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Cash holding adjustments and managerial entrenchment

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ABSTRACT

We find that, on average, firms close 31% of their gap between target and actual cash ratio each year. The adjustment speed is generally swifter if the actual cash ratio exceeds the target ratio, possibly because it is cheaper to disgorge cash than it is to raise it. But as firms become more insulated from the threat of takeovers, they decelerate their cash adjustment at high cash ratios. This evidence suggests that self-interested managers are reluctant to disburse excess cash, and they will allow cash levels to remain high unless the firms are subject to external pressure.

1. Introduction

At the end of June, 2013, Apple Inc. had $146 billion in cash and cash equivalents. This cash hoard, enough to buy either Citigroup Inc. or Bank of America Corp., has triggered public outcry and shareholder activism. For example, by August, 2013, investor Carl Icahn had accumulated shares in Apple valued at $1.5 billion and pressed the company to buy back more shares. Apple is not the only company to hold substantial amounts of cash. In the beginning of 2013, the S&P 500 firms held a total of $1.2 trillion in cash, more than the GDP of both Mexico and South Korea, making corporate cash policy integral to the whole economy.

Several recent studies have attempted to explain the large corporate cash stockpiles, including Foley et al. (2007), Bates et al. (2009), and Fresard (2010). These studies generally presume that firms trade off the benefits of liquid assets, such as ensuring funds for investments without having to incur costly external capital transactions, versus potential costs, such as overinvestment (Opler et al. (1999)). For example, Apple might hold cash primarily to seize strategic opportunities as they arise, whereas its competitor RIM might hold cash as an insurance policy against demand uncertainty. Yet both companies might squander any cash that is viewed as excessive, especially in the absence of disciplinary mechanisms.

In this study we focus on what firms do when their cash balances have drifted away from what might be regarded as optimal. We believe that it is at that point that firms' and managers' preferences toward cash policy can truly be tested. In particular, we examine the speed at which firms close the gap between their actual and target cash ratios from year to year. We conjecture that the adjustment speed reflects three major factors: (1) the costs of deviating from the target ratios, (2) the costs of cash adjustments, and (3) the willingness of self-interested managers to make cash adjustments.

The costs of deviating from the target ratios include the costs associated with financial distress and underinvestment if the ratios are too low and the costs of overinvestment if the ratios are too high. Because the types of costs differ for deficient versus excessive cash

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levels, the magnitude likely also differs. We conjecture that it is more costly to operate with scarce cash than it is to have abundant cash, prompting managers to take swifter action to remedy any cash shortfalls than instances of excess cash. If so, all else equal, we expect that the speed of adjustment toward the target is faster when the cash is below the target. We further conjecture that indicators of the severity of such costs, such as financial and operating risk, affect the speed of adjustments.

Adjusting cash ratios is also costly. If the cash ratio is below the target, it can be raised by either cutting back on investments or raising new capital, both of which impose nontrivial costs on the firm. Alternatively, if the cash ratio is above the target, the excess cash can be used to pay down debt or disbursed to shareholders via dividends or repurchases. This adjustment is also costly, e.g., because shareholders have to pay taxes on dividend income and capital gains. We conjecture that the costs of increasing the cash ratio exceed the costs of lowering it, in which case the adjustment speed of cash would be faster when the cash ratio is above the target, all else equal.

There are competing hypotheses on the effect of managerial self-interest on the adjustment speed of cash. On the one hand, Opler et al. (1999) argue that managers inherently wish to accumulate excess cash (i.e., cash in excess of the level that maximizes firm value), because they are risk averse or want greater flexibility to pursue personal objectives. This could hinder timely use or disbursement of cash hoards in the absence of external pressure to maximize firm value, such as Carl Icahn's pressure on Apple. Consequently, we should observe decelerated adjustment at high cash levels among entrenched firms. On the other hand, Jensen (1986) argues that self-interested managers are inclined to invest cash inefficiently, because even negative NPV projects can increase managerial utility. Therefore, these managers are likely to spend any excess cash on investments and acquisitions instead of saving it. Harford et al. (2008) also argue that managers of entrenched firms want to curb stockpiles of cash, because such stockpiles could draw unwanted attention from activist shareholders. The implication of these arguments is that the adjustment speed at high cash levels is faster among entrenched firms than among other firms. Consistent with this conjecture, Harford et al. find that entrenched firms are more likely to dissipate excess cash through acquisitions and capital expenditures than other firms. Similarly, Dittmar and Mahrt-Smith (2007) find that firms that are entrenched, as measured by the GIM index of Gompers et al. (2003), reduce excess cash more quickly than well governed firms. They conclude that corporate governance affects the *use* of cash, and not its accumulation.

Using a large sample of firm-years between 1980 and 2006, we estimate that the average firm closes 31% of the gap between actual and target cash ratios each year. Thus, managers actively consider target ratios for the cash level, although the annual adjustment toward the target is incomplete. We further document that, across all sample firms, the adjustment speed is faster if the cash level is above the target than if it is below. The estimated adjustment speed when the cash level is above the target is 33%, and it is 29% when the cash level is below the target. We interpret this as consistent with the transaction costs of adjusting cash levels toward the target being lower when the cash is above the target, i.e., it is cheaper to disgorge cash than it is to raise cash.

Next, we relate adjustment speed to measures for financial and operating risk. As measures of financial risk, we employ financial leverage and an indicator of whether the firm has rated debt. We conjecture that if leverage is low and/or the firm has rated debt, the firm can readily raise more funds. As a result, managers are less worried about a low cash balance, and will be in less of a hurry to seek additional cash. In contrast, if leverage is high and/or the firm has no rated debt, a low cash balance can become detrimental and managers will take swift remedial actions. The evidence supports this conjecture. At low cash levels (but not at high cash levels), the adjustment speed is faster for firms with high leverage and no rated debt. We propose that operating risk, as measured by cash flow volatility and asset beta, also speeds up the cash adjustments at low cash levels. The results weakly support our conjecture—operating risk speeds up cash adjustment at low cash levels, but the statistical significance is marginal.

To study the role of managerial self-interest and entrenchment, we examine the effect of business combination (BC) laws that were passed by many different states between 1985 and 1991. The passage of these laws has been used as an exogenous entrenchment shock in numerous papers, including Garvey and Hanka (1999), Bertrand and Mullainathan (2003), Cheng et al. (2005), Rauh (2006), and Giroud and Mueller (2010). In addition, we exploit the change in the takeover landscape in Delaware in the mid 1990s, which arguably made hostile takeovers practically impossible, thereby effectively entrenching Delaware firms. Rauh (2006), Low (2009), and Yun (2009) have recently used the same change as an exogenous shock of firm entrenchment.

We find that firms in states that passed BC laws reduce their adjustment speed after these laws were passed compared to firms in other states, but only if the cash level is above the target. Similarly, Delaware firms reduce their adjustment speed of cash after 1995 compared to non-Delaware firms if the cash level is above the target. These reductions are roughly nine percent, thus representing more than a quarter of the average speed across all firm-years.

The changes in adjustment speeds further suggest that entrenched firms end up with higher cash levels. This is precisely what Yun (2009) documents based on the change in takeover protection in Delaware in the mid 1990s. Thus, our results establish a consistent link between firm entrenchment, cash adjustment speeds, and the resulting cash levels.

The entrenchment results are consistent with the argument of Opler et al. (1999), but seemingly at odds with the conclusions in Dittmar and Mahrt-Smith (2007) and Harford et al. (2008). We use a different methodology and entrenchment measure than the latter two studies. Unlike the methodologies in Dittmar and Mahrt-Smith and Harford et al., our empirical methodology has been carefully developed in the capital structure adjustment literature, and our entrenchment measure is arguably less susceptible to endogeneity concerns (see Garvey and Hanka (1999), Bertrand and Mullainathan (2003), Cheng et al. (2005), and Bebchuk et al. (2009)). Our results suggest that, in the absence of external pressure, managers decelerate cash adjustment at high levels. We interpret this as evidence that managers acting with self-interest are less inclined to disburse excess cash in a timely manner. Closer scrutiny suggests that the primary reason for why our conclusion differs from that of Dittmar and Mahrt-Smith and Harford et al. resides in different entrenchment measures. That is, we find no evidence that firms categorized as entrenched based on the GIM index have a different adjustment speed, nor that these firms dissipate excess cash more quickly. The differing results question the use of the GIM index in other corporate governance studies as well.

2. Literature review

2.1. Cash levels and adjustments

Opler et al. (1999) and Bates et al. (2009) discuss the motives for firms to hold cash in detail. These motives include (i) transaction costs, (ii) insurance against adverse shocks, (iii) taxes associated with payouts, and (iv) managers' desire to spend on perks and projects that enhance their power. Various motives for holding cash can be used to develop a tradeoff theory, in which firms weigh the costs and benefits of cash holdings. Such a tradeoff implies that firms have an optimal cash level that they should pursue. This optimal ratio is often referred to as the target ratio. An alternative to the tradeoff theory is that cash holdings is secondary to other objectives of the firm, such as raising new equity when equity is overpriced or minimizing transaction costs by using cash as a source of financing for new projects instead of external funds. This dynamic view and the tradeoff theory are not mutually exclusive. Combined, they imply that firms might optimally deviate from their target ratios, and the speed at which they close any gap between actual and target cash levels depends on the relative importance of the two views of cash level formations. If the tradeoff theory is important to managers, the adjustment speed should be high.

Opler et al. (1999) report that the predictions of the static tradeoff theory are empirically relevant. In particular, firms that are small, have few investment opportunities, and are engaged in risky activities hold more cash. They also regress the change in cash ratios against the past deviation from the estimated target, and find a coefficient of −0.26, suggesting that 26% of the deviation from the estimated target is closed in the subsequent year.

Bates et al. (2009) show that the average cash holdings have increased considerably in recent decades. They attribute this secular trend to an increase in the risk of firms' cash flows, a decrease in inventories, a decrease in capital expenditures, and an increase in R&D intensity. They also conjecture that managers in entrenched firms hoard more cash, but find no evidence that the cash increase over time is attributable to entrenchment.

Inconsistent with the conjecture of Bates et al., both Bates et al. and Harford et al. (2008) find that the most entrenched firms, as proxied by the GIM index of Gompers et al. (2003), have *smaller* cash reserves in the cross section. Harford et al. attribute the lower cash reserves for entrenched firms to overly aggressive spending among these firms. In support of this argument, they find that the combination of entrenchment and excess cash increases capital expenditures, acquisitions, and share repurchases.[1] More generally, Dittmar and Mahrt-Smith show that entrenched firms, again based on the GIM index, dissipate excess cash more quickly, and conclude that "governance influences cash policy not via the decision to *accumulate*, but rather via the decision to *use* excess cash" (p. 621).[2] In a related test, Dittmar and Mahrt-Smith also show that a dollar of cash at a well-governed firm is worth twice as much as a dollar of cash at a poorly governed (i.e., entrenched) firm.

Dittmar and Duchin (2011) estimate cash adjustment speeds ranging from 21% to 46%, depending on the methodology they use. They further report that the cash adjustment speed decreases with firm age and conclude that older firms' cash holdings are more likely to vary with the fortunes the firms.

2.2. Capital structure adjustments

Numerous recent papers estimate the speed of capital structure adjustments. Flannery and Rangan (2006) estimate the annual speed to be more than 30%, while Lemmon et al. (2008) estimate the speed to be around 30%, depending on the methodology used.[3] Faulkender et al. (2012) find that the adjustment speed depends on the proxies for the adjustment costs. Firms with very high or very low free cash flow, which are likely to have a relatively low marginal cost of adjusting leverage, have the fastest adjustment speed.

Byoun (2008) documents asymmetries in the adjustment toward a target capital structure. The adjustment speed is greater for firms that have debt above the target level relative to firms with debt below the target level. Furthermore, the adjustment speed for firms with debt above the target level is greater if they also have a large financial surplus that can be used to pay off debt, whereas the adjustment speed for firms with debt below the target level is greater if they also have a financial deficit that that can be covered with debt issues.

2.3. Business combination (BC) laws and Delaware rulings as exogenous entrenchment shocks

Individual firms can adopt various antitakeover measures (e.g., poison pills) that shield the firms and their managers from undesired takeovers. The most relevant of these measures are included in the GIM index. The problem with using these individual firm measures and the GIM index to study the effect of entrenchment is that their adoptions are endogenous. This problem is well recognized in extant literature (e.g., Garvey and Hanka (1999), Bertrand and Mullainathan (2003), Cheng et al. (2005), and Bebchuk et al. (2009)), but there is no widely accepted econometric solution.

[1] However, Harford et al. (2008) also report that the combination of entrenchment and excess cash *decreases* R&D expenditures and dividends, so their results on the relation between entrenchment and use of excess cash are mixed.

[2] In a related study, Liu and Mauer (2011) find a positive relation between CEO risk taking incentives (vega) and cash levels, but no reliable relation between pay-for-performance incentives (delta) and cash levels.

[3] Chang and Dasgupta (2009) question the interpretation of the magnitudes of the adjustment speeds for capital structure, reporting that in simulated data the adjustment speeds are also considerable, such that there appear to be mechanical effects.

The 1980s and 1990s witnessed the adoption of several antitakeover laws and important court rulings at the state level. Between 1985 and 1991, 30 BC laws were passed on a state-by-state basis.[4] These laws impose a moratorium on certain transactions (including mergers and asset sales), thereby preventing corporate raiders from gaining access to the target's assets for the purpose of paying down acquisition debt. BC laws therefore effectively shield firms from hostile takeovers. In the mid-1990s, court rulings in Delaware validated the use of poison pills, even in conjunction with a staggered board, thus effectively lowering the probability that firms incorporated in Delaware can be acquired without the cooperation of target management. While Delaware adopted BC laws in 1988, the later court rulings arguably entrenched firms in the state further.

Numerous studies have used adoptions of BC laws and the Delaware court rulings as exogenous entrenchment shocks to examine how entrenchment affects managerial behavior. Garvey and Hanka (1999) find that firms in states that adopted BC laws reduce their debt levels relative to other firms following the adoption of the laws. Bertrand and Mullainathan (2003) find that firms in states that adopted the laws increased wages (especially to white-collar workers) and exhibited reduced productivity at the plant level relative to other firms. Cheng et al. (2005) report that managers of firms in states that adopted the laws reduce their stockholdings, especially if their prior holdings were high and the firms lacked poison pills. Giroud and Mueller (2010) find that firms in competitive industries experience a drop in operating performance after the passage of the laws, whereas firms in non-competitive industries do not. The evidence is collectively consistent with the notion that BC laws entrench firms and increase the potential for managerial slack.

Rauh (2006) reports that employee ownership decreased after 1995 for Delaware firms, consistent with the notion that managers induce employees to hold company stock to protect the firm when the probability that the firm will the target of a hostile takeover is high. Low (2009) finds that firm risk decreased for Delaware firms after 1995, consistent with the notion that risk-averse managers reduce risk as they become more entrenched. She also finds that the decrease in risk is concentrated among firm with low managerial equity-based incentives, suggesting that entrenchment and equity-based incentives act as substitutes in this context. Yun (2009) finds that Delaware firms increased cash holdings and lowered credit lines after 1995, suggesting that firms carry relatively more cash as the entrenchment intensifies. Interestingly, he finds no change in leverage for Delaware firms during the same period. He interprets his results as evidence that poor governance result in higher liquidity reserves in the form of cash.

3. Sample

The construction of our sample is similar to that of Bates et al. (2009). First we collect firm-year observations from Compustat over the sample period from 1980 to 2006. The reason we stop at 2006 is to avoid the financial crisis, during which period, the determinants of cash holding are quite different from those in the non-crisis period. We require firms to have positive assets and sales. Financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) are excluded from the sample, because their cash holdings can be subject to regulatory supervision.

Table 1 presents means and medians for the variables used in our analysis. While we list statistics for an array of variables, the cash ratio is perhaps of greatest interest. The mean (median) cash and cash equivalents scaled by assets across more than 180,000 firm-years is 15.8% (7.0%). Thus, it is clear that firms generally keep a large portion of their assets in cash, and the handling of this cash balance is therefore likely to be of great consequence to firm performance and value.

Fig. 1 presents the 25th, 50th, and 75th percentiles of the cash ratio over time. The figure largely confirms the secular trend observed in Bates et al. (2009). From 1980 until 2006, there is a gradual increase in cash ratios, and this seems particularly pronounced from 1990 onwards.

4. Empirical analysis

4.1. Contemporanous determinants of cash holdings and leverage

We begin our empirical analysis with contemporaneous regressions of cash ratios against variables that have been used in extant literature. These form the first-stage regressions for our later estimates of adjustment speeds. In particular, we use the predicted values from the contemporaneous regressions as firms' target ratios. Table 2 presents pooled regressions with year fixed effects, industry fixed effects, and/or firm fixed effects. However, we actually use 27 yearly regressions for the first stage to allow for changes in cash determinants and target ratios over time, but these would naturally be cumbersome to tabulate. The main benefit of yearly regression is to allow time-varying determinants for target level of cash holdings.

We follow Opler et al. (1999) and Bates et al. (2009) in the choice of our basic independent variables, which include firm size, the Tobin's Q, industry cash flow risk, cash flow, net working capital, capital expenditure, leverage ratio, R&D expenditures, a dividend dummy, and acquisition activity. Following Dittmar and Duchin (2011), we include firm age to control for the effect of firm life cycle on the cash policy. In addition, we include some other variables that we use in the second stage, including asset beta, and a dummy variable for whether the firm lacks a debt rating. The results are consistent with those reported in earlier studies. Generally, firms retain more financial flexibility in the form of more cash if they are young, small, have large growth opportunities (as proxied by the market-to-book ratio and R&D activity), and face greater risk (as measured by industry cash flow volatility and

[4] See Table 1 of Giroud and Mueller (2010) for a list of these states along with the year that the BC law was passed.

Table 1
Descriptive statistics.
The sample includes Compustat observations from 1980 to 2006 with non-negative data for the book value of total assets and sales revenue. The book value of total assets in 2007 dollars has to be greater than $10 million. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) firms are excluded. We also require non-missing data for the required financial variables in this table yielding a panel of 84,822 firm-year observations across 10,975 unique firms. Cash is defined as cash and marketable securities. Cash is scaled by either total book value of assets, net total assets (i.e. total assets minus cash), or sales. Log(Real size) is the natural log of the book value of total assets in 2007 dollars. Tobin's Q is (book value of total assets − book value of equity + market value of equity) scaled by the book value of total assets. Dividend is a dummy variable set to one if the firm pays dividend and zero otherwise. Industry cash flow risk is the mean of the standard deviations of cash flow scaled by total assets over ten years for firms in the same industry, as defined by the two-digit SIC code. Asset beta is defined as unlevered beta, similar to the definition in Acharya, Almeida and Campello (2013). Non-Rated is a dummy variable set to one if the firm has no public debt and zero otherwise. Cash flow is (EBITDA–interest–taxes–common dividends) scaled by total assets. Net working capital is net working capital minus cash and marketable securities scaled by total assets. Capex is capital expenditures scaled by total assets. Book leverage is total debt scaled by total assets. Acquisition activity is a dummy variable set to one if the firm has undertaken an acquisition during the year and zero otherwise. Firm age is the number of years since the firm's IPO. IPO date is gathered from SDC. If the date is missing from this source, we use Jay Ritter's database provided on his Web page. If the date is not available from either of these sources, we use the first date the firm was listed on CRSP. All variables are winsorized at the first and 99th percentiles.

	Mean	Median
Assets	4070	306
Log(Real size)	5.897	5.723
Tobin's Q	1.866	1.362
Dividend dummy	0.360	0.000
Industry cash flow risk	0.166	0.111
Asset beta	0.987	0.848
Non-Rated	0.818	1.000
Cash flow	0.012	0.062
Net working capital	0.103	0.104
Capex	0.069	0.048
Book leverage	0.249	0.216
Acquisition activity	0.019	0.000
Firm age	13.733	10.000
Cash/Assets	0.149	0.071
Cash/Net total assets	0.333	0.076
Cash/Sales	0.658	0.063
No. of observations	84,822	

asset beta). Further, greater debt payments (i.e., higher leverage), greater capital expenditures, and greater acquisition activity appears to deplete the cash balances.

The pooled regressions also include the effect of the exogenous entrenchment variables. We discuss these variables and their effect in Sections 4.4 and 4.6, respectively. In any event, the yearly regressions we use for the first stage do not permit these exogenous entrenchment variables to be included.

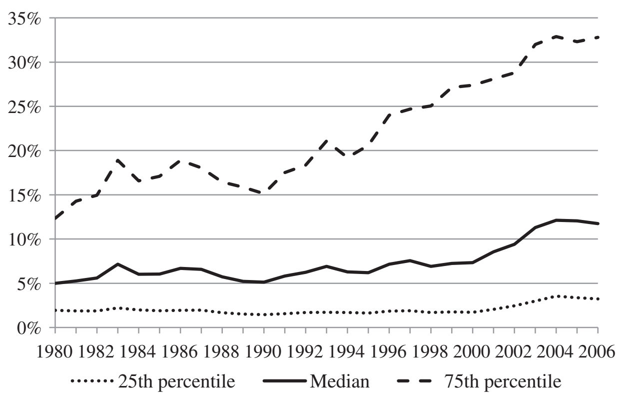

Fig. 1. The figure presents median values for the ratios of cash to assets from 1980 to 2006. The sample includes Compustat observations with non-negative data for the book value of total assets. The book value of total assets in 2007 dollars has to be greater than $10 million. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) firms are excluded.

Table 2
Contemporaneous determinants for cash holdings.
This table reports determinants for optimal cash holdings. The sample is described in Table 1. The dependent variable is the cash ratio and the independent variables include firm characteristics described in Table 1. Year and industry dummies (based on one-digit SIC codes) are included in all regressions to control for year and industry fixed effects. P-values based on standard errors robust to clustering by firm are reported in parentheses.

	Dependent variable: Cash/Assets					
Log(Real size)	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Tobin's Q	0.019	0.019	0.018	0.018	0.010	0.010
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Dividend dummy	−0.029	−0.027	−0.031	−0.029	−0.007	−0.006
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Industry cash flow risk	0.097	0.096	0.082	0.081	0.015	0.014
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Asset beta	0.010	0.010	0.010	0.010	0.003	0.003
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Non-rated	0.004	0.004	0.003	0.004	−0.006	−0.006
	(0.019)	(0.003)	(0.061)	(0.011)	(<0.001)	(<0.001)
Cash flow	−0.034	−0.033	−0.032	−0.031	0.009	0.009
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.134)	(0.104)
Net working capital	−0.170	−0.170	−0.177	−0.176	−0.148	−0.148
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Capex	−0.354	−0.352	−0.315	−0.313	−0.247	−0.246
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Book leverage	−0.310	−0.310	−0.309	−0.309	−0.239	−0.239
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
R&D	0.029	0.029	0.029	0.028	0.014	0.014
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Acquisition activity	−0.217	−0.219	−0.218	−0.220	−0.160	−0.160
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Firm age	−0.001	−0.001	−0.001	−0.001	−0.003	−0.002
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
BCL dummy	0.003		0.003		0.005	
	(0.017)		(0.069)		(0.003)	
Delaware × After95		0.009		0.010		0.007
		(<0.001)		(<0.001)		(<0.001)
Delaware		0.009		0.009		0.029
		(<0.001)		(<0.001)		(<0.001)
Intercept	0.245	0.242	0.232	0.228	0.303	0.287
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effects	NO	NO	YES	YES	NO	NO
Firm fixed effects	NO	NO	NO	NO	YES	YES
No. of observations	84,822	84,822	84,822	84,822	84,822	84,822
R-squared	0.409	0.410	0.415	0.416	0.445	0.448

There are alternative ways to estimate the target cash level other than using yearly regressions. We can use a panel regression with firm and year fixed and control for heteroskedasticity and autocorrelation, or a dynamic panel regression with GMM methods. We discuss this in detail in Section 5.

Table 3
Adjustment speeds for cash holdings.
This table presents the models for estimating adjustment speeds in cash holdings following the procedure in Byoun (2008). Cash/Assets$_t$* represents the target cash in year *t*, and is proxied by the predicted values from the regressions in Table 2. High cash is a dummy variable set to one if the cash ratio is above the target ratio, and zero otherwise. Other variables are defined in Table 1. Year dummies and industry dummies (based on one-digit SIC codes) are included in all regressions to control for year and industry fixed effects. P-values based on standard errors robust to clustering by firm are reported in parentheses for all regressions.

	Dependent variable: Cash/Assets$_t$ − Cash/Assets$_{t-1}$	
Deviation from target cash:	−0.314	−0.286
Cash/Assets$_{t-1}$ − Cash/Assets$_t$*	(<0.001)	(<0.001)
Deviation from target cash × High cash		−0.042
		(0.006)
Intercept	−0.002	−0.000
	(0.704)	(0.930)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
No. of observations	81,637	81,637
R-squared	0.215	0.215

4.2. Adjustment speed estimates

Prior studies have used several methods to estimate the adjustment speed for capital structure (e.g., Flannery and Rangan (2006) and Byoun (2008)), and these methods can also be adapted for the purpose of estimating the adjustment speed for cash ratios. In our study, we follow the estimation procedure in Byoun (2008), which entails estimating the target cash ratio in a first stage regression and then regressing the subsequent change in the cash ratio during a year against the deviation in the current cash ratio from the target ratio at the beginning of the year. The advantage of this procedure is that it is suitable for estimating interactive effects in adjustment speeds, which is what Byoun (2008) does for capital structure. Thus, we can readily estimate the differential adjustment speeds for high and low cash ratios, and how other firm characteristics and exogenous entrenchment shocks affect adjustment speeds. The regression model is as follows:

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}{}_{i,t} - Cash_{i,t-1}\right) + \varepsilon_{i,t}. \tag{1}$$

The first model in Table 3 presents the initial set of simple cash adjustment speed regressions following Eq. (1), where we estimate the cash ratio changes in a year against the deviation from the target cash ratio at the beginning of the year. The target cash ratio is estimated as the predicted value from the yearly cash ratio regression discussed above. The coefficient on the deviation from the target cash ratio is −0.314, meaning that the estimated adjustment speed for the cash ratio is 31.4% in each year. Firms close a substantial portion of the gap between actual and target cash ratios in each year, indicating that managers actively consider target ratios. Yet the adjustment is far from complete (in which case the estimated adjustment speed would be 100%), likely because of the costs of making adjustments and possible agency problems.

Next, we estimate the asymmetry in adjustment speeds by augmenting the regressions with an interaction variable between the deviation from the target ratio and a dummy variable indicating whether the actual ratio exceeds the target.

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}{}_{i,t} - Cash_{i,t-1}\right) + \gamma_1\left(Cash^{*}{}_{i,t} - Cash_{i,t-1}\right) \times HighCash + \varepsilon_{i,t} \tag{2}$$

where High cash is a dummy variable set to one if the cash ratio is above the target ratio, and zero otherwise.

The second model of Table 3 presents the results from this augmented regression. The coefficient on the deviation from target cash is −0.286 with a p-value of less than 0.001 and the coefficient on the interaction variable is −0.044 with a p-value of 0.005. Thus, the estimate of the adjustment speed for cash in each year is 28.6% when the cash ratio is less than the target and 32.8% (28.6% + 4.2%) when the cash ratio is above the target.

The faster adjustment speed at high cash levels is consistent with the conjecture that it is cheaper to disgorge cash than it is to raise cash. It is indeed a relatively straightforward matter to disburse excess cash, e.g., by repurchasing shares in the open market or paying down some debt, and these transactions are even likely to be viewed favorably by the stock market (see Allen and Michaely (2003) for a review of the effect of corporate payouts). In contrast, raising cash can be challenging and expensive, and transactions used to raise cash, e.g., equity issues, are viewed negatively by the stock market (see Eckbo et al. (2007) for a review of security issue announcement effects).

The faster adjustment speed at high cash levels is not, however, consistent with the conjectures that it is more costly to operate with cash levels below the target than above or that self-interested managers are reluctant to disburse cash that is in excess of the target. But we are cautious to reject these conjectures, because the effects might be disguised in the aggregate by the adjustment cost effect discussed above. For example, we might find that the effect from agency problems is only evident among firms that are entrenched.

In Table 4, we examine further the determinants of adjustment speeds. To do so, we interact the variables of interest with the cash deviation variable. As in Table 3, the dependent variable is the adjustment in cash from last year to the current year. The regression model is as follows:

$$\begin{aligned} Cash_{i,t} - Cash_{i,t-1} = {} & \lambda\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) + \gamma_1\left(Cash^{*}{}_{i,t} - Cash_{i,t-1}\right) \times Entrenchment \\ & + \gamma_2\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) \times OtherVariableOfInterest + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where the Entrenchment measure and other variable of interests are discussed below.

We are particularly interested in the effect of firm risk and entrenchment shocks on the adjustment speed, which we discuss in the next two subsections. Another effect that is interesting is the distance between the actual cash level and the target level. We conjecture that the adjustment speed accelerates when the cash is further away from the target level. To test this, we include squared cash deviation as an independent variable. The results support our conjecture. The coefficient on the squared deviation is negative for firms with cash above the target level, suggesting that the adjustment speed accelerates as the cash becomes very high relative to the target (i.e., as the deviation increases). Moreover, the coefficient is positive for firms with cash below the target level, suggesting that the adjustment speed accelerates as the cash becomes very low relative to the target (i.e., as the deviation decreases by becoming more negative).

Table 4
The effect of entrenchment on adjustment speeds.
This table presents an analysis of the effect of entrenchment on adjustment speeds for cash ratios when the cash ratio is above (Deviation ≥ 0) or below (Deviation < 0) the target cash ratio. The dependent variable is the adjustment in cash from last year to this year, same as in Table 3. The first independent variable (deviation from target cash) is described in Table 3. High leverage is a dummy variable set to one if the leverage ratios is above the target ratio, and zero otherwise. High FCF dummy is a dummy variable set to one if the free cash flow is among the top 15% percentile and zero otherwise. BCL dummy is a dummy variable set to one for firms incorporated in a state and in a year that the business combination law has been passed. The year when the business combination law was passed is obtained from Giroud and Mueller (2010). Delaware is a dummy variable set to one for firms incorporated in Delaware and zero otherwise. After95 is a dummy variable set to one for firm-years after 1995 (i.e., 1996 onwards), and zero otherwise. Other control variables are defined in Table 1. Year dummies are included to control for year fixed effects. Industry fixed effects and firm fixed effects are also included in the regressions. P-values based on standard errors robust to clustering by firm are reported in parentheses.

	Deviation < 0		Deviation ≥ 0	
	(1)	(2)	(3)	(4)
Deviation from target cash	0.138	0.121	−0.391	−0.367
	(0.143)	(0.199)	(0.000)	(0.000)
Deviation from target cash × BCL dummy	−0.006		0.077	
	(0.843)		(0.001)	
Deviation from target cash × Delaware × After95		0.055		0.081
		(0.214)		(0.020)
Deviation from target cash × Delaware		−0.038		−0.005
		(0.252)		(0.858)
Deviation from target cash × High leverage	−0.062	−0.063	−0.006	−0.006
	(0.004)	(0.003)	(0.761)	(0.738)
Deviation from target cash × High FCF dummy	−0.036	−0.036	0.013	0.016
	(0.129)	(0.134)	(0.587)	(0.524)
Deviation from target cash × Log(Real size)	−0.013	−0.012	0.018	0.016
	(0.051)	(0.062)	(0.007)	(0.016)
Deviation from target cash × Tobin's Q	0.010	0.010	−0.006	−0.007
	(0.019)	(0.018)	(0.293)	(0.254)
Deviation from target cash × Non-Rated dummy	−0.143	−0.142	0.066	0.062
	(0.000)	(0.000)	(0.071)	(0.087)
Deviation from target cash × Industry cash flow risk	−0.085	−0.086	0.093	0.091
	(0.056)	(0.052)	(0.050)	(0.056)
Deviation from target cash × Asset beta	−0.007	−0.007	0.002	0.002
	(0.322)	(0.331)	(0.741)	(0.661)
Deviation from target cash × Age	0.001	0.001	0.004	0.004
	(0.446)	(0.455)	(0.000)	(0.000)
Deviation from target cash × Deviation from target cash	0.358	0.355	−0.274	−0.276
	(0.003)	(0.003)	(0.000)	(0.000)
Intercept	0.010	0.011	0.004	0.003
	(0.259)	(0.248)	(0.657)	(0.751)
Deviation from target cash × Year dummies				
	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
No. of observations	42,600	42,600	30,281	30,281
R-squared	0.105	0.105	0.206	0.206

4.3. The effect of financial and operating risk on adjustment speeds

Cash is often used as insurance against various risk factors to which the company is exposed. Naturally, this insurance is more important for firms with greater risk. We therefore conjecture that managers of firms with high operating and financial risk will be quicker to take action to remedy any cash shortfall than managers of other firms.

To test our conjecture, we estimate the effect of operating and financial risk on cash adjustment speeds. As measures for operating risk, we focus on industry cash flow volatility, but we also include asset beta. To measure financial risk we use leverage and an indicator variable for whether the firm lacks a debt rating. Firms that lack a debt rating face a constraint in accessing the debt markets compared to other firms, and we therefore regard the lack of a debt rating as an additional financial risk factor.

Table 4 presents results from our regressions where we interact the deviation from the target ratio with the operating and financial risk measures. We run the regressions separately for those firm-years with cash above versus below the target. This allows us to see not only whether the risk measures affect adjustment speeds, but also whether any effect is asymmetric.

The coefficients on the interaction variable between target deviation and industry cash flow risk are negative with p-values between 0.05 and 0.06 in regression models for low cash levels, providing some evidence that the cash adjustment speed increases with industry cash flow risk when the cash level is low. The asset beta has no effect on the adjustment speed. Thus, managers appear to adjust the cash ratio more swiftly when the cash level is low and industry cash flow risk is high. A possible interpretation is that managers of high-risk firms are generally more attentive to low cash balances.

The coefficient on the interaction variable between target deviation and high leverage is negative and statistically significant when using the full sample of firm-years with cash below the target. No similar effect is present for firm-years with cash above the target. Thus, managers raise below-target cash levels more quickly when financial risk is high, as we expected. The coefficient on the interaction variable between target deviation and the no debt-rating dummy is also negative and statistically significant for firm-years with cash below the target, whereas for firm-years with cash above the target the coefficient is positive but only marginally statistically significant (p-value are both above 0.07). These results are also consistent with our conjecture. Apparently, managers raise cash levels below the target more quickly when the firm lacks a debt rating. In those cases, a shock in its operation could be devastating, because the access to the debt market is more limited and the cash buffer might prove insufficient to weather the storm. Overall, we view the evidence on the effect of our risk measures as consistent with the notion that managers are more attentive to low cash levels when the risk is high.

4.4. The effect of exogenous entrenchment shocks on adjustment speeds

To gain further insight into the effect of managerial self-interest on adjustment speeds of cash, we examine the effect of changes in firm entrenchment. The underlying premise of this analysis is that managers' self-interested behavior will proliferate as firms become entrenched, and thus manifest itself in the cash adjustment speed. We could instead measure managerial self-interest more directly via the extent of their holdings, and relate this measure to the cash adjustment speed. However, we worry that managerial holdings are endogenous (Himmelberg et al. (1999)), and that firms' financial policies affect managerial holdings. Moreover, managerial holdings measure both the alignment of interests between managers and shareholders as well as entrenchment (Stulz (1988)). That is, as managerial holdings increase, alignment between managers and shareholders increases (thereby muting the effect of managerial self-interest) and so does entrenchment (thereby exacerbating the effect of managerial self-interest), making the interpretation of any relation between managerial holdings and cash adjustment speed difficult.

Motivated by the studies of Garvey and Hanka (1999), Bertrand and Mullainathan (2003), Cheng et al. (2005), Rauh (2006), Low (2009), Yun (2009), and Giroud and Mueller (2010), which also examine the effect of firm entrenchment on managerial behavior, we exploit the exogenous shocks to the takeover landscape in (i) 30 different states from 1985 and 1991 as a result of adoptions of BC laws and (ii) Delaware in the mid 1990s as a result of court rulings, both of which we described briefly earlier. Specifically, we estimate the effect that these exogenous shocks had on adjustment speeds. We believe this approach largely circumvents the endogeneity concerns associated with using the GIM index as an entrenchment measure. But we also recognize the controversy regarding the use of these measures for identification purposes (e.g., Karpoff and Wittry (2015)), and we report relevant robustness tests in Section 5.

Table 4 presents the results from our regressions where we incorporate the exogenous entrenchment shocks. In particular, we interact the deviation from the target ratio with either a indicator variable for whether the observation is a firm in a state that at that time had adopted BC laws (*Deviation from target* × *BCL dummy*) or an indicator for whether the observation is a Delaware firm after 1995 (*Deviation from target cash* × *Delaware* × *After1995*). As noted earlier, we run the regressions separately for the firm-years with above and below target cash to examine the differential effect.

The coefficient on the BCL interaction variable is negative and statistically insignificant for firm-years with cash levels below the target and positive and statistically significant for firm-years with cash levels above the target. These results show that firm entrenchment decelerates cash adjustment at high cash levels, but not at low cash levels. The coefficient of 0.077 for firm-years with high cash levels suggests that the adjustment speed decreases by 7.7% following the adoption of the BC laws.

The coefficient on the Delaware after 1995 interaction variable is also positive when the cash balance exceeds the target level. The coefficient is 0.081, which is statistically different from zero at the 0.02 level. Thus, our results are robust to the measure of exogenous entrenchment shock.

We also examined the effect of the GIM index on cash ratio adjustments, primarily because this index has been used extensively as a measure of entrenchment in the literature. In particular, we include an interaction variable between the deviation from target cash and the GIM index in our regression model. The regression results (not tabulated) show that the coefficient on these interaction variables is not statistically different from zero, irrespective of whether the cash level is above or below the target. Thus, there is no evidence that the GIM index affects the adjustment speed of cash. We are hesitant to interpret these results because, as noted earlier, the GIM index might itself be dictated by firms' financial policies and is *ad hoc* in its construction. It is nevertheless interesting to observe that the GIM index produces different empirical results from the entrenchment measures based on changes in the takeover landscape at the state level. One interpretation of this set of results is that the use of the GIM index as an independent variable yields results that are difficult to decipher.

Overall, our results indicate that self-interested managers are reluctant to disburse excess cash, but not to alleviate cash deficiencies. This is consistent with the broader notion that managers are risk-averse and in no rush to disburse the accumulation of excess cash.

4.5. The effect of entrenchment on excess cash accumulation and dissipation

We pointed out earlier that Dittmar and Mahrt-Smith (2007) and Harford et al. (2008) find that entrenched firms, as measured by the GIM index, exhibit some tendencies to dissipate cash more aggressively than other firms. However, this tendency in Harford, Mansi, and Maxwell only pertains to capital expenditures, acquisitions and share repurchases, while the opposite tendency pertains to R&D expenditures and dividends, so it is hard to gauge the overall effect. The tendency in Dittmar and Mahrt-Smith is more general. In particular, they regress changes in excess cash against the GIM index and a control variable that

Table 5
The effect of entrenchment on excess cash changes.
This table shows the results for regressions of changes in excess cash ratios on entrenchment measures. The regression models are based on similar models in Table 7 of Dittmar and Mahrt-Smith (2007), except that we use a different entrenchment measure and include the control variables from previous tables. The sample includes all firms that have cash ratio above the target cash ratio (Deviation ≥ 0) in year *t*. Excess cash ratio is the same as the deviation from target cash ratio, as defined in Table 3. Following Dittmar and Mahrt-Smith (2007), we include the industry average change in excess cash as a control variable. The lagged variables refer to year $t-1$ instead of year *t*. Other control variables are defined in Table 1. Year dummies are included in all regressions to control for year fixed effects. P-values based on standard errors robust to clustering by firm are reported in parentheses for all regressions.

	Dependent variables			
	Excess Cash/Assets$_t$ − Excess Cash/Assets$_{t-1}$ (Accumulation of excess cash)		Excess Cash/Assets$_{t+1}$ − Excess Cash/Assets$_t$ (Dissipation of excess cash)	
BCL dummy			0.006 (0.007)	
Delaware × After95				0.008 (0.013)
Delaware				−0.005 (0.019)
Industry average change in excess cash			0.926 (<0.001)	0.927 (<0.001)
Lagged BCL dummy	0.001 (0.554)			
Lagged Delaware × Lagged After95		0.003 (0.222)		
Lagged Delaware		−0.007 (<0.001)		
Lagged industry average change in excess cash	0.622 (<0.001)	0.622 (<0.001)		
Intercept	−0.075 (<0.001)	−0.073 (<0.001)	−0.118 (<0.001)	−0.115 (<0.001)
Control variables	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
No. of observations	37,649	37,649	25,415	25,415
R-squared	0.069	0.070	0.064	0.064

captures the industry trend and find that while the accumulation of excess cash is unrelated to the GIM index, the dissipation of excess cash is more pronounced for entrenched firms (with a p-value of 0.051).

We revisit the regression analysis in Dittmar and Mahrt-Smith using our sample and entrenchment measure. Table 5 presents our regression results. In the first two models, we regress changes in the excess cash ratio from year $t-1$ to t for those firm-years that have positive excess cash in year t against a lagged industry trend variable (to correspond to the period for which the change in excess cash is measured) and our lagged entrenchment measures. The coefficients on *Lagged BCL dummy* and *Lagged Delaware* × *Lagged After95* are positive but statistically indistinguishable from zero, suggesting that the exogenous entrenchment shocks do not affect the accumulation of excess cash. In the last two models, we regress changes in the excess cash ratio from year t to $t+1$ for those firm-years that have positive excess cash in year t against an industry trend variable and our entrenchment measures. The coefficients on *BCL dummy* and *Delaware* × *After95* are both positive with p-values of 0.007 and 0.013, respectively, suggesting that the exogenous entrenchment shocks decelerate the dissipation of excess cash.

These regression results are consistent with our adjustment speed estimates, suggesting that the methodology is not consequential for our general interpretations. Moreover, the regressions results for the cash accumulations are consistent with those of Dittmar and Mahrt-Smith based on the GIM index. However, the regression results for the cash dissipations appear to be inconsistent with those of Dittmar and Mahrt-Smith.[5] Overall, the results point to the entrenchment measure as the culprit. This reaffirms our belief that the apparent inconsistency resides in the difficulty of interpreting the results using the GIM index, as discussed earlier.

Next, we examine the effect of entrenchment on five ways that excess cash is dissipated. In particular, we examine the effect of entrenchment on changes in capital expenditures, R&D expenditures, dividends, share repurchases, and debt retirements for firm-years with excess cash. Table 6 reports the results. The entrenchment shocks have a negative effect on both changes in capital expenditures (with p-values of 0.002 and 0.095 for *BCL dummy* and *Delaware* × *After95*, respectively) and changes in R&D expenditures (with p-values of 0.012 and <0.001 for *BCL dummy* and *Delaware* × *After95*, respectively), and possible on debt retirement (with a p-value of 0.029 for *Delaware* × *After95*). But there is no evidence that entrenchment shocks affect changes in dividend payouts or share repurchases. Combined with the earlier results, these results suggest that entrenchment decelerates cash dissipation by reducing capital and R&D expenditures but does not affect payout policy. Thus, there is no evidence here that entrenchment results in overinvestment, but rather that entrenchment potentially reduces value-increasing investments resulting in underinvestment.

[5] We also replicated Dittmar and Mahr-Smith's (2007) analysis using the GIM index (not tabulated). Like Dittmar and Mahr-Smith, we find a positive and marginally coefficient on the GIM index in the dissipation of excess cash regressions (we find a p-value of 0.092, compared to 0.051 in Dittmar and Mahr-Smith).

Table 6
The effect of entrenchment on investment and payout policy when there is excess cash.
This table shows the effect of entrenchment on the change in investment and payout policy when there is excess cash. The sample includes all firms that have a cash ratio above the target cash ratio (Deviation ≥ 0) in year t. Excess cash ratio is the same as the deviation from target cash ratio, as defined in Table 3. Change in capital expenditure is defined as the difference between Capex/Asset$_{t+1}$ and Capex/Asset$_t$. Similarly, change in R&D expenditure is defined as the difference between R&D expense/Asset$_{t+1}$ and R&D expense/Asset$_t$ and change in dividend payout is defined as the difference between Dividend payout/Asset$_{t+1}$ and Dividend payout/Asset$_t$. Change in share repurchase is defined as the difference between Purchase of common and preferred stocks/Asset$_{t+1}$ and Purchase of common and preferred stocks/Asset t. Change in debt retirement is defined as the difference between long term Debt retirement/Asset$_{t+1}$ and Debt retirement/Asset t. The independent variables and control variables are defined in Table 1. Year dummies and industry dummies are included in all regressions to control for year and industry fixed effects. P-values based on standard errors robust to clustering by firm are reported in parentheses for all regressions.

	Change in capital expenditure		Change in R&D expenditure		Change in dividend payout		Change in share repurchase		Change in debt retirement	
BCL dummy	−0.014		−0.003		−0.001		−0.000		−0.001	
	(0.002)		(0.012)		(0.215)		(0.755)		(0.664)	
Delaware × After95		−0.010		−0.008		0.001		−0.000		−0.009
		(0.095)		(<0.001)		(0.180)		(0.918)		(0.029)
Delaware		−0.005		0.002		−0.001		0.000		0.002
		(0.043)		(0.023)		(0.001)		(0.987)		(0.372)
Intercept	0.091	0.092	0.005	0.004	0.012	0.012	−0.005	−0.005	0.049	0.048
	(<0.001)	(<0.001)	(0.502)	(0.568)	(<0.001)	(<0.001)	(0.066)	(0.066)	(0.003)	(0.004)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,898	32,898	32,898	32,898	32,898	32,898	32,898	32,898	32,898	32,898
R-squared	0.017	0.017	0.032	0.033	0.006	0.006	0.025	0.025	0.006	0.006

4.6. The effect of entrenchment on excess cash levels

We have shown that entrenchment decelerates the adjustment speed at high cash levels. This, in turn, might result in higher cash levels. To examine this more directly, we revisit the cash regressions in the first-stage analysis. Recall that the first-stage cash prediction model was based on a series of yearly regressions, yet we tabulated pooled regressions for presentation purposes. Another advantage of the pooled regression is that it permits the use of our entrenchment variables as independent variables.

Table 2 shows the effect of the entrenchment variables on cash levels based on pooled regressions. The coefficients on the entrenchment variables are positive and statically significant. This supports our conjecture that entrenchment leads to higher cash levels. The collective evidence suggests that entrenchment tempers the use of excess cash on capital investments and R&D, which, in turn, results in relatively higher cash levels.

Given the effect that entrenchment has on cash levels, a concern is that this effect will bias the predicted target ratios and therefore the adjustment speed estimates. To mitigate this concern, we conducted a robustness analysis in which we eliminated firms that are considered to be entrenched from the first stage regressions, where entrenchment is based on either the Business Combination Law dummy or the Delaware 1995 dummy. Then we used the coefficients derived from these alternate first stage regressions to calculate the target cash ratio for all firm-years, irrespective of whether they are considered to be entrenched. Finally, we ran our second stage regressions to estimate the adjustment speed and the effect of entrenchment on adjustment speed. Our results (not tabulated) are robust to using these smaller samples in the first stage regressions.

5. Robustness

5.1. Different estimation methods

In our main analysis, we estimate the target level of cash holdings using a panel regression, and control for year fixed effects as well as industry or firm fixed effects. Alternatively, we can control for heteroskedasticity and autocorrelation using two different methods. The first method is the GLS method, which allows for estimation in the presence of autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Bertrand, Duflo and Mullainathan (2004) also propose GLS as a viable solution to autocorrelation problems. With the target cash level from this approach, we present the second stage regression in Panel A of Table 7. We use robust standard errors in columns 1 and 2, bootstrapped standard errors in columns 3 and 4, and include firm fixed effects in columns 5 and 6. All columns show consistent results.

The second procedure shown in panel B uses Driscoll and Kraay (1998) standard errors in the panel regressions. The error structure is assumed to be heteroskedastic, autocorrelated up to some lag, and possibly correlated between the groups (panels).

We can also use dynamic panel regressions following Faulkender et al. (2012) for the first stage. To do so, we plug the following equation into Eq. (1).

$$Cash_{i,t^*} = \beta X_{i,t-1} + \varepsilon_{i,t} \tag{4}$$

Table 7
Robustness tests on different first-stage estimation models.
This table shows the effect of entrenchment on adjustment speeds when cash exceeds the target using different first-stage regression models. Panel A provides the second-stage results when the first stage is a panel regression using GLS controlling for year-fixed effects, industry- or firm-fixed effects, heteroskedasticity, and autocorrelation. Panel B provides the second-stage results when the first stage is a panel regression using Driscoll and Kraay (1998) standard errors. Panel C provides the second-stage results when the first stage is a dynamic panel regression using Blundell and Bond's GMM. P-values are reported in parentheses.

Panel A: The first-stage is based on GLS

	(1)	(2)	(3)	(4)	(5)	(6)
Deviation from target cash	0.546	0.501	0.546	0.501	0.544	0.499
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × BCL dummy	−0.105		−0.105		−0.106	
	(<0.001)		(<0.001)		(<0.001)	
Deviation from target cash × Delaware × After95		−0.130		−0.130		−0.131
		(<0.001)		(<0.001)		(<0.001)
Deviation from target cash × Delaware		0.013		0.013		0.013
		(0.514)		(0.594)		(0.531)
Deviation from target cash × High leverage	−0.027	−0.028	−0.027	−0.028	−0.029	−0.029
	(0.197)	(0.190)	(0.133)	(0.092)	(0.174)	(0.170)
Deviation from target cash × High FCF dummy	−0.025	−0.030	−0.025	−0.030	−0.025	−0.030
	(0.387)	(0.313)	(0.319)	(0.202)	(0.383)	(0.307)
Deviation from target cash × Log(Real size)	0.008	0.010	0.008	0.010	0.008	0.011
	(0.214)	(0.094)	(0.235)	(0.097)	(0.187)	(0.080)
Deviation from target cash × Tobin's Q	0.001	0.002	0.001	0.002	0.001	0.002
	(0.779)	(0.666)	(0.806)	(0.628)	(0.775)	(0.660)
Deviation from target cash × Non-Rated dummy	−0.015	−0.011	−0.015	−0.011	−0.014	−0.010
	(0.683)	(0.779)	(0.652)	(0.687)	(0.703)	(0.797)
Deviation from target cash × Industry cash flow risk	−0.647	−0.654	−0.647	−0.654	−0.648	−0.655
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × Asset beta	−0.015	−0.014	−0.015	−0.014	−0.015	−0.014
	(0.013)	(0.019)	(0.003)	(0.021)	(0.012)	(0.018)
Deviation from target cash × Age	−0.007	−0.007	−0.007	−0.007	−0.007	−0.007
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × Deviation from target cash	−0.263	−0.257	−0.263	−0.257	−0.262	−0.256
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Intercept	− <0.001	−0.003	−0.003	−0.006	−0.001	−0.004
	(0.959)	(0.690)	(0.736)	(0.538)	(0.872)	(0.663)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	No	No
Firm fixed effects	No	No	No	No	Yes	Yes
No. of observations	31,214	31,214	31,214	31,214	31,214	31,214
R-squared	0.442	0.442	0.442	0.442	0.651	0.651
No. of firms					8918	8918

Panel B: The first-stage is based on Driscoll–Kraay standard errors

	(1)	(2)	(3)	(4)	(5)	(6)
Deviation from target cash	0.561	0.519	0.561	0.519	0.560	0.518
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × BCL dummy	−0.091		−0.091		−0.091	
	(<0.001)		(<0.001)		(<0.001)	
Deviation from target cash × Delaware × After95		−0.107		−0.107		−0.108
		(<0.001)		(<0.001)		(<0.001)
Deviation from target cash × Delaware		0.014		0.014		0.014
		(0.492)		(0.531)		(0.493)
Deviation from target cash × High leverage	−0.043	−0.044	−0.043	−0.044	−0.044	−0.045
	(0.041)	(0.038)	(0.032)	(0.035)	(0.035)	(0.032)
Deviation from target cash × High FCF dummy	−0.015	−0.019	−0.015	−0.019	−0.014	−0.018
	(0.607)	(0.525)	(0.518)	(0.499)	(0.627)	(0.540)
Deviation from target cash × Log(Real size)	0.011	0.013	0.011	0.013	0.011	0.013
	(0.074)	(0.033)	(0.069)	(0.004)	(0.065)	(0.028)
Deviation from target cash × Tobin's Q	−0.004	−0.003	−0.004	−0.003	−0.004	−0.003
	(0.421)	(0.504)	(0.447)	(0.536)	(0.417)	(0.501)
Deviation from target cash × Non-Rated dummy	−0.008	−0.004	−0.008	−0.004	−0.007	−0.003
	(0.831)	(0.925)	(0.773)	(0.917)	(0.846)	(0.939)
Deviation from target cash × Industry cash flow risk	−0.530	−0.536	−0.530	−0.536	−0.531	−0.537
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × Asset beta	−0.012	−0.012	−0.012	−0.012	−0.012	−0.012
	(0.041)	(0.051)	(0.037)	(0.086)	(0.037)	(0.047)
Deviation from target cash × Age	−0.008	−0.008	−0.008	−0.008	−0.008	−0.008
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)

(continued on next page)

Table 7 (*continued*)

Panel B: The first-stage is based on Driscoll–Kraay standard errors

	(1)	(2)	(3)	(4)	(5)	(6)
Deviation from target cash × Deviation from target cash	−0.265	−0.262	−0.265	−0.262	−0.264	−0.261
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Intercept	0.001	−0.004	−0.002	−0.004	0.004	0.002
	(0.937)	(0.682)	(0.871)	(0.637)	(0.673)	(0.859)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	No	No
Firm fixed effects	No	No	No	No	Yes	Yes
No. of observations	31,069	31,069	31,069	31,069	31,069	31,069
R-squared	0.446	0.446	0.446	0.446	0.651	0.651
No. of firms					8915	8915

Panel C The first-stage is based on a dynamic panel with Blundell and Bond's (1998) GMM

	(1)	(2)	(3)	(4)	(5)	(6)
Deviation from target cash	0.363	0.352	0.363	0.352	0.359	0.347
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × BCL dummy	−0.037		−0.037		−0.036	
	(0.001)		(0.001)		(0.001)	
Deviation from target cash × Delaware × After95		−0.070		−0.070		−0.070
		(<0.001)		(<0.001)		(<0.001)
Deviation from target cash × Delaware		0.021		0.021		0.021
		(0.111)		(0.118)		(0.101)
Deviation from target cash × High leverage	−0.059	−0.059	−0.059	−0.059	−0.061	−0.061
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × High FCF dummy	0.005	0.005	0.005	0.005	0.008	0.007
	(0.735)	(0.767)	(0.695)	(0.715)	(0.626)	(0.660)
Deviation from target cash × Log(Real size)	0.013	0.013	0.013	0.013	0.014	0.013
	(0.011)	(0.011)	(0.017)	(0.008)	(0.008)	(0.008)
Deviation from target cash × Tobin's Q	−0.003	−0.003	−0.003	−0.003	−0.003	−0.002
	(0.387)	(0.401)	(0.390)	(0.409)	(0.416)	(0.431)
Deviation from target cash × Non-Rated dummy	0.058	0.057	0.058	0.057	0.058	0.057
	(0.016)	(0.020)	(0.008)	(0.021)	(0.017)	(0.022)
Deviation from target cash × Industry cash flow risk	−0.316	−0.332	−0.316	−0.332	−0.317	−0.334
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × Asset beta	−0.003	−0.003	−0.003	−0.003	−0.004	−0.004
	(0.431)	(0.443)	(0.425)	(0.429)	(0.402)	(0.415)
Deviation from target cash × Age	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
	(0.001)	(0.001)	(0.001)	(<0.001)	(0.001)	(<0.001)
Deviation from target cash × Deviation from target cash	−0.092	−0.089	−0.092	−0.089	−0.093	−0.090
	(<0.001)	(<0.001)	(<0.001)	(0.002)	(<0.001)	(<0.001)
Intercept	0.003	0.001	0.009	0.008	0.012	0.011
	(0.736)	(0.908)	(0.319)	(0.309)	(0.137)	(0.174)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	No	No
Firm fixed effects	No	No	No	No	Yes	Yes
No. of observations	32,445	32,445	32,445	32,445	32,445	32,445
R-squared	0.455	0.455	0.455	0.455	0.618	0.617

Based on the recommendation of Flannery and Hankins (2013), we estimate the combined model (5) using Blundell and Bond's (1998) GMM method to compute $Cash^{*}_{i,t}$. Then, we use this computed target cash ratio to estimate Eq. (1) using OLS with either robust or bootstrapped standard errors given the generated regressor (Pagan (1984)).

$$Cash_{i,t} = \lambda\beta X_{i,t-1} + (1-\lambda)Cash_{i,t-1} + \varepsilon_{i,t} \tag{5}$$

Table 8
Descriptive statistics for target cash levels and deviations from target cash levels across different first-stage estimation methods.
This table presents means and medians for the target cash level and the deviation from target cash level using different first-stage estimation methods.

	Target cash level		Deviation from target cash	
	Mean	Median	Mean	Median
Yearly regression	0.144	0.096	−0.011	0.002
GLS	0.149	0.094	−0.006	0.005
Driscoll and Kraay correction	0.150	0.096	−0.005	0.005
Blundell and Bond GMM	0.143	0.099	−0.012	0.003

The corresponding second-stage regression results shown in Panel C are consistent with our previous findings. The summary statistics in Table 8 suggest that the results for the target cash level and the deviation from target cash level are similar across different estimation methods.

5.2. The use of business combination laws for identification

Karpoff and Wittry (2015) raise concerns regarding the use of business combination laws for identification. First, the first-generation antitakeover laws were effectively invalidated by a U.S. Supreme Court decision in Edgar V. MITE Corp. in 1982. That is, until the MITE decision, the first-generation antitakeover laws provided managers with unusually aggressive defenses against unwanted takeover bids. Second, almost immediately after the MITE decision in June 1982, states began adopting second-generation antitakeover laws. Although, Francis et al. (2010) observe that "… Business Combination laws… are considered in the extant literature as the most stringent state antitakeover laws" and Amore and Bennedsen (2013) argue that "Business combination laws were the most stringent," Karpoff and Wittry (2015) argue that other laws such as directors' duties laws, control share acquisition laws, poison pill laws, and fair price laws also provide strong takeover protections. Third, in addition to antitakeover laws, court rulings can affect takeover protection. A prominent example is American General Corp's unsolicited tender offer for Unitrin in 1995. The Delaware Supreme Court held that Unitrin's poison pill was legal, and this decision broadened the set of circumstances under which pills are valid and changed the takeover landscape in Delaware after 1995. This is, incidentally, one of the court cases that motivate our Delaware 1995 variable. We should also note that Heron and Lie (2015) find no evidence to suggest that the two Delaware case rulings in 1995 had any effect on the use or effectiveness of poison pills, thus raising doubts about whether these cases were sufficiently consequential to be used for identification purposes. The use of both business combination laws and the Delaware court decisions are helpful to mitigate these concerns.

To address the concerns regarding the use of business combination laws for identification, we applied four robustness checks. First, as a simple way to address the first-generation law, we eliminate observations prior to 1983. Second, we include a first-generation law control variable as well as control variables for directors' duties laws (DD dummy), control share acquisition laws (CS dummy), poison pill laws (PP dummy), and fair price laws (FP dummy) following Karpoff and Wittry (2015). Third, as Karpoff and Wittry note, strictly speaking, only two of the 36 states with business combination laws – Delaware and Texas – passed business combination laws on a stand-alone basis and without at least one other antitakeover law already in place. We checked whether our results still hold if we reduce our sample to only Delaware and Texas. Fourth, we already examined the individual effects of business combination laws and the Delaware 1995 court rulings on the cash adjustment speed. We include both to check whether each still has an incremental effect. Table 9 presents the results. All the control variables as well

Table 9
Robustness tests for the use of state anti-takeover laws for identification.
This table shows the effect of entrenchment on cash adjustment speeds when cash holdings exceed the target. Models 1–4 employ different methods to test the robustness of state anti-takeover laws for identification. The first model excludes observations before 1983. The second model includes additional control variables: a first-generation law dummy, a directors' duties laws dummy (DD dummy), a control share acquisition laws dummy (CS dummy), a poison pill laws dummy (PP dummy), and a fair price laws dummy (FP dummy). The third model restricts the sample to firms in Delaware and Texas. The fourth model controls for the Delaware 1995 court rulings. P-values are reported in parentheses.

	(1)	(2)	(3)	(4)
Deviation from target cash	0.404	0.412	0.462	0.411
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Deviation from target cash × BCL dummy	−0.045	−0.045	−0.078	−0.040
	(<0.001)	(<0.001)	(<0.001)	(0.001)
Deviation from target cash × First-generation law dummy		−0.010		
		(0.676)		
Deviation from target cash × CS dummy		0.003		
		(0.894)		
Deviation from target cash × FP dummy		−0.001		
		(0.958)		
Deviation from target cash × DD dummy		0.011		
		(0.615)		
Deviation from target cash × PP dummy		−0.018		
		(0.356)		
Deviation from target cash × Delaware × After95				−0.038
				(0.012)
Deviation from target cash × Delaware				0.031
				(0.006)
Intercept	0.008	0.007	0.019	0.007
	(0.245)	(0.280)	(0.066)	(0.276)
Control variables	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
No. of observations	31,055	32,836	16,477	32,836
R-square	0.478	0.487	0.483	0.487

as the deviation from target cash level interacted with the controls variables are exactly as in previous tables. In short, we find that our results are robust, as the coefficient of the interaction between the cash deviation and the BCL dummy is negative and statistically significant in all four models.

6. Conclusion

Numerous studies have analyzed firms' cash policies by estimating cash balances and their cross-sectional determinants. We instead focus on the speed at which firms adjust cash ratios toward target levels. A high adjustment speed suggests that managers pay close attention to the cash level and consider deviations from the target level to be costly, whereas a slow adjustment speed suggests that the costs of making adjustments to the cash ratio is high.

But managers' decisions to adjust cash levels are likely influenced by their personal preferences. We put forth competing hypotheses from the extant literature on the influence of managerial self-interest on cash adjustment speeds. On the one hand, managers might wish to accumulate cash beyond what might be optimal for the firm, because they are risk averse or want flexibility to pursue personal objectives. This would manifest itself in *slower* adjustment speeds at high cash levels for entrenched firms. On the other hand, managers might have a great desire to spend cash, and will rush to spend any excess cash that the firm accumulates. This would manifest itself in *faster* adjustment speeds at high cash levels for entrenched firms.

We find that firms close about 31% of the gap between actual and target cash levels each year. This adjustment speed, however, is affected by the level of entrenchment of the firm. Using changes in BC laws in various states from 1985 to 1991 and a series of court cases in 1995 in Delaware as exogenous entrenchment shocks, we estimate that an increase in entrenchment significantly decelerate cash adjustment at high levels. Thus, managers of entrenched firms are less eager to disburse or spend cash in excess of the target levels. This, in turn, leads such firms to carry higher cash balances.

Our results seemingly contradict those in Dittmar and Mahrt-Smith (2007), Harford et al. (2008), and Bates et al. (2009). Those studies do not estimate adjustment speeds, but instead examine the determinants of cash reserves and cash changes among firms with excess cash. Using the GIM index as an entrenchment measure, they find that entrenched firms have smaller cash reserves than other firms, apparently because entrenched firms are more aggressive in their dissipation of excess cash. We believe that the GIM index suffers from several weaknesses in this context, most prominently that it might be endogenously determined by firms' corporate financial policies and that its construction is *ad hoc*. Thus, results based on the GIM index are more difficult to interpret than those based on an exogenous shock in takeover landscape. Our new results and interpretations therefore bring us back to the view emphasized in Opler et al. (1999) that managers are inherently reluctant to expend excess cash.

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