.00*
Age	–0.0038	*0.03*	–0.0050	*0.00*
R&D	–0.3879	*0.00*	–0.3722	*0.00*
Risk	–0.0073	*0.05*	–0.0064	*0.07*
Fixed assets growth	–0.0011	*0.39*	0.0003	*0.84*
Cash reserves	–0.1026	*0.00*	–0.0984	*0.00*
Sales volatility	0.0180	*0.00*	0.0162	*0.00*
Cash flow	0.0080	*0.00*	0.0074	*0.00*
Financial distress dummy	–0.0255	*0.00*	–0.0246	*0.00*
Sales growth	0.0082	*0.00*	0.0052	*0.01*
Firm- and year-fixed effects	Yes		Yes	
Adjusted R-squared	0.086		0.095	
Fisher statistic	34.86	*0.00*	36.66	*0.00*
Number of observations	84,245		84,245	

Table 8

Excess Net Working Capital and Firm Risk.

This table presents the fixed effects firm risk regressions. The dependent variable is firm risk, which is defined as the annualized standard deviation of firm daily returns in year *t*. The independent variables are lagged by one period with respect to the dependent variables. Column 1 reports the estimation of the linear model, and column 2 the estimation of the asymmetric model. Excess NWC is the industry-median adjusted NWC. *D* is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., firms with abnormally high level of cash tied up in NWC) and 0 otherwise. The used proxy for firm size is the market value of equity. Variable definitions are provided in Appendix. Standard errors are robust and clustered at firm level.

Variable	(1)		(2)	
	Coef.	*p*-value	Coef.	*p*-value
Excess NWC_{t-1}	–0.0186	*0.04*		
Excess $NWC_{t-1} \times D$			–0.0024	*0.85*
Excess $NWC_{t-1} \times (1 - D)$			–0.0385	*0.01*
Firm size	–0.0972	*0.00*	–0.0972	*0.00*
Leverage	0.1031	*0.00*	0.1029	*0.00*
Age	0.0007	*0.85*	0.0009	*0.81*
Book-to-market	0.0228	*0.00*	0.0227	*0.00*
Cash reserves	–0.0651	*0.00*	–0.0658	*0.00*
Sales volatility	0.0925	*0.00*	0.0927	*0.00*
Cash flow	–0.0060	*0.00*	–0.0059	*0.00*
Financial distress dummy	0.0910	*0.00*	0.0909	*0.00*
Sales growth	–0.0002	*0.94*	0.0003	*0.91*
Firm- and year-fixed effects	Yes		Yes	
Adjusted R-squared	0.308		0.308	
Fisher statistic	400.54	*0.00*	390.24	*0.00*
Number of observations	95,040		95,040	

Table 9

Regression-based excess NWC.

This table revisits our main tests by using an alternative measure of excess NWC. We adopt a two-stage procedure. We first estimate the firm's working capital needs using variables known to affect the NWC-to-sales ratio (first stage). To do so, we regress for each industry/year the NWC-to-sales ratio on the following determinants: sales volatility, sales growth, free cash flow, financial distress dummy and firm age. Then, we use in the performance (Panel A) and investment (Panel B) regressions the residual from the first stage as a measure of the firm's excess NWC (second stage). The table reports the second-stage regressions. *Stand. Excess NWC* corresponds to excess NWC divided by its standard error. *D* is a dummy variable identifying positive excess NWC, and 0 otherwise. Variable definitions are provided in Appendix. Standard errors are robust and clustered at firm level.

Panel A. Performance regressions

Variable	1-year excess return		ROA	
	Coef.	*p*-value	Coef.	*p*-value
Stand. excess NWC_{t-1} × D	–0.0158	*0.02*	–0.0210	*0.00*
Stand. excess NWC_{t-1} × (1 – D)	0.0027	*0.75*	0.0078	*0.00*
Firm size	–0.2810	*0.00*	0.0220	*0.00*
Intangible assets	–0.0442	*0.25*	–0.0761	*0.00*
Leverage	–0.1688	*0.00*	0.0024	*0.74*
Age	–0.0172	*0.08*	–0.0113	*0.00*
R&D	0.4360	*0.00*	–0.4450	*0.00*
Risk	0.0377	*0.03*	–0.0074	*0.06*
Fixed assets growth	–0.0072	*0.19*	–0.0020	*0.13*
Cash reserves	–0.0033	*0.92*	–0.1062	*0.00*
Firm- and year-fixed effects	Yes		Yes	
Adjusted R-squared	0.145		0.063	
Fisher statistic	180.25	*0.00*	28.28	*0.00*
Number of observations	77,001		77,004	

Panel B. Investment regressions

Variable	Change in investment		Change in CAPEX		Change in acquisition	
	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value
Stand. excess NWC_{t-1} × D	–0.0111	*0.00*	–0.0005	*0.41*	–0.0095	*0.00*
Stand. excess NWC_{t-1} × (1 – D)	0.0035	*0.10*	0.0030	*0.00*	0.0003	*0.83*
Firm size	–0.0357	*0.00*	–0.0134	*0.00*	–0.0205	*0.00*
Leverage	–0.2274	*0.00*	–0.0586	*0.00*	–0.1494	*0.00*
Risk	–0.0076	*0.01*	–0.0013	*0.33*	–0.0068	*0.00*
Log of Tobin's Q	0.0730	*0.00*	0.0276	*0.00*	0.0405	*0.00*
Cash flow	0.0007	*0.04*	0.0001	*0.45*	0.0006	*0.03*
Sales growth	–0.0484	*0.00*	–0.0155	*0.00*	–0.0311	*0.00*
Cash reserves	0.1510	*0.00*	0.0325	*0.00*	0.1129	*0.00*
Firm- and year-fixed effects	Yes		Yes		Yes	
Adjusted R-squared	0.094		0.055		0.064	
Fisher statistic	73.16	*0.00*	58.61	*0.00*	41.46	*0.00*
Number of observations	76,199		82,193		77,075	