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The more, the merrier: Performance effects of cash over the business cycle

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ABSTRACT

This paper adds to the recent interest in the link between cash and firm performance, by studying how this relationship varies across boom- and bust cycles. We use data of Norwegian firms from a broad range of sectors in the period 2005–2015, and both replicate and extend previous findings on the relationship between cash and performance over the business cycle. We find that i) cash has a positive, but weakly diminishing effect on operational firm performance (ROA) throughout the entire sample period, and ii) that the curvilinear relationship between cash and firm performance is the most pronounced in the pre-recession years, while it is virtually linearly positive in recessions and post-recession periods. We conclude that cash indeed has an impact on firms' operational performance, and especially so in recessionary times.

1. Introduction

Traditionally, strategy scholars have disregarded cash as a strategic asset (e.g. Barney, 1986), while finance scholars have viewed cash holdings as a signal that a firm lacks profitable investment opportunities or have managerial issues (e.g. Jensen, 1986). Recent studies have questioned these views by documenting that cash may indeed be positively related to performance (Kim & Bettis, 2014), and that contextual factors such as state of the business cycle (Nason & Patel, 2016) and competitive dynamics (Deb et al., 2017; Jung et al., 2020; O'Brien & Folta, 2009) are important moderators for the strength of the cash-performance relationship.

While this recent research stream has made important advancements to our understanding of the relationship between cash and firm performance, we know less about how these insights can be generalized to other contexts than large, listed (manufacturing) companies operating in relatively stable periods, and if relationships between cash and market-based measures of performance also holds for operational measures of performance. Currently, most studies on the cash-performance relationship use samples of large, listed, US, (manufacturing) firms (e.g. Deb et al., 2017; Jung et al., 2020; Kim & Bettis, 2014; O'Brien & Folta, 2009), study relatively stable periods and not more turbulent times such as economic downturns where financing constraints tends to increase (Forseth et al., 2015), and/or use market-based measures of firm performance such as Tobin's Q as their dependent variables (e.g. Deb et al., 2017; Jung et al., 2020; Kim & Bettis, 2014; O'Brien & Folta, 2009).

The purpose of this paper is to add to the small emergent stream of papers that address this gap in the extant literature on the performance effects of cash (e.g. Alnori, 2020; Dimitropoulos et al., 2020; La Rocca et al., 2019). More specifically, we set out to do four main things: First, we rely on a sample of both listed and unlisted Norwegian firms from a broad range of industries in the period 2004–2015, which allows us to generalize findings to a broader set of firms and industries. Second, we use return on assets (ROA) instead of Tobin's Q as a performance measure, to study the effect of cash on operational profits. Third, we study the effect of cash over the different phases of the business cycle to tease out variations in the impact of cash in stable and more turbulent periods. Finally, we replicate the model of Nason and Patel (2016), one of the few studies that have analyzed the performance implications of cash over the business cycle using both Tobin's Q and ROA as their DV, before we extend this model by adding additional control variables. This allows for a more meaningful comparison of our results to previous studies using Tobin's Q.

Our main findings are as follows. First, by replicating Nason and Patel's (2016) model on Norwegian data, we find a strong, curvilinear relationship between cash and operational firm performance, with a positive linear term and a negative quadratic term. We also find that the curvilinear relationship is more pronounced in recessions. These findings echo the original findings of Nason and Patel (2016). Second, we find that adding controls for prior performance, market share and sales

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growth changes the curvilinear relationship between cash and firm performance from pronounced to weakly diminishing, and also reduces the strength of the cash-performance relationship. This may indicate that the performance effects of cash may be over-estimated if controls for prior performance, market share and sales growth are omitted. Third, when running split-sample regressions of our full model for the different phases of the business cycle we find that cash is positively correlated with firm performance in all periods, but also that the curvilinear relationship only materialized during the pre-recession period. In the recession and post-recession (recovery) periods the relationship between cash and performance is almost linear, indicating that more cash is better. This implies that the benefits of holding cash seems to outweigh the costs more clearly during the recession- and post-recession (recovery) times.

In sum, our analyses answer recent calls for more research on the cash-performance relationship using samples that cover different types of firms and different contexts (da Cruz et al., 2019; Kim & Bettis, 2014). Our findings also directly complement previous research on the topic. We show that the relationship between cash and ROA in the pre-recession phase is similar to the inverse-u relationship between cash and Tobin's Q documented in earlier studies (Kim & Bettis, 2014; Nason & Patel, 2016), but when the economy enters a recession the relationship in our model turns linear implying that more cash is better. This contrasts Nason and Patel's (2016) finding that the curvilinear relationship becomes more pronounced in recession, while it is in line with Jung et al. (2020) and Deb et al. (2017) who found that cash holdings are the most useful in dynamic and complex settings. It is also in line with La Rocca et al. (2019) who found that the positive relationship between cash and ROA was stronger in recessionary times. In the Discussion section, we examine potential explanations and implications of our findings for research and practice.

2. Theory and hypotheses

Cash has traditionally been disregarded as a strategic asset in both strategy and finance. In strategy, cash (and financial assets more generally) has been viewed as an unlikely direct source of competitive advantage because of its homogenous nature (Barney, 1991). Strategy research have also tended to (implicitly) assume that financial markets are sufficiently efficient for positive NPV-investments to be financed (Knudsen & Lien, 2014). This means that cash holdings also has been disregarded as an important indirect source of advantages through the financing of other (strategic) assets. In finance, cash has been viewed in an even dimmer light as it earns low returns and have high opportunity costs (Kim & Bettis, 2014), and because it could signal that a firm lacks profitable investment opportunities or has managerial problems (Jensen, 1986).

Recent studies question these traditional views on the performance implications of cash (Bates et al., 2009; Deb et al., 2017; Fresard, 2010; Jung et al., 2020; Kim & Bettis, 2014). This emergent literature documents that cash may have both beneficial and detrimental effects on performance, and that which of the two forces that dominate depends on factors such as the level of cash (Kim & Bettis, 2014), firm-level moderators (Deb et al., 2017; La Rocca et al., 2019) and contextual moderators (Deb et al., 2017; Jung et al., 2020; La Rocca et al., 2019; Nason & Patel, 2016). In what follows, we first review some of the (general) performance benefits and -costs of holding cash highlighted in the literature, before developing our hypotheses about how the performance effects of cash will change over the business cycle.

2.1. Performance effects of cash

2.1.1. Benefits of holding cash

The most highlighted benefit of holding cash is to provide firms with increased flexibility. Cash-rich firms do not have to go to the external capital market to finance strategic responses to market turbulence, or to finance other strategic initiatives that involves detouring from the firms' existing trajectory (Bates et al., 2009; Hall & Lerner, 2009; Kjellman & Hansén, 1995; Orens & Reheul, 2013). Rich cash reserves also give leeway for quick decision making and implementation of strategies to act on potentially profitable opportunities before their competitors (Gamba & Triantis, 2008; Rapp et al., 2014). For example, a cash rich firm can act on, and secure, a profitable acquisition before competitors that depend on the external capital market to fund investments. Excess cash also allows firms to endure the option value of waiting longer for more and updated information in times of uncertainty (Bernanke, 1983). This allows firms to postpone irreversible resource commitments until key uncertainties have been resolved (Ghemawat & Del Sol, 1998).

A second broad benefit of cash is that it can influence the product market choices of other firms (Fresard, 2010). That is, cash can have a strategic value. For example, cash reserves can be used to deter entry by signaling a firm's ability to respond aggressively to entrants by for example initiating price wars (Kim & Bettis, 2014). More generally, cash can be used to distort or influence the investment or expansion decisions of rivals, and ultimately serve as a barrier to entry for potential competitors (Fresard, 2010). And cash can mitigate product market threats and be a competitive tool in industries with high competitive intensity or dynamics (Hoberg et al., 2014; Jung et al., 2020).

Finally, cash holdings also enable firms to invest more in the accumulation of intangible (and other uncertain) assets that are difficult to finance through external capital markets (Hall & Lerner, 2009). Intangible assets like innovation, R&D and human capital, are usually costly (or even impossible) to finance by the means of credit (Hall, 2010; He & Wintoki, 2016). Most intangible assets do a very poor job as collateral for creditors, with low salvage value, high levels of asymmetric information, and low initial cash flows. Many intangible investments must therefore be financed by retained profits, through credit that draws on available borrowing capacity in other (physical) assets, or by equity. As the latter two financing options are costly and often difficult to assess, firms with a high share of intangible assets tend to rely primarily on internal finance (Hall, 2010). A cash rich firm will therefore face fewer financial constraints on their strategic priorities, which both enables them to invest more than externally financed competitors, and to have a better ability to sustain ongoing investments in intangible assets through periods of low profits (Brown & Petersen, 2011).

2.1.2. Costs of holding cash

Cash is often seen as financially wasteful since it earns very low measurable returns and incurs large opportunity costs (Kim & Bettis, 2014; Orens & Reheul, 2013). Large cash holdings might also lead to over-investment in less profitable investment opportunities (Bhuiyan & Hooks, 2019; Richardson, 2006), increased entrenchment (Nason & Patel, 2016), and poor governance (Jensen, 1986).

The key idea here is that large cash holdings might signal that the managers are reluctant to pay out cash to shareholders, or that they prefer to use that cash for investments that are in their personal interest (which may differ from the interests of shareholders). The worry is that firms with agency problems are more likely to hoard cash despite a lack of good investment opportunities (Jensen, 1986). This view is perhaps the main reason why excess cash has been viewed in a dim light for decades and led to the view that cash should either be invested or paid out to shareholders instead of being held by firms.

2.1.3. Cash and firm performance

Recent evidence suggests that the benefits of cash tends to dominate the costs for lower levels of cash, while the costs tends to dominate for higher levels of cash (Kim & Bettis, 2014; Nason & Patel, 2016; O'Brien & Folta, 2009). This essentially suggests that the relationship between cash and firm performance follows an inverse U-shaped pattern where the marginal benefits of an additional unit of cash is positive (at a diminishing rate), until a point where the costs of holding cash starts to dominate and the relationship turns negative (Kim & Bettis, 2014; Nason

& Patel, 2016). That is; additional cash is beneficial when a firm has little cash from before. The more cash it has, the less additional benefits it will get from an extra unit of cash. And if a firm has sufficiently high levels of cash, it may purse less profitable investment opportunities, be punished by stakeholders, and face governance problems, which means that additional cash starts to be detrimental for performance. Based on this, we suggest the following baseline hypothesis:

Hypothesis 1. *Cash has a curvilinear relationship to firm performance, with a positive linear term and a negative quadratic term.*

2.2. Performance effects of cash over the business cycle

From the earlier discussion, two instances where cash holdings may be especially beneficial is when markets are more turbulent or less predictable (Deb et al., 2017; Hoberg et al., 2014; Jung et al., 2020), and when a firm face financing constraints (Almeida et al., 2014; da Cruz et al., 2019; Hall, 2010). In such situations, large cash holdings increase the flexibility of firms to pursue investments without having to rely on the expectations and evaluations of these investments by the financial market, and they will not be bound by financing constraints created by costlier external finance. In broad, these simple insights predict that the cash-performance relationship is likely to change over the business cycle.

Starting with booms, these are periods with high environmental munificence, high optimism, stability, low uncertainty, and a plethora of attractive investment opportunities. Linked to the earlier discussion, this means that the adaptive benefits of cash should be relatively lower in booms compared to the other phases of the business cycle. Booms have less turbulence and uncertainty, and more stable growth (Jung et al., 2020). At the same time, the negative signal from holding large cash reserves (Jensen, 1986) is likely to be bigger in booms as the high munificence implies more available investment opportunities, and higher opportunity costs of holding cash. Or to put it more bluntly, if a firm cannot find attractive investment opportunities in a boom, when should it find them?

The curvilinear relationship between cash and firm performance predicted by H1 should thus be more pronounced in boom-periods. The marginal benefits of additional cash should be higher for firms with low cash levels, and the turning point in which the benefits of cash is outweighed by the costs should move to the left. That is, the costs of holding cash will dominate the benefits for lower cash-ratios compared to "normal" times. This leads to our second hypothesis:

Hypothesis 2. *Cash has a more pronounced curvilinear relationship to firm performance in booms, with a positive linear term and a negative quadratic term.*

Moving to recessions, these are periods of high turbulence, high uncertainty, low environmental munificence and relatively less efficient financial markets (Reinhart & Rogoff, 2009). The two most defining characteristics of recessions are reductions in aggregate demand and a reduction in access to finance (Campello et al., 2010; Hausman & Johnston, 2014; Kashyap & Zingales, 2010; Knudsen, 2019). For the majority of firms in an economy, these two factors reduce investment opportunities (Ghemawat, 2009), reduce profits and access to internal funding (Bond et al., 2005), and lead to more expensive (or unavailable) external funding (Bernanke & Gertler, 1990; Ivashina & Scharfstein, 2010). In sum, all this have a negative impact on both firms' *ability* and *incentive* to invest (Knudsen & Lien, 2014, 2019).

Studies on the Great Recession document how financing constraints caused by a recession have a negative (indirect) effect on performance through affecting firms' resource accumulation and investment behavior. Campello et al. (2010) found that 90 % of financially constrained firms in their sample reported that financing constraints restricted their pursuit of attractive projects during the financial crisis of 2008, and more than half of these firms were forced to cancel promising investments. Constrained firms also displayed a much higher propensity to sell off productive assets as a way to generate funds, and they were also forced to burn a sizable portion of their cash savings during the crisis. Duchin et al. (2010) showed that the tightened supply of external financing following the crisis, mainly hurt investment levels in firms with small cash reserves. Fresard (2010) found that firms with low cash levels had to cut R&D, employees, and capital spending to cope with the tightened credit conditions. Finally, Knudsen & Lien, 2019 found that financially constrained firms were forced to reduce their investments in R&D and innovation during the great recession, even though they had the incentives to maintain them.

In sum, all this implies that many of the benefits of holding cash outlined earlier become even more beneficial in a turbulent and uncertain recession where access to external finance is constrained (Bliss et al., 2015; Jung et al., 2020; Knudsen & Lien, 2014). Cash-rich firms have a better ability to prioritize long run growth and profitability, and they are not forced to make short term adjustments that may hamper their longer-term competitive potential. However, cash-rich firms can also take advantage of the environmental turbulence. They can engage in efforts to strengthen their position vis-à-vis competitors that face more binding financing constraints (Fresard, 2010), or take advantage of other factor-market imperfections to acquire assets at potentially large discounts (Shleifer & Vishny, 2011). At the same time, many of the costs associated with holding cash should also be lower in recessions. High uncertainty, reduced environmental munificence, and fewer investment opportunities means that the opportunity costs and the negative signals associated with holding cash should be lower in recessions compared to both boom- and more stable periods. Combined, this means that the curvilinear relationship between cash and performance predicted by H1 should be less pronounced in recessions, and that the turning point in which the costs of holding cash outweigh the benefits should move to the right. That is, it should take a relatively higher level of cash for a firm to experience negative marginal performance for additional units of cash. This leads to our third hypothesis:

Hypothesis 3. *Cash has a weaker curvilinear relationship to firm performance in recessions, with a positive linear term and a negative quadratic term.*

Finally, we have the recovery phase, where the economy starts to leave the recession behind. In the recovery phase, uncertainty is lower, environmental munificence improves, and more investment opportunities emerge. However, since many firms- and managers are to some extent scarred by the recession years (Ouyang, 2009), the general level of optimism-, the ability to finance investments, and the general risk-appetite among both firms and investors are all likely to be lower compared to the boom years (but higher compared to recessions). This means that a recovery phase should have a cash-performance relationship that sits in the middle of that observed in booms, and that observed in recessions.

We therefore expect a curvilinear relationship between cash and performance, where the turning point where the costs of holding cash starts to exceed the benefits will be located somewhere between the turning points in the boom- and recession periods.

Hypothesis 4. *Cash has a more pronounced curvilinear relationship to firm performance compared to recession, but less pronounced compared to the boom-period.*

3. Data and methods

3.1. Research context

We use the financial crisis of 2008 and the subsequent recession in Norway as our research context and compare the performance effects of cash in this period with the preceding boom and subsequent recovery-periods.

The Great Recession was weaker in Norway compared to many other countries, but still strong in absolute terms. To exemplify, data from Statistics Norway[1] shows that Norway's GDP growth dropped from 2.7 % in 2007 to 1.8 % in 2008 and − 1.5 % in 2009. Gross capital investments dropped from a yearly growth of 16.1 % in 2007, to a negative growth of − 7 % in 2009, while bankruptcies increased with 106 % between 2007 and 09. Finally, 67 % of the surveyed firms in Knudsen, Lien, Timmermans, & Wuebker, 2022 report to have experienced contractions in demand because of the recession. The fact that the crisis originated outside of Norway, also implies that the recession can be seen as an exogenous shock to Norwegian firms (Knudsen & Foss, 2015).

3.2. Sample

To construct our sample, we started out with a database of all Norwegian firms in the period 2004–2015, and then removed firms with certain characteristics following a similar procedure as Knudsen & Lien (2019) who also used Norwegian data. First, we removed firms with sales revenue < 10MNOK (approximately 1.3 M USD) to avoid the smallest firms to dominate our sample..[2] Second, we removed firms with personnel costs < 3 M NOK (approximately 0.4 M USD), to ensure that firms had at least 3–5 employees.[3] Third, we excluded firms from industries that are not considered competitive or profit maximization, firms with missing NACE codes, or firms in industries with very different reporting practices and capital structures (such as banking, finance and insurance).[4] Fourth, we excluded firms with missing geographical information, based on the assumption that missing geographical information weakens the validity of the observation. Finally, we removed firms with extreme values of ROA, EBITDA-margin, debt ratio and cash ratio, and we removed observations with Cook's D > 1. The final dataset consists of 241.517 firm-year observations. See the Appendices for an overview over the effect of each cut-off criteria on our sample size and the industries included in the sample.

3.3. Variables

3.3.1. Dependent variable

Our dependent variable is *return-on-assets (ROA)*. As a robustness check, we also ran our models using EBITDA margin as the dependent variables. Overall, the results were very similar across the two measures; both coefficient signs and significance are nearly identical, though the absolute coefficient values are lower using EBITDA.

3.3.2. Independent variables

Our two independent variables are *cash ratio,* and *business cycle phase. Cash ratio* is measured as the ratio of cash to total assets. To capture the phase of the business cycle, we first split the period 2004–2015 into the three different phases: *pre-recession-* (2005–2007), *recession-* (2008–09) and *post-recession* period (2010–2015). Then, in our regressions, we first use *recession* as a dummy variable, with the non-recession years as the baseline. Finally, we run split-sample regressions on the different time periods.

3.3.3. Instrumental variable

We perform the Durbin-Wu-Hausman test for endogeneity, and the p-value of 0.000 clearly indicates that firm cash ratio should be treated as an endogenous variable. To correct for this, we apply an instrumental variable (IV) analysis using the ivregress 2SLS command in STATA. More specifically, we follow Nason and Patel (2016) and use *peer cash holdings* as an instrumental variable (IV). To calculate this variable, we first aggregate yearly total cash holdings and total asset values in each 2-digit NACE-industry, before we calculate peer cash holdings for each industry *i* in each year *t*:

$$Peer\ cash\ holdings_{it} = Total\ cash_{it} / Total\ assets_{it}$$

We then subtract peer cash holdings from the cash ratio for all observations which results in the final instrumental variable (IV).

The requirement for using an IV to reduce endogeneity problems is that the IV does not affect the dependent variable directly, but only through the explanatory variable. Using peer cash holdings as an instrument sees to fulfill this requirement; the industry cash average will most likely explain a significant amount of a firm's given cash level, but it will not directly affect a specific firm's performance (Nason & Patel, 2016). First stage tests of peer cash holdings clearly reject the null-hypothesis of peer cash holdings as a weak instrument and supports the decision of including this variable as an instrumental variable in our regressions.

Another issue that arise with the assumption that firm cash ratio may be endogenous is that any interaction with an endogenous variable should also be considered endogenous. Løken, Mogstad, & Wiswall, 2012 argue that there are two ways to solve this endogeneity problem. First, since we assume that peer cash holdings is a valid instrument, any interaction with another independent variable will by definition also be exogenous and can be used as an instrument. The second method revolves around using predicted values of firm cash ratios as instruments instead of interacting independent variables. According to Carneiro et al. (2011) and Mogstad and Wiswall (2010), this second approach is superior when it comes to estimate efficiency. We therefore follow the second approach, by regressing the cash ratio variable using the instruments and control variables to predict the value *Cash hat,* which we then use in our analyses of interaction effects between recession and cash holdings.

3.3.4. Control variables

We also include several control variables to our regressions. Our first set of controls are derived directly from Nason and Patel (2016), and includes *absorbed slack, debt ratio, capital intensity, Altmans Z, firm size* and *industry dummies*. Absorbed slack is a measure of how much of unaccounted costs or reduced income a firm has included in their financial reporting, and is usually reported as the ratio between selling-, general- and administrative costs (SG&A), and sales income (Kim & Bettis, 2014). In Norway, these costs are not reported directly in the income statement, so we had to generate an approximate variable. We therefore define *absorbed slack* as the sum of personnel expenses, loss on receivables and operating expenses, divided by sales. *Debt ratio* is calculated by scaling the sum of long-term and short-term debt on total assets, while *Capital intensity* is measured as capital expenditure divided by sales. For *Altman's Z, we* use Altman's revised Z-score, since this relies on book value on equity and not market value (which we do not have for our unlisted firms). *Firm size* is measured as the natural logarithm of sales. Ideally, we would have liked to follow Nason and Patel (2016) and used natural log of employees as a proxy variable, but the this was not possible as most of the firms in our sample are not required to report changes in the number of employees to the registry we are drawing our dataset from. Finally, *industry dummies* are based on 2-digit NACE-group codes.

Our second set of control variables goes beyond Nason and Patel. *Lagged return on assets* is measured as ROA the previous year. We include this for two main reasons. The first is the "persistence-of-profit effect" where firms that do well one year, are more likely to do well the next year as well. The problem in our context is that firms that did well the previous year, are likely to have more cash from retained profits. By not

[1] https://www.ssb.no/statbank

[2] Adjusted for inflation with 2015 as the base year.

[3] Ideally, we would have liked to use data on the number of employees, but unfortunately it is not mandatory for firms to update their employee-data for the register we base our data on. This makes the number of employees a less reliable measure

[4] Firms with the following 2-digit NACE codes were removed from the sample: 01, 02, 65, 66, 68, 75, 80, 81, 85, 90, 91, 92, 99

Table 1
Descriptive statistics of key variables.

	Full Sample					Pre-Recession		Recession		Post-Recession	
	Count	Mean	SD	Min	Max	Mean	SD	Mean	SD	Mean	SD
ROA	227,403	0.09	0.15	-1	3.33	0.11	0.14	0.09	0.15	0.09	0.15
Cash Ratio	227,403	0.21	0.2	0	1	0.2	0.19	0.21	0.2	0.22	0.2
Absorbed Slack	227,403	0.49	0.29	-0.74	16.06	0.47	0.29	0.49	0.29	0.5	0.29
Debt	227,403	0.71	0.21	0	1.5	0.75	0.19	0.72	0.21	0.7	0.22
Capital Intensity	204,289	0.04	0.74	-65.35	60.88	0.04	0.62	0.04	0.63	0.04	0.8
Altman's Z	227,397	3.58	2.41	-5.25	431.1	3.53	2.26	3.58	3.04	3.6	2.24
Size*	227,403	135,480	941,468	10,000	9.39E+07	136,797	1,103,824	131,117	913,782	136,303	876,739
Sales Growth	204,289	0.08	0.37	-0.99	16.08	0.14	0.39	0.02	0.37	0.07	0.36
Market Share	227,403	0	0.02	0	1	0	0.02	0	0.02	0	0.02
Wages	227,403	25,169	116,708	3000	7975,236	23,828	116,421	24,501	111,318	25,915	118,438

*Descriptives presented without log.

Table 2
Correlation matrix.

	ROA	Cash Ratio	Cash^2	IV	Market Share	Annual Sales Growth	Slack	Debt Ratio	Altman's Z	C. Intensity	Size
ROA	1.000										
Cash ratio	0,316***	1.00									
Cash^2	0,276***	0,939***	1.00								
IV	0,302***	0,978***	0,925***	1.00							
Market Share	-0,007***	-0,048***	-0,032***	-0,036***	1.00						
Annual Sales Growth	0,117***	-0,006***	-0,009***	-0,009***	0,027***	1.00					
Slack	-0,135***	0,063***	0,063***	0,066***	0,007***	-0,071***	1.00				
Debt Ratio	-0,179***	-0,182***	-0,151***	-0,199***	-0,017***	0,064***	-0,000	1.00			
Altman's Z	0,303***	0,249***	0,194***	0,232***	-0,051***	0,028***	-0,295***	-0,079***	1.00		
C. Intensity	-0,004*	-0,036***	-0,029***	-0,032***	0,005**	0,035***	0,063***	-0,011***	-0,049***	1.00	
Size	-0,031***	-0,211***	-0,167***	-0,173***	0,294***	0,134***	-0,307***	0,005**	0,036***	0,007***	1.00

* $p < 0.10$, * * $p < 0.05$, * ** $p < 0.01$

including lagged ROA in the model, a concern is therefore that some of this effect will be captured by the cash variable, and in essence lead to an overestimation of the performance effects of cash. The second reason is to control for autocorrelation of the residuals (we return to this point below). *Market share* is calculated as the share of firm sales to the total sales of the respective industry (two-digit NACE) for each firm each year. We include this to control for the possibility that high ROA is driven by a firm's market power. Cash may indeed be used as a deterrent for new entrants, but by adding market share as a control, the cash variable will pick up how variations in cash levels affect performance, given a level of market share, instead of picking up the effect of market share on ROA. *Sales growth* is the growth in sales from the previous year. Sales growth was included in the models of Kim and Bettis (2014) and La Rocca et al. (2019), because earlier studies show that growth is positively associated with cash holdings (e.g. Opler, 1999). One reason is that high growing firms have more investment opportunities, while another is that they also face issues (e.g. higher costs) accessing external finance. Because we are interested in the effect of cash over the business cycle, it is important to control for growth rate to avoid the cash variable to pick up these characteristics of the firm and provide incorrect estimates of the "pure" cash effect.

Descriptive statistics of key variables are presented in Table 1, and the correlation matrix is presented in Table 2.

3.4. Data concerns

We employ several measures to account for common problems that arise when using panel data. First, we use robust standard errors to correct for heteroskedasticity errors.[5] Second, we did both a visual examination of our correlation matrix with all the independent and control variables, and VIF-tests to check for multicollinearity.[6] Third, as mentioned, we apply Instrumental Variable analysis to correct for the possibility of endogeneity.

Finally, we also add lagged ROA in our full model to control for autocorrelation. Because of the mentioned persistence-of-profit-effect, we suspected that autocorrelation might be an issue with our dependent variable. To see whether this was the case we both examined the scatter plots of Y against Yt,1 examined the correlation between the two variables, and we tested for autocorrelation using xtserial in STATA on our OLS model with predicted values of cash. From this, we concluded that autocorrelation was present.

While there undoubtedly are arguments in disfavor of adding a lagged dependent variable to control for autocorrelation, there are also arguments that implies that the problems are less severe in our case. One argument is our large sample size (Kiviet, 1995). A second is that our dependent variable is at least weakly stationary (Keele and Kelly, 2006). While we believe there is a relationship between firm performance from one period to the next, we find it very unlikely that ROA will display the characteristics of a highly persistent time trend (e.g. D'Aveni et al., 2010). We thus interpret this as the loosened criterion of stationarity holds (Keele and Kelly, 2006). A third argument is that the inclusion of lagged ROA makes theoretical sense (cfr. earlier discussion), and its omission would therefore create a problem with omitted variable bias.

[5] The Breusch-Pagan- and White tests provide a p-value of 0.000, indicating that our model exhibits heteroskedastic errors for both linear and non-linear relationships.

[6] We have no independent or control variables that have a correlation above.4, except for the squared term and the IV, and we had no variables with VIF value above 4.

Table 3
Baseline regression: replication of Nason and Patel (2016) with ROA as DV.

	OLS	2SLS			
	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA
Focus Variables					
Cash ratio		0,169***	0,217***	0,164***	0,206***
		(0,003)	(0,009)	(0,003)	(0,009)
Cash^2			-0,075***		-0,066***
			(0,011)		(0,012)
Recession				-0,007***	-0,009***
				(0,001)	(0,001)
Recession*Cash hat				0,026***	0,052***
				(0,004)	(0,012)
Recession*Cash hat^2					-0,042**
					(0,019)
Control variables					
Slack	-0,058***	-0,060***	-0,060***	-0,060***	-0,060***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Debt ratio	-0,108***	-0,081***	-0,080***	-0,081***	-0,080***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
C. Intensity	0,002***	0,004***	0,004***	0,004***	0,004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Altman's Z	0,019***	0,015***	0,015***	0,015***	0,015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Size	-0,007***	-0,002***	-0,002***	-0,002***	-0,002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0,189***	0,095***	0,088***	0,096***	0,090***
	(0.010)	(0.007)	(0.006)	(0.007)	(0.006)
Industry controls	YES	YES	YES	YES	YES
R^2	0.138	0.183	0.184	0.183	0.184
Observations	204,283	204,283	204,283	204,283	204,283

Standard errors in parentheses
*p < 0,10, * * p < 0,05, * ** p < 0,01

In sum, we recognize that including this lagged ROA as a control in our full model potentially opens for methodological problems, but we believe that doing so outweigh the costs in this case. With that said, we still want to note that we cannot rule out that doing so will cause our estimates to be downward biased and somewhat conservative (Kiviet, 1995). This should be kept in mind when interpreting the results of our full models.

4. Analyses and results

To make comparisons to earlier research using Tobin's Q and other research settings more meaningful, we first run a regression model based on Nason and Patel (2016) that we have replicated and adapted to our data set (Table 3). We chose this model for two reasons. The first is that it is the only paper that study the cash-performance relationship over the business cycle, while the second is that they also ran their models using ROA as robustness checks. Next, we expand the initial model by adding additional control variables (Table 4) to arrive at our full model. Finally, we run the full model on sub-samples of the different phases of the business cycle (Table 5).

4.1. Replicated regression model

The results from the replica-model are shown in Table 3 below. Model 1 shows the OLS with only the control variables, while Model 2–5 switch from simple OLS regression to 2SLS using industry cash ratio as an instrument of firm cash ratio.

From Model 1 in Table 3 we find that *cash ratio* is positive and statistically significant ($p < 0.01$) in all the models, and that *cash ratio squared* is negatively signed and statistically significant ($p < 0.01$). We also used the nestreg command in STATA to test whether adding the cash ratio squared to Model 3 significantly improved the model, which it did (F-value of 121.25). These results are in support of H1 which

Table 4
Expanded regression model.

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Focus variables				
Cash ratio	0.206***	0.103***	0.103***	0.093***
	(0.009)	(0.007)	(0.007)	(0.007)
Cash^2	-0.066***	-0.025***	-0.025***	-0.015
	(0.012)	(0.009)	(0.009)	(0.009)
Recession	-0.009***	-0.015***	-0.015***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)
Recession*Cash hat	0.052***	0.021**	0.021**	0.019**
	(0.012)	(0.010)	(0.010)	(0.010)
Recession*Cash hat^2	-0,042**	-0,014	-0,014	-0,015
	(0.019)	(0.015)	(0.015)	(0.015)
Added variables				
L. ROA		0517***	0,517***	0,525***
		(0,005)	(0,005)	(,0005)
Market Share			0,073***	0,090***
			(0,011)	(0,012)
Annual Sales Growth				0,056***
				(0,002)
Control Variables				
Slack	-0,060***	-0,043***	-0,044***	-0,038***
	(0,003)	(0,003)	(0,003)	(0,002)
Debt Ratio	-0,080***	-0,048***	-0,048***	-0,055***
	(0,002)	(0,002)	(0,002)	(0,002)
C. Intensity	0,004***	0,002***	0,002***	0.001
	(0,001)	(0,001)	(0,001)	(0,001)
Altman's Z	0,015***	0,011***	0,011***	0,011***
	(0,001)	(0,001)	(0,001)	(0,001)
Size	-0,002***	0.000	-0,000	-0,002***
	(0,000)	(0,000)	(0000)	(0,000)
Constant	0,090***	0,022***	0,027***	0,054***
	(0,006)	(0,005)	(0,005)	(0,005)
Industry Controls	YES	YES	YES	YES
R^2	0.184	0.403	0.403	0.422
Observations	204,283	196,628	196,628	196,628

Standard errors in parentheses
*p < 0,10, * * p < 0,05, * ** p < 0,01

Table 5
Expanded model with time-periods.

	(1) Pre-recession	(2) Recession	(3) Post-recession
Focus variables			
Cash ratio	0.120***	0.115***	0.085***
	(0.009)	(0.011)	(0.010)
Cash^2	-0.057***	-0.026*	0,001
	(0.014)	(0.015)	(0.012)
Added variables			
L. ROA	0,506***	0,510***	0,528***
	(0,008)	(0,012)	(0,007)
Market Share	0,090***	0,052**	0,096***
	(0,022)	(0,026)	(0,016)
Annual Sales Growth	0,044***	0,063***	0,057***
	(0,003)	(0,005)	(0,003)
Control Variables			
Slack	-0,034***	-0,047***	-0,035***
	(0,003)	(0,006)	(0,003)
Debt Ratio	-0,078***	-0,067***	-0,052***
	(0,004)	(0,005)	(0,002)
C. Intensity	-0,000	0.002	0.001
	(0,001)	(0,002)	(0,001)
Altman's Z	0,011***	0,011***	0,011***
	(0,001)	(0,001)	(0,001)
Size	-0,004***	-0,000	-0,002***
	(0,001)	(0,001)	(0,000)
Constant	0,096***	0,036***	0,045***
	(0,008)	(0,011)	(0,007)
Industry Controls	YES	YES	YES
R^2	0.424	0.428	0.421
Observations	44,449	35,673	116,506

Standard errors in parentheses
*p < 0,10, * * p < 0,05, * ** p < 0,01

predicted a curvilinear relationship between cash and firm performance on the form X-X^2.

Next, we see from Model 4 that the *recession* dummy is negatively signed ($p < 0.01$), and that the interaction between *recession* and *cash hat* is positively signed ($p < 0.01$). The interpretation of the interaction term is that for the recession years (2008 and 2009), the effect of cash on ROA is stronger compared to non-recession years. Model 5 includes the interaction term between the squared cash ratio and the recession dummy. This variable capture whether the curvilinear relationship of cash is different in a recessionary environment compared to a non-recessionary environment. The interaction coefficient is negative and statistically significant ($p < 0.05$), which indicates that the effect of cash on ROA is more sensitive in recessions and diminishes at a higher rate. Again, we test for changes in explanatory power; including the recession dummy and the two cash interactions significantly improve the model (F- value of 18.84), but the effect is too small to change the R2 with three decimal places compared to Model 4. In all, these results indicate that the relationship between cash and firm performance is more pronounced curvilinear during recessions.

In sum, the results from our replica are remarkably similar to those of Nason and Patel's (2016) models. In their full specification using Tobin's Q as the dependent variable, they too find a positive term for cash ratio, a negative term for cash ratio squared, a negative term for recession, a positive term for cash ratio x recession, and a negative term for cash ratio squared x recession. One difference is that all these terms are significant on a $p < 0.05$ or $p < 0.01$ level in our model, while *cash squared* in their full specification was only significant on a $p < 0.1$. Turning to Nason and Patel's robustness checks where they used ROA, the major difference between their results and ours is that the interactions of *recession* and *cash/cash squared* were not statistically significant in their ROA-model. We will return to a more elaborated discussion of potential explanations for these differences the Discussion section.

4.2. Full regression model

Next, we expand the model by including *lagged ROA*, *market share*, and *firm sales* as control variables. These results are show in Table 4 below.

From Table 4 we see that the three new control variables are all positive and statistically significant ($p > 0.01$), and that their inclusion increases the explanatory power of the model from 0.184 to 0.422 (Model 5 vs Model 8). Although lagged ROA accounts for most of the increase in R2, including the controls separately showed that all three variables led to significant increases in R2. We also see that adding the three new controls change the values of our focus variables. The linear effect of cash has dropped by roughly half, from 0.206 to 0.093. A similar, albeit more pronounced effect, can be found in the linear interaction term between cash and recession. The curvilinear relationship from the replicated model (Model 5 in Table 4), is no longer statistically valid at conventional levels (p-value of 10.1) With that said, the positive linear term and a negative quadratic term is as predicted and the fairly low p-value indicate that we should not completely disregard the nonlinear effect of cash on performance in the expanded model despite the lack of statistical significance. We therefore reject the part of the hypothesis that claims a pronounced curvilinear relationship, and instead conclude that this relationship is weakly curvilinear.

4.3. Full model with time periods

The partial rejection of H1 above occurred when examining the entire time period. We now turn to see if this relationship between cash and ROA is different for the pre-recession, recession, and post-recession period. Table 5 presents the regression results of the expanded model for the time periods *pre-recession (boom)* (2004–2007), *recession* (2008–2009) and *post-recession (recovery)* (2010–2015).

The first thing we note is that the explanatory power for all three time periods are similar and within a 0.7 % point interval of the regressions on the entire period. These differences are all statistically significant ($p < 0.01$). We note that the lagged term of ROA might introduce some interpretation issues in these split-sample regressions. Since the recession only lasted 2 years, only one lagged recessionary period is included. The same problem arises for the post-recession period as the lagged value from 2009 disappears. Though this might cause the lagged variable in Table 5 to be slightly incorrect, we do not believe that this problem causes any crucial issue in our model.

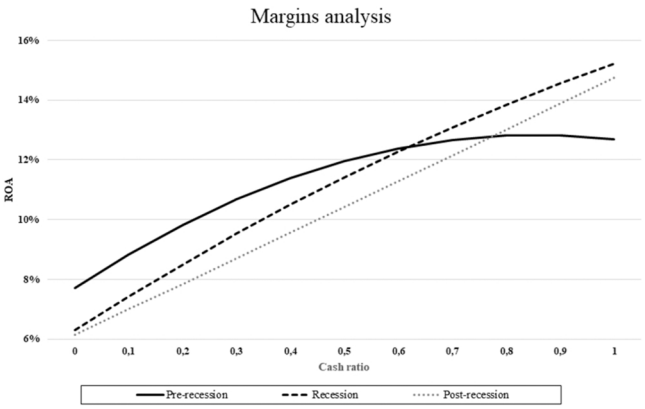

Fig. 1. Margins analysis time-periods. Margins analysis of the three time periods. The graph was generated by adding cash ratio levels from 0 to 1 in increments of 0.1, while holding all other significant variables at their mean levels for the corresponding time period.

Second, we note that the models covering the pre-recession (boom) and recession periods have both the predicted signs for the linear and quadratic terms, and that they are statistically significant. However, we also see that during the post-recession period, the quadratic cash-term becomes insignificant (t-value of 0.07). This implies that the relationship between cash and firm performance in the post-recession period is no longer curvilinear and instead the effect of cash is linear. In theory, this entails that more cash is better and that firms ideally should have as much cash as possible.

Third, we see from Table 5 that cash has a more pronounced curvilinear relationship to firm performance during booms (pre-recession), compared to recessions and recovery (post-recessions)-periods. The quadratic term is higher in the pre-recession model, which indicates that the curvilinear relationship is the most pronounced during the pre-recession period. Also, we see that the curvilinear relationship between cash and performance is relatively weaker during recessions compared to the post-recession period. Both findings are in line with the predictions of H2 and H3 respectively. However, the already mentioned fact that cash did not have the expected curvilinear relationship in the post-recession phase, is a surprise.

Fig. 1 shows the marginal effects of cash for all three time periods. The margins have been calculated by adding cash ratios at an incremental of 0.1 from 0 to 1, whilst the coefficients for all other variables in Table 5 have been held at their mean value for each period. We see that the curvilinear relationship is, as mentioned above, most pronounced for the pre-recession period which shows an inverse U-shaped curve. The margins in the recession are also diminishing, but at a much slower rate than pre-recession. This is the exact opposite of what Nason and Patel (2016) and Kim and Bettis (2014) find in their studies using Tobin's Q as dependent variable. For cash ratios < 0.3, firms benefit more from an additional unit of cash during the pre-recession period compared to the other two periods since the slope of the line is steeper. The post-recession curve is close to perfectly linear since the quadratic term is more or less equal to zero.

In sum, the results are for the most part in line with our predictions, with a few notable exceptions. As expected, we find that the relationship

between cash and performance is curvilinear (H1), that the curvilinear relationship is the most pronounced in booms (H2) and the least pronounced in recessions (H3). As for the surprises, we find that in recessions, the benefits of holding cash seems to outweigh the costs to such an extent that for any meaningful cash-ratio (CR<2.0), an additional unit of cash is better. That is, although we find a curvilinear relationship, the practical interpretation is closer to more cash being better in recessions for nearly any initial level of cash. As for the post-recession period, the relationship between cash and performance is positively linear, pointing to more cash being better for performance measured as ROA. These findings are thus not in line with the predictions of H4.

5. Discussion

This paper has provided empirical evidence of the impact of cash on operational firm performance over the business cycle. In this section, we first compare our results to those of Nason and Patel (2016) and other studies using Tobin Q as dependent variable, before moving to discuss the results of our full (expanded) model, and theoretical and practical implications of our findings.

5.1. Our results vs Nason and Patel (2016)

The findings of our replicated model are remarkably consistent with those of Nason and Patel (2016). To make for a more meaningful comparison of effect sizes across the two studies, we will in the following focus on the results of Nason and Patel's robustness checks where they used ROA as an alternative dependent variable. The ROA-results were not fully reported in their published paper, but we have received the full results directly from the authors to facilitate comparison of results.

The first thing we note is that the effect of cash (both linear and quadratic) in Nason and Patel's model is both higher and considerably more curvilinear compared to our model. This indicates that listed US manufacturing firms have higher marginal benefit of cash for low cash levels compared to our Norwegian sample and that the performance penalty for hoarding too much cash is comparably larger for the US sample. One reason for this may be that our sample was much broader, with many small and medium sized firms. Earlier research has documented that cash holdings are on average larger in smaller firms (Bigelli & Sánchez-Vidal, 2012), which supports that smaller private firms should face less performance penalties of holding more cash.

The second thing we note is that the signs of all the independent variables are equal across the two studies, with one exception. The interaction term with the quadratic variable of cash ratio and recession was positive, but non-significant, in Nason and Patel's ROA-model, while it was negative and statistically significant in our study. This indicates that the ROA of Norwegian firms are more sensitive to cash changes in recessions compared to listed US manufacturing firms. One potential reason for this is that our sample has a higher share of (smaller) knowledge-intensive firms that usually experience amplified struggles to raise external finance in economic downturns. A key finding from the literature on cash in finance is that cash reserves are particularly valuable for firms facing financing constraints (Almeida et al., 2004; Campello et al., 2011).

Finally, we also note that the recession terms in our models are smaller than the similar terms from Nason and Patel's ROA-models. Since the US economy was hit harder by the 2008/2009 recession than Norway, the results add up.

In sum, the consistent results across the original and replicated study imply that the findings and insights from Nason and Patel (2016) seems to be generalizable also beyond their sample of large and listed US manufacturing firms.

5.2. Findings from our full model

Our expanded model added three additional control variables to the replication model: lagged ROA, market share and annual sales growth. The positive relationship between cash and performance is consistent throughout our study and across the phases of the business cycle. This is as expected as a positive relationship between cash and performance has been documented in several recent studies (Kim & Bettis, 2014; La Rocca et al., 2019; Nason & Patel, 2016). However, when it comes to the strength and shape of the cash-performance relationship, our findings differ from those of earlier findings. We now turn to discuss two key findings from our full model specifications.

5.2.1. Finding no. 1: the effect of cash is weakly curve-linear

When we added the three additional control variables to the replication model, the curvilinear relationship between cash and performance became less pronounced. Our prediction of a non-linear relationship was based on the idea that cash has both benefits and costs, and that the benefits would outweigh the costs until a certain point. Our findings indicate that the marginal benefit of an additional unit of cash is continuously decreasing, but also that the relationship does not evolve into an inverse U-shape for any rationally high cash-ratios. This means that the firms with the highest cash-levels in our sample did not experience the performance penalty shown in e.g. Nason and Patel (2016) and Kim and Bettis (2014).

One plausible explanation for why we did not see the pronounced inverse-U-shaped relationship in our data is that our sample has a higher proportion of small- and medium sized firms compared to the samples of large, listed US firms used in many of the extant studies. As documented by Bigelli and Sánchez-Vidal (2012), smaller, unlisted firms are likely to benefit relatively more from holding cash due to larger difficulties accessing finance,.

Another plausible explanation is that we relied on ROA instead of Tobin's Q. Much of the theoretical rationale for the negative effects of having high cash holdings is related to the negative signals it sends to external stakeholders, which will be more directly captured by forward-looking performance measures like Tobin's Q than backwards-looking performance measures such as ROA. That is, when using Tobin's Q as a proxy for firm performance the effect of cash is determined largely by how the external market perceives the cash holdings, while the use of ROA will capture more of how cash affects firms' internal strategic choices and how these choices determine profitability. It is, however, still theoretically plausible that these effects could also be visible in firms' accounting-based performance measures, but our analyses clearly indicate that cash-rich firms are not punished as hard for hoarding cash as theory predicts. More broadly, this finding raises questions about how the signaling effects of cash affect *operational* performance as captured by ROA, compared to measures that also capture *expected* future performance such as Tobin's Q. To better understand if- and how the signaling-effect of cash impact operational profits is an interesting avenue for future research.

5.2.2. Finding no. 2: the effect of holding cash changes over the business cycle

When studying the impact of cash over the business cycle, we first used a recession-dummy. Here we found that the interaction term of recession and cash was statistically significant across all our regression models, meaning that cash has a more positive impact on performance in recessions compared to normal times. This was as expected, as previous studies have found that the demand contractions and credit squeezes firms typically experience in recession and under low environmental munificence, increase the benefits of internal finance (Almeida et al., 2014; Campello et al., 2011; Jung et al., 2020; Knudsen & Lien, 2014).

Then we examined the impact of cash over the business cycle by comparing the effect of cash on firm performance over three different phases: pre-, during, and post-recession. Starting with the pre-recession period, we found that the curvilinear relationship (inverse U-shape) was relatively more pronounced in this period compared to recessions and post-recessions. A theoretical explanation for this result is that holding

high cash levels in boom years means that a firm faces higher opportunity cost of not investing in the many investment opportunities presumably present in these periods. This finding is thus in line with the theoretical argument that holding high levels of cash is a troubling signal of a firms' performance potential (Jensen, 1986).

For the recession period, we found that the diminishing performance effect does not shift to an inverse U-shaped relationship for cash ratios between 0 and 1 in any of the time periods. In Nason and Patel (2016) the penalty for holding cash starts for cash ratios of 0.4 in recessions, while our results using ROA show that the marginal effect of cash on firm performance during recession does not become negative before cash ratios above 2. The relationship between cash and firm performance during the recession is thus virtually linear in our model. The fact that the curvilinear relationship from the pre-recession period dissipates in recessions, entails that the marginal effect of cash in recessions no longer diminishes as cash levels increase. That is, firm's returns can benefit from higher cash levels in recessions compared to the pre-recession phase. This implies that the benefits of holding cash is enhanced during recessions, which aligns with previous studies documenting that firms to a greater degree than before have to rely on internal funds to finance investments in recession when external financing tightens (Campello et al., 2011).

For the post-recession period, we found that the relationship between cash and performance becomes even more linear compared to the recession period. Yearly average cash ratios also slowly increased in the post-recession period. One possible explanation for these findings is that managers gained first-hand experience from the recession of how pivotal cash is in obtaining a stable financial state in unstable times. The linear relationship between cash and performance in the post-recession period could therefore reflect a shift from more people viewing large cash holdings with greater skepticism before the recession, to realizing the importance of accumulating cash buffers after the recession. How managers and stakeholders' *perceptions* about the competitive implications of cash changes after a recession, is therefore an issue that should warrant scrutiny by future research. Another potential avenue for future research is to study *why* increased cash holdings is beneficial for firm performance in the post-recession periods. Is it because improved growth opportunities increases the value of financial flexibility as demonstrated in the theoretical model of Gamba and Triantis (2008), or is it because cash enable firms to keep up or increase the accumulation of important intangible investments in R&D and human capital as documented by Brown and Petersen (2011)? Or is it because cash is used more reactively, to avoid problems that less cash-rich competitors fail to avoid? Unfortunately, our data has not allowed us to answer such questions.

5.3. Implications for research

Our findings directly complement previous research on the topic of cash and performance and add nuance by discussing the generalizability of earlier documented findings. We show that the relationship between cash and ROA in the pre-recession phase is similar to the inverse-u relationship between cash and Tobin's Q documented in earlier studies (Kim & Bettis, 2014; Nason & Patel, 2016), but when the economy enters a recession the relationship in our ROA-model turns linear implying that more cash is better for operational performance. This contrasts Nason and Patel's (2016) finding that the curvilinear relationship becomes more pronounced in recession, while it is in line with Jung et al. (2020) and Deb et al. (2017) who found that cash holdings are the most useful in dynamic and complex settings, and with La Rocca et al. (2019) who found that the positive relationship between cash and ROA was stronger in recessionary times.

More broadly, our findings add to the conversation in strategy and neighboring fields on *how* and *when* cash (and financial assets more generally) can be a strategic resource. Starting with *how,* we add to the emerging stream of papers that present evidence on the performance effects of cash (Deb et al., 2017; Kim & Bettis, 2014; La Rocca et al., 2019; O'Brien & Folta, 2009), by showing that previously documented relationships also extend to operational performance and to a broader sample of firms in a different context. Our findings, together with our predecessors', contrasts the standard implicit assumption in strategy of efficient financial markets (Barney, 1986), and imply that cash is more important for our understanding of competitive outcomes then presumed by classic resource-based theory. While cash and financial capital are homogenous assets (Barney, 1991), our data reveal that the *level* of cash can be a source of heterogeneity across firms and that variations in cash-levels can lead to variation in competitive outcomes. Our data does not allow us to detail the exact mechanisms through which this happen, but plausible explanations include that cash-rich firms are relatively better positioned to seize profitable investment opportunities and accumulate valuable assets as they are not prevented by financing limitations. One example documented in earlier research is related to the role of internal finance for firms' ability to maintain- or increase investments in R&D and innovation projects. Research from finance and economics show that such investments are difficult to finance externally, because of high levels of uncertainty, low initial cash flows and low salvage values (Brown et al., 2008; Hall & Lerner, 2009), and that firms for this reason use cash to smooth R&D investments over time (Brown & Petersen, 2011). This suggests that cash can have an important indirect effect on performance through affecting the ability to accumulate knowledge assets. An interesting avenue for future research is therefore to investigate which of these more detailed mechanisms that are the important underlying drivers for relationship between cash and operational performance, by e.g. studying firm level moderators like firms' innovation- or knowledge intensity.

Turning to *when*, our findings add to existing research on the cash-performance relationship by demonstrating how the competitive potency of cash varies over the business cycle. In recessions, financial markets becomes more inefficient, financing becomes harder to obtain, and, as shown in this paper, the competitive value of cash increases. Previous studies document that rising costs of external finance in recessions leads firms without sufficient internal capital to forgo profitable investments (Campello et al., 2010; Duchin et al., 2010), and that financially constrained firms may be forced to reduce their ongoing investments in R&D and innovation in such periods. (Knudsen & Lien, 2014, 2019). Our findings complement such studies that demonstrate how access to finance affect the ability to invest in recessions, by showing that cash (access to internal finance) is also linked to positive operational performance in recessions. In addition, we show that the competitive potency of cash in recessions largely extends to the post-recession period, which raises new questions about longer term-effects of recessions on the competitive value of cash. An interesting avenue for future research is therefore look closer at the post-recession periods, and investigate explanations for why cash retains its potency also when the recession has passed.

Finally, differences between our full model, and the baseline replication model points to the importance of adding sufficient controls when analyzing performance effects of cash. Lagged performance is the main predictor of current performance in our full models, and its inclusion in the model reduce the estimated effect size of cash on performance. As firms with high profits one year will have more cash available the next year, not including controls for historical performance may overestimate the performance effect of cash, as a portion of the persistence-of-profit-effect will be captured by cash ratio. An interesting avenue for future research is to investigate this effect using other estimation models than used in this paper.

5.4. Practical implications

Our findings also have implications for practice. Our first, and perhaps most important insight for managers, is that there are both benefits and costs with holding cash and that the influence of each of

these two factors vary across the phases of the business cycle. Our results suggest that the downsides of holding high levels of cash in a boom period are more pronounced compared to the recession and post-recession periods. These insights are beneficial for managers to take under consideration when evaluating cash policies.

A second practical implication concerns policy. Our analyses show that cash has a consistently positive effect on ROA for very high cash ratios throughout our analysis. This implies that managers have incentives to increase cash levels beyond the amount required to maintain existing assets. This may be problematic from a societal point of view. If more firms hoard cash at the expense of investing in activities that spur economic growth, this may ultimately contribute to slower economic growth. More broadly, the fact that the optimal value of cash holdings from managers' perspective may differ from the optimal value of cash holdings from a socioeconomic perspective, creates a challenge that policy makers may have to address.

6. Conclusion

The purpose of this paper was to examine the relationship between cash and firm performance over the business cycle.

Throughout our analysis we find that cash has a positive impact on firm performance across the different phases of the business cycle. The linear term of cash is highly significant in all our models and across all time periods. The quadratic term is less consistent; in some cases, we identify a curvilinear relationship, whilst sometimes the quadratic term is low and insignificant indicating a linear relationship between cash and firm performance.

After running our full and expanded models, we conclude that the curvilinear relationship between cash and performance is weakly curvilinear for our sample of Norwegian firms, and that this curve-linearity is the most pronounced in the pre-recession period, and more or less linear during the recession and post-recession periods.

In closing, we believe that our results add to an important stream of research at the intersection of strategy and finance. Mainstream theories, especially in strategy discard cash and other financial assets as less important drivers for heterogeneity and performance differences. Our findings, and the findings of the studies we build on, challenge these assumptions. It is, however, important to note that cash seems more likely as an indirect source of performance differences, through enabling firms to make investments and deploy strategies that in turn create performance heterogeneity. That is, cash appears to be less of a king, but more a key member of the court that pull some important strings.

CRediT authorship contribution statement

Fredrik Prøsch Hage: Methodology, Formal analysis, Investigation, Writing. **Eirik Sjåholm Knudsen:** Conceptualization, Methodology, Writing, Supervision. **Martha Benan Vethe:** Methodology, Formal analysis, Investigation, Writing.

Data availability

The authors do not have permission to share data.

Appendix

See Tables A1 and A2.

Table A1
Implications of cut-off criteria on the sample size.

	Observations	Share of remaining sample
All observations of Norwegian firms from 2004 to 2015	2,839,655	100.00 %
Removing firms with revenue with less than 10 MNOK	2,438,045	85.86 %
Removing firms with salary costs less than 3 MNOK	107,523	26.77 %
Removing firms in selected industries	32,616	11.09 %
Removing firms with missing NACE codes	9256	3.54 %
Removing firms based on legal form	6926	2.75 %
Removing firms with extreme performance indicator values	3592	1.46 %
Removing firms with missing geographical information	180	0.07 %
	241,517	8.50 %

Table A2
Industry composition in the sample.

Industry group	Industry name	2-digit NACE codes	Frequency	Percent	Cumulative
G	Wholesale and retail trade	45-47	77,379	32.04%	32.04%
F	Construction	41-43	47,899	19.83%	51.87%
C	Manufacturing	10-33	38,971	16.14%	68.01%
M	Professional, scientific and technical activites	69-74	19,235	7.96%	75.97%
H	Transportation and storage	49-53	15,977	6.62%	82.59%
J	Information and communication	58-63	13,524	5.60%	88.19%
I	Accommodation and food services	55, 56	10,168	4.21%	92.40%
N	Business support activities	77-79, 82	8,677	3.59%	95.99%
A	Fishing	3	4,216	1.75%	97.73%
B	Mining and quarrying	05-09	2,440	1.01%	98.75%
S	Other service activities	94-96	1,621	0.67%	99.42%
E	Water supply	36-39	661	0.27%	99.69%
R	Sports and recreation	93	546	0.23%	99.92%
Q	Human health and social work	86-88	106	0.04%	99.96%
K	Financial activities	64	67	0.03%	99.99%
D	Electricity and gas	35	29	0.01%	100.00%
O	Public administration and defense	84	1	0.00%	100.00%

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