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Article

Inflation, operating cycle, and cash holdings

China Journal of Accounting Research

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Suggested Citation: Wang, Yanchao; Ji, Yu; Chen, Xu; Song, Chunlei (2014) : Inflation, operating cycle, and cash holdings, China Journal of Accounting Research, ISSN 1755-3091, Elsevier, Amsterdam, Vol. 7, Iss. 4, pp. 263-276, <https://doi.org/10.1016/j.cjar.2013.07.001>

This Version is available at:

<https://hdl.handle.net/10419/187592>

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China Journal of Accounting Research

journal homepage: www.elsevier.com/locate/cjar

Inflation, operating cycle, and cash holdings

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ARTICLE INFO

Article history:

Received 24 May 2012

Accepted 19 July 2013

Available online 2 January 2014

JEL classification:

G31

G20

E32

Keywords:

Inflation

Operating cycle

Cash holdings

ABSTRACT

A corporate cash-holding strategy is a trade-off between the costs and benefits of holding cash. At the macrolevel, firms are inclined to adjust and optimize their cash-holding strategies in response to changes in purchasing power due to inflation. At the microlevel, the operating cycle, which indicates the speed and turnover of corporate cash flow, also influences the corporate cash-holding strategy. Firms flexibly adjust their cash-holding strategies in response to changes in the internal and external environment, which is referred to as the cash adjustment strategy. We examine these predicted relationships using a sample of listed firms in China's stock market over the 1998–2009 period. Consistent with our predictions, the empirical results indicate a significant negative association between cash holdings and the CPI, but the relationship is reversed when the CPI reaches a certain level. There is also a U-shaped relationship between operating cycle and cash holdings, and this relationship is similarly influenced by changes in the inflation level. In examining the macroeconomic environment and microlevel firm-specific characteristics simultaneously, our findings supplement the literature on firms' cash-holding strategies and provide theoretical and practical implications.

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1. Introduction

A firm's cash-holding strategy determines its fate and future. In an incomplete market, firms tend to hold and accumulate cash for future trading and to mitigate risk (Keynes, 1936). However, holding too much cash can increase opportunity costs, while holding too little can induce shortage costs that disadvantage invest-

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ment. The optimum level of corporate cash holdings is a trade-off between the costs and benefits of holding cash (Opler et al., 1999; Harford, 1999). Increases in inflationary pressure undoubtedly influence the amount and cost of monetary supply, thus affecting the trade-off between the costs and benefits of holding cash. In addition, a firm's operating cycle, which is directly related to the time and speed at which it gains cash, also influences its cash-holding level. By considering both the economic cycle at the macrolevel and the firm-specific operating cycle at the microlevel, this study extends our knowledge of the factors affecting corporate cash holdings under inflation.

Studies on corporate cash holdings discuss the effects of corporate financial conditions, governance systems, capital structures, external financing costs, and so forth on the level of cash holdings. In the financial condition literature, for example, the corporate cash-holding level is found to have a significant relationship with firms' financial features (Xin and Xu, 2006b); a positive relationship with leverage, information asymmetry, corporate age and size, investment opportunities and cash flow changes (Faulkender, 2002); and a negative relationship with corporate size and credit-ratings (Ozkan and Ozkanm, 2004; Wang, 2009). Bates et al., 2008 find that riskier cash flow, decreasing inventory holdings and receivables, and increasing R&D lead to increasing levels of corporate cash holdings in the US. In the corporate governance systems and capital structures literature, Kusnadi (2003) finds that the relationship between cash holdings and board size is positive, whereas the relationship between cash holdings and non-management block-holder ownership is negative. Zhang and Liu (2005) find a negative linear relationship between corporate cash holdings and shareholder protection, dependent on ownership structure. Similarly, Xin and Xu (2006) find that Chinese listed firms with better corporate governance mechanisms have more reasonable levels of cash holdings with less cash redundancy or shortages. Chen and Chuang (2009) find that CEO ownership, risk investment, and the number of independent directors also have a strong effect on cash policy. Faleye (2004) examines the relationship between takeover defenses and cash holdings from a control-rights market perspective and finds that the more cash firms hold, the more bidders they face in a takeover bid. Studies on the external financing environment also report important findings. For example, firms with greater growth opportunities and those that find it more risky and more difficult to enter the capital market hold more cash (Opler et al., 1999). A firm's financial restraints policy plays a decisive role in its cash holdings (Wang, 2009). The monopoly power of banks (Pinkowitz and Williamson, 2001) and past financing difficulties (Faulkender, 2002) also have important effects on cash holdings. Some studies find that diversified enterprises hold less cash compared with those in the same industry (Subramaniam and Tang, 2010). Firms are likely to hold more cash to help smooth R&D expenditure but face financing frictions (Brown et al., 2010).

In contrast, recent research on corporate cash holdings focuses on the macrolevel or medium level, including political, economic, legislative, and industry-environment factors. In a cross-country comparison, Pinkowitz et al. (2006) finds that firms in countries with low levels of investor protection and more political risk tend to hold more cash. Firms facing financing constraints increase their cash holdings during economic recession periods and raise their liquidity levels during credit crunch periods (Custodio et al., 2005). The increase in tax costs due to differences in tax rates between countries also contributes to increases in the proportion of cash holdings of multi-national corporations (Titman et al., 2004). Some studies examine the specific macroenvironment in China. In China's weak institutional environment, firms that face high financing constraints can gain higher yields with high-level cash-holding policies (Zhou and Xie, 2007). In China's specific institutional and governance environment, the judgments made by Chinese enterprises and their agents regarding the costs and benefits of cash holdings may be different or distorted, which may affect their cash-holding decisions (Gu and Sun, 2009). Cash holdings vary with the tightening of monetary policies. During periods of monetary contractions, firms that grow rapidly will increase their cash holdings to reduce external financing constraints and thus meet the future demand for investment (Zhu and Lu, 2009). Viewed from an industry competition and market characteristics perspective, a firm's cash-holding level is the equilibrium outcome of the corporate financing, investment, and market environment. Enterprises tend to hold more cash as a precautionary measure to maintain their market share and reduce the risk of being exploited (Haushalter et al., 2007). Competition intensity and life-cycle stage also have significant effects on cash-holding levels (Zhang and Zhang, 2009). Higher levels of cash holdings enable enterprises to benefit from market share segmentation and competition in the future, especially in the face of financing constraints and fierce competition (Fresard, 2010).

In conclusion, although numerous studies focus on the microdeterminants of cash holdings, few examine the operating cycle, and studies at the macrolevel and medium levels could be further developed or extended. Although [Zhu and Lu \(2009\)](#) examine the relationship between monetary policy tightening and cash-holding levels, few studies examine the mutual influence of macrolevel and microlevel factors on cash holdings. Investigating the effects of inflation levels on firms' cash-holding policies would provide direct and useful evidence because it is usually inflation that induces governments to tighten their monetary policies.

From the perspective of the costs and benefits of cash holdings, inflation affects the capital supply cost and value. Increasing inflation also induces government macroeconomic control, which directly affects the capital supply cost and value. A firm's operating cycle indicates the speed and scale of its cash flow acquisition, which then influences the costs and benefits of internal cash holdings. A business is inseparable from its external environment. In this study, we not only consider the influence of firms' operating characteristics on the costs and benefits of holding cash, but also examine changes in the external environment and how firms make adjustments to the tradeoff. Hence, this study provides a comprehensive examination of how corporate enterprises determine their cash-holding policies in response to changes in the macroeconomic environment. The current macroeconomic inflation provides us with an opportunity to extend the study.

[Fig. 1](#) illustrates the large fluctuations in the consumer price index (CPI) between 1998 and 2009. China's CPI indicates that inflationary pressure increased consistently from 2003 to the beginning of 2008. The huge effect of the 2009 global economic crisis on Chinese real economics, together with the reversion and rebound in the domestic economic cycle, pulled the CPI down for the first time. This fluctuation prompted firms to adjust or optimize their production and operation plans, either actively or passively, and then change their cash-holding behavior ([Rao and Jiang, 2013](#)). Changes in macroeconomic policy, especially monetary policy, due to fluctuations in the CPI also influence firms' external financing costs and capabilities, which in turn influence their cash-holding levels. We examine the relationship between operating cycle and cash holdings by highlighting the interaction between the operating cycle and the "generating blood" function, which becomes more complex when the CPI or inflation is fluctuating. Therefore, it is important to understand the mutual influence of the operating cycle and CPI on corporate cash-holding levels.

This study investigates the effect of inflation levels and operating cycles on corporate cash holdings from both the macro- and the microperspective in China's current situation. The empirical results confirm that corporate cash-holding levels decline as the level of inflation increases. Once inflation reaches a certain level, corporate cash-holding levels start to rise; hence, there is a U-shaped relationship between a firm's operating cycle and its cash holdings. We further examine the interactive effect of inflation and operating cycle on the level of cash.

The main contributions of our study are as follows. We reveal the effects of inflation and operating cycle on corporate cash holdings from both the macroperspective of the financial environment and the microperspective of firm characteristics, thus enriching the literature on cash holdings at home and abroad. We also present a preliminary analysis of the factors that influence the relationship between inflation, operating cycle, and cash-holding levels to enhance our understanding of corporate cash-holding behavior and to provide listed firms with empirical evidence on how best to adjust their cash holdings according to price changes and their

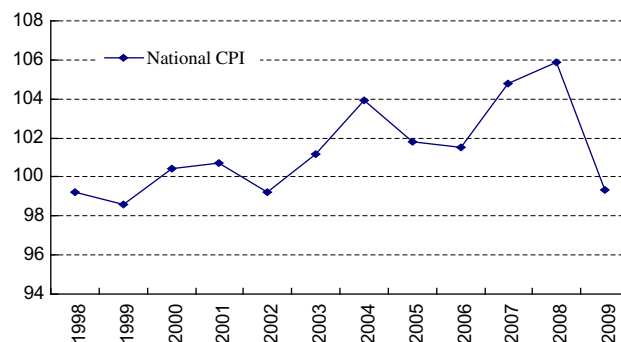


Figure 1. National CPI from 1998 to 2009.

operating cycle. Given the current background of accelerated inflation and increasing *CPI* in China, this study is particularly timely. It also reveals the effect of macrocontrol policies on microlevel corporate cash holdings and provides a reference for enterprises to optimize their allocation of resources based on changes in the macrofinancial environment and their own financial circumstances.

The remainder of this article is structured as follows. Section 2 presents the theoretical analysis and assumptions. Section 3 describes the research design. Section 4 reports the results and Section 5 provides the conclusions.

2. Theoretical analysis and hypothesis development

2.1. Effect of inflation on corporate cash holdings

In recent years, China's *CPI* and inflation have been consistently increasing. Periods of inflation influence firms' operating performance, management situation, and need for and supply of cash; thus, they need to actively or passively change their levels of cash holdings. The level of corporate cash holdings is a balance between the costs and benefits (Opler et al., 1999; Peng and Zhou, 2006). As cash is a non-profitable asset, especially during periods of inflation, cash holdings can cause a loss of purchasing power which increases the cost of holding cash and, as prices and interest rates rise, capital costs also rise. As a result, currency financing demands higher interest rates to compensate for the loss of purchasing power, investors require an additional investment rate of return, which determines the expected investment return rate. When evaluating an investment project, the expected investment return rate is usually used as the discount rate to adjust the amount of future cash flow to the present value. This results in a positive net present value of enterprise investment projects, as the value of investment opportunities and the potential future investment returns of corporate cash holdings are reduced. As a result, the enterprise will reduce their cash holdings for investment (Ferreira, 2003). In addition, when firms hold a cash equivalent that can be converted into cash at a lower cost, it is economical to raise funds through selling these assets (Shleifer and Vishny, 1984). Firms that hold many realizable assets tend to hold less cash. They will transfer assets that can be held at a lower cost into cash to raise money, particularly during periods of inflation when prices are higher and the fair value of assets is generally above their book value. Therefore, rather than holding cash, firms tend to increase their liquid assets, for instance by stocking up on inventory, to obtain price gains, and avoid their monetary assets shrinking. For these reasons, we believe that during periods of inflation, when the cost of corporate cash holdings is high and income is reduced, enterprises will have less demand for cash and may actively reduce their levels of cash holdings.

Inflation may also affect an enterprise's cash supply. In times of inflation, firms need more money to purchase the same amount of raw materials and other goods, thus taking up more of their working capital, while they also generate less money through their operating cycles. As prices continue to rise, firms may anticipate further inflation and thus will purchase raw materials in advance to avoid increases in cost or to serve as excess reserves. Others may invest in gold or real estate to avoid the loss of purchasing power and generate excess earnings, which may result in firms holding too much working capital and reducing their cash holdings. In the capital market, rising prices can lead to interest rate rises and increasing uncertainty over investment income, so that the residents or institutions are less likely to invest in stocks and bonds, thus increasing stock prices and making it more difficult to raise money in capital markets (Friedman, 1977).

However, when inflation reaches a certain level, the continued deterioration in macroeconomic regulation will cause the government to exert tighter macroeconomic control, which in turn changes the external financing environment. As the level of inflation continues to rise, the government must adopt tighter monetary policies for macroeconomic regulation, such as raising the deposit reserve rate, improving the level of interest rates, and controlling the scale of credit in commercial banks. Banks will become more cautious about lending and loan conditions will be stricter, thus creating strong external financing constraints that make it more difficult for firms to obtain loans (Stiglitz and Weiss, 1981). External financial constraints in the finance market cause the value of money to become more apparent due to the sharp drop in the overall supply of funds and extremely scarce cash resources. Under such conditions, corporate cash holdings inevitably change and firms

tend to hold more cash. The primary benefit of holding more cash is to protect against the increasing risk of bankruptcy.

To sum up, due to the current economic situation in China, ongoing inflationary pressures have devalued the currency assets held by firms. Under such conditions, firms significantly increase their inventories to minimize risk and fulfill long-term contracts. Consequently, they experience reduced liquidity for resource allocation, production, sales distribution and operating capacity, together with a deteriorating business environment and a shortage of cash. Meanwhile, the emergence of inflation also causes a tightening of macrocontrol policies, especially monetary policies, which also affects the cost and capacity of external financing and in turn influences the level of corporate cash holdings. Based on the above theoretical and practical analysis, we propose [Hypothesis 1](#).

H1. As inflation rises, corporate cash holdings decline. However, when inflation reaches a certain level, corporate cash holdings increase as the level of inflation increases.

2.2. *The effect of the operating cycle on cash holdings*

The length of a firm's operating cycle is affected by industry factors, the firm's business model, and its management efficiency. Generally, corporate operating assets and working capital need to be kept in balance if the firm is to continue as a going concern. In other words, from the demand perspective, if the products have a shorter operating cycle, capital takes relatively less time to circulate and the firm must continuously invest funds to complete the rapid cycle of purchase, production, and sales. Such firms have to hold more cash to cover ongoing transactions, which is consistent with the transactions motive for holding cash. From the supply perspective, a shorter operating cycle means that the process of obtaining inventory, selling and regaining cash is shorter. Internal capital accumulation is then more efficient, the amount of current capital taken up by inventory and accounts receivable declines, and the firm's own cash supply increases, with a subsequent increase in internal cash holdings.

Conversely, in firms with longer operating cycles, it takes longer to purchase raw materials and produce products. From the demand perspective, the period of continuous investment in production and operation is extended accordingly, which reduces average cash holdings. From the supply perspective, a longer operating cycle means a slower turnover of cash flow, inventory sales, and recovery of accounts receivable. More cash is frozen in current assets for a longer time, which decreases the firm's own cash supply and reduces its cash holdings.

As the operating cycle increases, a firm's own "blood-making" capacity becomes weaker, capital turnover is likely to create problems, the capital chain cannot meet the firm's normal production needs, and operational demands and good investment opportunities may be lost. [Opler et al. \(1999\)](#) analyze the effects of cash flow risk and financing capacity on cash holdings and find that firms suffering from higher risk and with less access to the capital market tend to hold more cash. If firms cannot fully spread the risk of breaks in their cash flow, they must hold more cash to meet future transactions and speculative demand. Thus, once the operating cycle reaches a certain point, firms raise their cash-holding levels to prevent risk and to meet uncertain production and management demands and investment needs, which is consistent with the precautionary motive theory of cash holdings.

Based on the above analysis, we argue that there is a U-shaped relationship between the operating cycle and cash holdings. Within a certain range, extending the operating cycle means that there is a continuous supply of money pouring through the longer cash cycle, and firms do not need to hold large amounts of cash for transactions. At the same time, extending the operating cycle reduces the efficiency of working capital, more money is taken up by inventory and accounts receivable and the lower speed of inventory realization leads to a decline in cash holdings. However, at a certain level, with the product turnover cycle increasing, especially when the collection rate of accounts receivable falls, firms experience a longer operating cycle and with the consequent risk need to hold an increasing amount of cash to guard against future risk and uncertainty. Therefore, we state the above relationship as follows:

H2. As the operating cycle increases, cash holdings decline. However, when the operating cycle reaches a certain level, cash holdings increase as the operating cycle increases.

3. Data and empirical methodology

Our sample consists of all A-share firms listed on the Shanghai and Shenzhen stock exchanges from 1998 to 2009. We select our sample firms as follows. First, we exclude financial firms. Second, we remove firms with total assets and operating cycles below zero. Third, we remove firms with missing related data. Fourth, we exclude the top and bottom 1% (greater than 99% quantile) of the variables as extreme values. As our model is based on the differences between consecutive years, all of the data are from firms that have been listed for more than two years and the overall data range is from 1997 to 2009. Our final sample comprises 9165 firm-year observations. The data on regional *CPI* are only available from 1999 to 2009, so we use the national rather than the regional *CPI* for 1998. All of the data were retrieved from the WIND, CSMAR, and CCER databases.

According to Almeida et al. (2004), the actual situation in China and the above theoretical analysis, we estimate the following equation to test our hypotheses:

$$\begin{aligned} \Delta Cash_{i,t} = & \beta_0 + \beta_1 CPI_{i,t} + \beta_2 CPI_{i,t}^2 + \beta_3 Cycle_{i,t} + \beta_4 Cycle_{i,t}^2 + \beta_5 CF_{i,t} + \beta_6 Tobinq_{i,t} + \beta_7 Lnasset_{i,t} \\ & + \beta_8 \Delta NWC_{i,t} + \beta_9 \Delta SDebt_{i,t} + \beta_{10} Risk_{i,t} + FixEffects + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Table 1 provides the variable definitions. Internal cash flow (*CF*) reflects corporations' self-blood-making function, and internal cash flow changes also affect cash holdings in the firm. The size and growth of investment opportunities can also change cash holdings. *Tobinq* is used to control for corporate growth opportunities. *Lnasset* is used to control for firm size, as levels of corporate expansion and financing constraints may differ among different-sized firms. Financial conditions may also influence corporate cash-holding behavior, so we use ΔNWC and $\Delta SDebt$ (working capital and current liabilities) from the previous to the current year to measure the effect of changes in financial conditions on corporate cash holdings (Opler et al., 1999). Firms may hold cash to protect against future risk, so we choose beta to measure *Risk* (beta is the regression coefficient of the daily stock return and market return for every firm in a fiscal year). Therefore, we include the following five control variables: cash flow (*CF*), size (*Lnasset*), growth (*Tobinq*), beta risk (*Risk*), and financial status (ΔNWC and $\Delta SDebt$). Following previous studies, we use fixed year effects to reduce the effect of macroenvironment changes to a certain extent. Price fluctuation is a macrolevel variable, so when the model includes *CPI*, we only control for firm fixed effects, but when the model excludes *CPI*, firm and year fixed effects are controlled for at the same time. We decompose the operating cycle into the inventory turnover period ($Invent_{i,t}$) and the accounts receivable payback period ($Recv_{i,t}$) to analyze the effects of the inventory turnover period and the accounts receivable payback period on the level of cash holdings.

Table 1
Variable definitions.

Variable	Definition
$\Delta Cash$	The difference in cash and securities investment between year t and year $t - 1$, divided by total assets
<i>CPI</i>	The consumer price index based on the previous year (last year = 100) for firm i in corresponding province
<i>Cycle</i>	Operating cycle divided by 1000 (inventory sales period + accounts receivable payback period)
<i>Invent</i>	Inventory turnover period ($360 \times$ average net inventory/operating cost)/1000
<i>Recv</i>	Accounts receivable payback period ($360 \times$ average accounts receivable/prime operating revenues)/1000
<i>CF</i>	Cash flow (regular income + depreciation – cash dividends) divided by total assets
<i>Lnasset</i>	Logarithm of total assets
<i>Tobinq</i>	Ratio of market value to book value of assets; market value of assets is proxied by market value of equity plus book value of total liabilities
<i>Risk</i>	Beta value (excluding financial leverage) = Beta/(1 + debt-equity ratio)
ΔNWC	The difference in net working capital between year t and year $t - 1$, divided by total assets in year t
$\Delta SDebt$	The difference in current liabilities between year t and year $t - 1$, divided by total assets in year t
<i>Indu</i>	Industry dummy variables, according to the 13 major categories of the CSRC classification criteria

4. Results

4.1. Descriptive statistics

Table 2 presents the descriptive statistics for the main variables. On average, the change in the cash holdings to total assets ratio for our sample firms is 1.1%, the standard deviation is 8.6%, the minimum is -63.7% and the maximum is 69.6%, indicating that there are large differences between the cash-holding changes of different firms. The average operating cycle in our sample is 282 days, with a standard deviation of 396 days and a range from 14 to 277 days, indicating that the operating cycle varies widely between firms. The average inventory turnover period in our sample is 203 days, and the average accounts payable turnover period is 75 days.

Table 2
Summary Statistics.

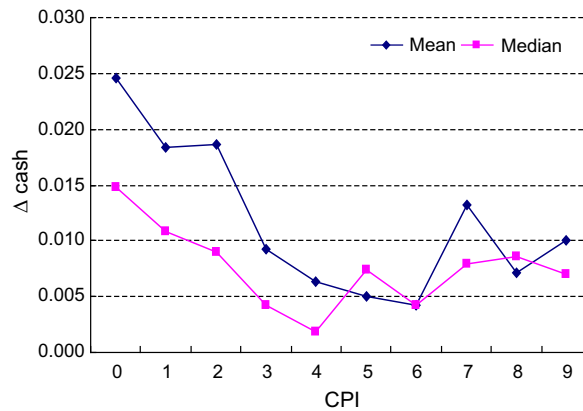
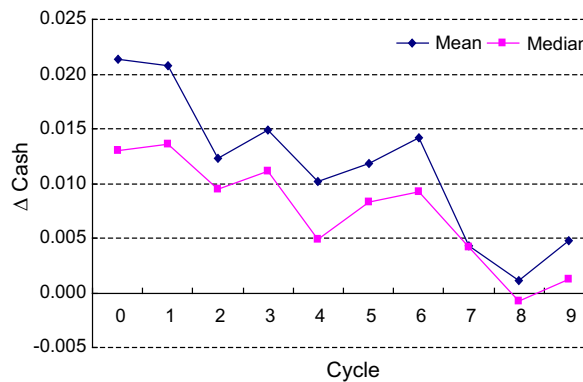
	<i>N</i>	Mean	SD	Min	Max
$\Delta Cash$	9165	0.011	0.086	-0.637	0.696
<i>CPI</i>	9165	101.660	2.265	96.700	110.090
<i>Cycle</i>	9165	0.282	0.396	0.014	0.277
<i>Invent</i>	9165	0.203	0.350	0.003	0.242
<i>Recv</i>	9165	0.075	0.089	0.000	0.567
<i>CF</i>	9165	0.139	0.156	-0.468	0.993
<i>Lnasset</i>	9165	21.352	0.992	19.076	24.254
<i>Tobinq</i>	9165	1.579	0.725	0.231	4.805
<i>Risk</i>	9165	0.471	0.245	0.001	1.214
ΔNWC	9165	-0.009	0.226	-13.805	3.550
$\Delta SDebt$	9165	0.040	0.285	-20.729	3.637

Table 3
CPI and $\Delta Cash$.

<i>CPI</i>	<i>N</i>	Mean	Median
0	902	0.025	0.015
1	911	0.018	0.011
2	952	0.019	0.009
3	748	0.009	0.004
4	1166	0.006	0.002
5	744	0.005	0.007
6	1062	0.004	0.004
7	841	0.013	0.008
8	913	0.007	0.009
9	926	0.010	0.007

Table 4
Operating cycle and $\Delta Cash$.

<i>Cycle</i>	<i>N</i>	Mean	Median
0	916	0.021	0.013
1	917	0.021	0.014
2	916	0.012	0.009
3	917	0.015	0.011
4	916	0.010	0.005
5	917	0.012	0.008
6	917	0.014	0.009
7	916	0.004	0.004
8	917	0.001	-0.001
9	916	0.005	0.001

Figure 2. CPI and $\Delta Cash$.Figure 3. Operating cycle and $\Delta Cash$.

Compared with receivables, inventory accounts for a greater amount of working capital and slower turnover, and the inventory turnover period constitutes the greatest proportion of the operating cycle.

In Tables 3 and 4, we divide our sample into 10 groups according to changes in the *CPI* and operating cycle, which are defined from 0 (low) to 9 (high). Table 3 and Fig. 2 reveal a strong negative relationship between the cash rate of public firms and the *CPI*. When inflation falls, the cash-holding ratio increases, and when inflation rises, the cash-holding ratio decreases. Specifically, as the inflation level drops toward its lowest point, the change in cash holdings is greater. From Table 4 and Fig. 3, we can also see a close relationship between the cash-holding rate and the operating cycle. When the operating cycle is longer, the cash-holding rate is lower, indicating a negative relationship, but when the operating cycle is very long, the ratio of cash holdings begins to increase.

4.2. Main results

The OLS regression results are shown in columns 4–6 of Table 5. To control the problem of biased estimates due to potentially important omitted variables, we construct non-balanced panel data to enhance the reliability. The panel regression results are shown in columns 1–3 of Table 5. The OLS results show that if we only take *CPI* and *CPI2* into account and do not consider the influence of *Cycle*, the regression coefficient of *CPI* is -0.1227 , which is significant at the 0.001 level. The regression coefficient of *CPI2* is 0.0006, which is significant at the 0.001 level. These results indicate a U-shaped rather than a simple linear relationship between

Table 5
Study of the U-shaped relationship between changes in the inflation rate and changes in cash holdings.

	Panel result		OLS result			
<i>Intercept</i>	8.7659 ^{***} (0.000)	−0.9020 ^{***} (0.000)	8.7868 ^{***} (0.000)	6.0772 ^{***} (0.000)	−0.2356 ^{***} (0.000)	6.1737 ^{***} (0.000)
<i>CPI</i>	−0.1851 ^{***} (0.000)		−0.1850 ^{***} (0.000)	−0.1227 ^{***} (0.000)		−0.1241 ^{***} (0.000)
<i>CPI</i> ²	0.0009 ^{***} (0.000)		0.0009 ^{***} (0.000)	0.0006 ^{***} (0.000)		0.0006 ^{***} (0.000)
<i>Cycle</i>		−0.0514 ^{***} (0.000)	−0.0310 ^{**} (0.003)		−0.0125 [*] (0.031)	−0.0201 ^{**} (0.002)
<i>Cycle</i> ²		0.0159 ^{***} (0.000)	0.0094 [*] (0.013)		0.0040 [*] (0.081)	0.0056 [*] (0.032)
<i>CF</i>	0.1204 ^{***} (0.000)	0.1390 ^{***} (0.000)	0.1190 ^{***} (0.000)	0.0368 ^{***} (0.000)	0.0325 ^{***} (0.000)	0.0355 ^{***} (0.000)
<i>Lnasset</i>	0.0267 ^{***} (0.000)	0.0346 ^{***} (0.000)	0.0266 ^{***} (0.000)	0.0113 ^{***} (0.000)	0.0102 ^{***} (0.000)	0.0106 ^{***} (0.000)
<i>Tobinq</i>	0.0212 ^{***} (0.000)	0.0125 ^{***} (0.000)	0.0208 ^{***} (0.000)	0.0168 ^{***} (0.000)	0.0175 ^{***} (0.000)	0.0167 ^{***} (0.000)
<i>Risk</i>	0.0038 (0.407)	−0.0026 (0.587)	0.0043 (0.347)	−0.0032 (0.373)	−0.0032 (0.375)	−0.0034 (0.339)
ΔNWC	0.1055 ^{***} (0.000)	0.1014 ^{***} (0.000)	0.1046 ^{***} (0.000)	0.1015 ^{***} (0.000)	0.1022 ^{***} (0.000)	0.1013 ^{***} (0.000)
$\Delta Sdebt$	0.0101 ^{***} (0.000)	0.0056 (0.113)	0.0098 ^{***} (0.000)	0.0223 ^{***} (0.000)	0.0224 ^{***} (0.000)	0.0219 ^{***} (0.000)
<i>Control</i>	Fixone	Fixtwo	Fixone	Yes	Yes	Yes
<i>R</i> ²	0.247	0.268	0.248	0.127	0.121	0.128
<i>N</i>	8658	8647	8656	9165	9165	9165

Absolute values of *t*-statistics are shown in brackets. Fixone controls for firm fixed effects; Fixtwo controls for year and firm fixed effects.

*** Significance at equal to or less than the 1% level.

** Significance at equal to or less than the 5% level.

* Significance at equal to or less than the 10% level.

inflation and changes in the cash holdings of listed firms. The panel results are similar to the OLS results. If we only take *CPI* and *CPI2* into account and do not consider the influence of *Cycle*, the regression coefficient of *CPI* is significantly negative and the regression coefficient of *CPI2* is significantly positive. Even when we take *Cycle* and *Cycle2* into consideration, the regression coefficients for *CPI* and *CPI2* remain at a similar level. This indicates that as the inflation level increases, firms reduce their levels of cash holdings for the purposes of trading and speculative dynamic opportunities. However, when the macroenvironment inflation deteriorates to a certain extent, the government's macrocontrol limits the size of funds in the capital markets, which creates financial constraints. The extreme scarcity of cash means it becomes an object of pursuit in the market, and listed firms increase their levels of cash holdings. This finding supports [Hypothesis 1](#).

The OLS regression results in column 5 show that without considering *CPI* and *CPI2*, the regression coefficient of *Cycle* is −0.0125, which is significant at the 1% level and the regression coefficient of *Cycle2* is significantly positive at the 10% level. Compared with the OLS regression, the regression results for the panel data in column 2 are much stronger. The regression coefficients also remain steady when we take *CPI* and *CPI2* into consideration. This indicates that the effect of operating cycle on cash holdings is not a simple negative linear relationship. The cash holdings of listed firms decrease as the operating cycle increases, but once it exceeds a critical value, listed firms increase their cash holdings as a precautionary measure, in response to the gradually increased operational risk. The mathematical meaning of the regression results is that in a coordinate system with *Cycle* along the x axis and $\Delta Cash$ along the y axis, *Cycle* is a concave function. The regression based on the panel data calculates the range of the inflection point distribution around 1.6164, with most of the data distributed on the left of the axis of symmetry, and few data points on the right (see [Fig. 4](#)). These results validate [Hypothesis 2](#).

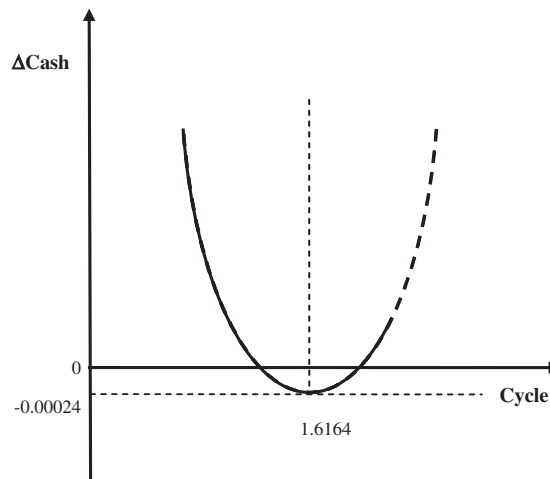


Figure 4. U-shaped curve of the relationship between operating cycle and cash holdings.

4.3. Further analysis

4.3.1. Inventory turnover period, accounts receivable turnover period and cash holdings

Table 6 further tests the effect of listed firms' cash holdings on the inventory turnover period and the accounts receivable turnover period. From the regression results in columns 1 and 4, we can see that *Invent* has a negative coefficient, significant below the 1% level. *Invent2* is not significant, indicating that the cash holdings of listed firms gradually reduce as the inventory turnover period increases and that there is a linear relationship between the inventory turnover period and cash holdings. The regression results in columns 2 and 5 indicate that *Recv* has a larger coefficient than *Invent* and is significantly negative at the 1% level, and *Recv2* has a positive coefficient and is significant below the 10% level. The results remain robust regardless of whether we use the *CPI* or its squared term. As the accounts receivable turnover period increases, listed firms gradually reduce their cash holdings, but start to increase them once the accounts receivable turnover period increases above a critical threshold. From the combined regression results in Tables 5 and 6, we can infer that due to the relationship between the level of cash holdings and the accounts receivable turnover period, firms will increase their cash holdings when the operating cycle increases beyond a certain level, perhaps because they are more sensitive to the extension of the receivables payback period. Inventory backlogs and slow-moving and defective risks can be dispersed by sales channels, price discounts, and re-working. However, receivables' bad debt losses have an immediate effect on the normal turnover of funds. When the accounts receivable turnover period reaches the critical level, according to the precautionary motive, listed firms will pay more attention to internal capital accumulation and increase their cash holdings to protect themselves against future uncertainties and the risk of loss.

4.3.2. Investigation of the interaction effect between inflation and the operating cycle

Inflation not only has a direct effect on firms' cash holdings by affecting the demand and supply for cash, but also an indirect effect via the operating cycle. Changes in the level of inflation, inventory turnover, and accounts receivable turnover have different effects on cash holdings. The level of inflation has different effects on cash holdings as the operating cycle (inventory turnover, accounts receivable recovery period) extends or shortens. Hence, we conduct further analysis to examine the interactive effect of *CPI* and *Cycle* on cash holdings.

Taking the level of inflation as the standard, we divide the whole sample into three groups according to *CPI*, with group 0 representing low *CPI* and group 2 representing high *CPI*. We use Model (1) to test the effect of operating cycle on the level of cash holdings under different levels of inflation and the results are presented in Table 7.

Table 6

Inflation, inventory turnover period, receivable accounts turnover period, and cash holding changes (panel results).

	Non-CP ²			CP ²		
<i>Intercept</i>	-0.5973*** (0.000)	-0.5648*** (0.000)	-0.5558*** (0.000)	8.7943*** (0.000)	8.8412*** (0.000)	8.8630*** (0.000)
<i>CPI</i>	-0.0015*** (0.000)	-0.0016*** (0.000)	-0.0016*** (0.000)	-0.1854*** (0.000)	-0.1857*** (0.000)	-0.1860*** (0.000)
<i>CP²</i>				0.0009*** (0.000)	0.0009*** (0.000)	0.0009*** (0.000)
<i>Invent</i>	-0.0278* (0.028)		-0.0263* (0.043)	-0.0273* (0.030)		-0.0258* (0.047)
<i>Invent²</i>	0.0051 (0.323)		0.0044 (0.402)	0.0049 (0.345)		0.0042 (0.429)
<i>Recv</i>		-0.0919* (0.022)	-0.0878* (0.030)		-0.0933* (0.020)	-0.0893* (0.027)
<i>Recv²</i>		0.1438* (0.070)	0.1669* (0.036)		0.1465* (0.064)	0.1699* (0.033)
<i>CF</i>	0.1117*** (0.000)	0.1128*** (0.000)	0.1111*** (0.000)	0.1185*** (0.000)	0.1195*** (0.000)	0.1178*** (0.000)
<i>Lnasset</i>	0.0276*** (0.000)	0.0260*** (0.000)	0.0266*** (0.000)	0.0271*** (0.000)	0.0255*** (0.000)	0.0261*** (0.000)
<i>Tobinq</i>	0.0221*** (0.000)	0.0219*** (0.000)	0.0217*** (0.000)	0.0209*** (0.000)	0.0207*** (0.000)	0.0205*** (0.000)
<i>Risk</i>	0.0066 (0.142)	0.0074* (0.099)	0.0070 (0.120)	0.0034 (0.453)	0.0042 (0.352)	0.0038 (0.404)
ΔNWC	0.1061*** (0.000)	0.1055*** (0.000)	0.1060*** (0.000)	0.1054*** (0.000)	0.1048*** (0.000)	0.1053*** (0.000)
$\Delta Sdebt$	0.0090** (0.010)	0.0096** (0.006)	0.0094** (0.008)	0.0097** (0.006)	0.0103** (0.003)	0.0101** (0.004)
Control	Fixone	Fixone	Fixone	Fixone	Fixone	Fixone
Adj <i>R</i> ²	0.245	0.244	0.246	0.248	0.247	0.249
<i>N</i>	8657	8657	8655	8656	8656	8654

Absolute values of *t*-statistics are shown in brackets. Fixone controls for firm fixed effects and Fixtwo controls for year and firm fixed effects.

*** Significance at equal to or less than the 1% level.

** Significance at equal to or less than the 5% level.

* Significance at equal to or less than the 10% level.

For group 0, when inflation is at a low level, the coefficient of *Cycle* is not significant under a linear specification. However, the coefficient of *Cycle* is significantly positive and the coefficient of *Cycle2* is significantly negative in the quadratic specification. For group 1, when inflation is at a medium level, the coefficient of *Cycle* is not significant. When inflation is high (Group 2), the coefficient of *Cycle* is significantly negative and the coefficient of *Cycle2* is significantly positive.

The regression results indicate that when the inflation level is low, there is a significant positive association between the operating cycle and cash holdings up to a certain point, after which the association turns negative. When the inflation level is high, there is a significant negative association between the operating cycle and cash holdings up to a certain point, after which the association turns positive. This difference may occur because in periods of low inflation, enterprises face a more relaxed financing environment and fewer financial constraints, and thus are able to obtain low-cost external funds. Meanwhile, firms with longer operating cycles realize that the value of their funds is reduced; hence, they increase their cash holdings as a precaution. As inflation rises, the excess liquidity in the country usually causes money supplies to tighten. The government may exercise macrocontrol by raising the deposit-reserve ratio to reduce the money supply. The size of the banks' credit will shrink, so the banks become particularly cautious in granting loans and set more demanding conditions, which causes strong external financing constraints. At the same time, for enterprises with long operating cycles, the usage efficiency of working capital is relatively low. An insufficient supply of operating cash flow

Table 7
Operating cycle and cash holding changes (grouped by CPI and without CPI²).

	Group 0		Group 1		Group 2	
	(1)	(2)	(1)	(2)	(1)	(2)
<i>Intercept</i>	0.2262 (0.336)	0.1929 (0.413)	-0.4925 (0.153)	-0.4842 (0.160)	-1.5534*** (0.000)	-1.5265*** (0.000)
<i>CPI</i>	-0.0076*** (0.001)	-0.0074*** (0.001)	0.0053* (0.093)	0.0052* (0.100)	0.0058*** (0.000)	0.0055*** (0.001)
<i>Cycle</i>	-0.0028 (0.690)	0.0367* (0.049)	-0.0006 (0.920)	0.0100 (0.563)	-0.0151* (0.056)	-0.0591* (0.011)
<i>Cycle</i> ²		-0.0161* (0.022)		-0.0042 (0.508)		0.0162* (0.043)
<i>CF</i>	0.2353*** (0.000)	0.2349*** (0.000)	0.1721*** (0.000)	0.1729*** (0.000)	0.1794*** (0.000)	0.1790*** (0.000)
<i>Lnasset</i>	0.0179*** (0.000)	0.0181*** (0.000)	-0.0039 (0.393)	-0.0039 (0.397)	0.0414*** (0.000)	0.0419*** (0.000)
<i>Tobinq</i>	0.0228*** (0.000)	0.0238*** (0.000)	0.0182*** (0.000)	0.0183*** (0.000)	0.0237*** (0.000)	0.0233*** (0.000)
<i>Risk</i>	-0.0021 (0.810)	-0.0041 (0.639)	0.0005 (0.946)	0.0002 (0.974)	-0.0042 (0.639)	-0.0028 (0.752)
ΔNWC	0.3454*** (0.000)	0.3480*** (0.000)	0.2803*** (0.000)	0.2809*** (0.000)	0.0731*** (0.000)	0.0736*** (0.000)
$\Delta Sdebt$	0.2474*** (0.000)	0.2499*** (0.000)	0.2218*** (0.000)	0.2217*** (0.000)	-0.0191*** (0.006)	-0.0191*** (0.006)
Control	Fixone	Fixone	Fixone	Fixone	Fixone	Fixone
Adj <i>R</i> ²	0.597	0.598	0.558	0.558	0.419	0.420
<i>N</i>	2881	2880	2891	2890	2886	2885

Absolute values of *t*-statistics are shown in brackets. Fixone controls for firm fixed effects.

*** Significance at equal to or less than the 1% level.

** Significance at equal to or less than the 5% level.

* Significance at equal to or less than the 10% level.

leads to greater operational risks, making it harder for them to obtain bank loans and thus increasing their external financing constraints. In addition, increases in raw material prices due to inflation demand more working capital, which makes internal funds generally tight and causes more serious delinquency, which extends the operating cycle. In other words, the effect of inflation on business enterprises leads to further deterioration in their ability to generate operating cash and external financing capacity. It becomes increasingly difficult for them to maintain a certain level of cash holdings. Therefore, when levels of inflation are high, the cash holdings of firms with longer operating cycles will be significantly reduced.

4.4. Robustness tests

We replace operating cycle with the cash turnover period to evaluate firms' operating capacity. Verlyn and Laughlin (1980) take the cash cycle as a measure of working capital management because it can reflect capital operating efficiency more comprehensively than the turnover rates of current assets, such as the inventory turnover and accounts receivable turnover rates. Wang et al. (2007) holds that the cash turnover period associates working capital management with supply chain management and avoids the contradiction derived from examining the elements in isolation without considering the relationship between them (for example, the easing of credit policy shortens the inventory turnover period and increases the accounts receivable, leading to a decrease in the accounts receivable turnover rate). In addition, different from the operating cycle, the cash turnover period takes into account both current liabilities in working capital and the time factor in cash inflows and outflows, so that we can identify the effects of the flow of inventory, accounts receivable and accounts payable on working capital as a whole. Therefore, we conduct this robustness test by substituting operating cycle with cash turnover period and achieve the same findings (see Fig. 5).

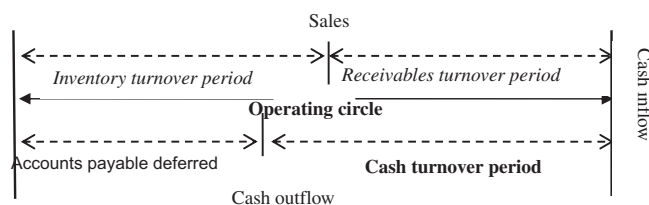


Figure 5. Cash turnover period = inventory turnover period + accounts receivable payback period – accounts payable deferred period.

5. Concluding remarks

At the macrolevel, continuously rising prices and inflation, which are the focus of state macrocontrol policies, affect firms' production decision making and cash holdings. Using the consumer price index, this study verifies and explains the finding that corporate cash holdings decrease as inflation increases from the perspective of the loss in purchasing power of monetary assets. However, when inflation reaches a certain level, firms increase their cash holdings to guard against bankruptcy. At the microlevel, we find that corporate cash holdings decrease with longer operating cycles, but when inflation reaches a certain level, firms increase their cash holdings to mitigate risk. Hence, there is a U-shaped relationship between operating cycle and cash holdings. This study also investigates the interactive influence of inflation and operating cycle on the amount of cash holding, thus expanding our knowledge of this area.

Acknowledgements

This study is supported by grants from the project No.71102123, National Natural Science Foundation of China, and also from the "Project 211" Fund of the Central University of Finance and Economics, China.

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