

Do Horizontal Mergers Affect Rivals' Cash Holdings?

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Abstract

The effect of horizontal mergers on industry competition relies on the relative importance of the efficiency effect to the market power effect. Under the efficiency hypothesis, the non-merging rivals would have more motives to improve their own efficiency to survive competition. This paper examines rivals' efficiency via the lens of their cash policies. I find that in response to horizontal mergers, rivals with higher Tobin's Q increase cash holdings and investments. The effect is greater among the constrained rivals. On the other hand, rivals with lower Tobin's Q reduce cash holdings and increase payouts. The effect is greater for the liquid rivals. Overall, these results suggest that horizontal mergers induce rivals to behave as if they improve the efficiency of cash policies, which is consistent with the idea that horizontal mergers on average do not harm industry competition.

JEL classification: G34, L41, G31

1. Introduction

The debate on the effect of horizontal mergers on industry competition focuses on the relative importance of the market power effect to the efficiency effect. On the one hand, Bain (1956) argues that horizontal mergers reduce the number of competitors in the industry, enabling the firms to collude more easily and charge higher prices (*the market power effect*). On the other hand, Stigler (1950, 1964) asserts that horizontal mergers can save the merging firms' operating costs, allowing them to lower prices (*the efficiency effect*). With sufficient efficiency gains, product prices may not necessarily increase. Since efficiency is unobservable, empirically it is difficult to measure the efficiency gains of a horizontal merger. Previous empirical literature mainly analyzes this issue by investigating either the price movement in certain industries or the stock market reactions of related market participants. However, the empirical results and interpretations are mixed. Intuitively, if a horizontal merger is dominated by the efficiency effect, at the equilibrium of an efficient market, rivals would have more motives to improve their efficiency to match that of the merging firms'. There are various types of efficiencies. In this paper, I examine the efficiency of rival firms' cash policies in response to a horizontal merger.

There are two types of inefficiencies in cash policies. One type is when a firm is financially constrained, the firm has to give up some positive-NPV investment projects (under-investment). The other is when a firm has too much free cash flow and the manager may pursue private benefit by undertaking some negative-NPV projects (over-investment). Under the efficiency hypothesis, a horizontal merger with sufficient efficiency gains may induce rivals to correct the inefficiency of cash policies. Specifically, firms with more investment opportunities would hold more cash as funding resources while firms with few investment opportunities may reduce cash reserves to avoid the costs of holding cash (such as agency costs). Under the market power hypothesis, such changes in cash holdings are less likely. To some extent, rivals' cash policies can be even less efficient in a less competitive environment.

To investigate rival firms' cash policies in response to horizontal mergers, I construct a sample of 16597 horizontal mergers between U.S. firms between 1984 and 2016. A horizontal merger is defined as an acquisition if the merging firms share the same 6-digit NAICS code. The mergers involve both public and private firms from 548 industries. The average deal size is \$272.4 million, and the median is \$26 million. Rival firms are defined as the Compustat firms with the same 6-

digit NAICS code as the merging firms. I examine the changes in rival firms' cash holdings over a three-year period around the year of merger completion, and then I test whether the changes are associated with rivals' investment opportunities.

I find that following horizontal mergers, rivals' cash holdings overall increase by 2.3% relative to the average. Moreover, rival firms with Tobin's Q in the top tercile tend to increase cash holdings by 3.2% while rivals with Tobin's Q in the bottom tercile tend to decrease cash holdings by 1.2% relative to the average, suggesting that the changes in rivals' cash holdings are closely associated with their investment opportunities. In particular, I find that among the high-Tobin's Q rivals, the increase in cash ratios is greater for the constrained firms. These firms also significantly increase capital and R&D expenditures following a horizontal merger. On the other hand, among the low-Tobin's Q rivals, the decrease in cash ratios is more pronounced among the liquid firms. These firms significantly reduce their expenditures on capital investment, R&D and acquisitions while they also increase dividends payout and stock repurchases. Overall, these financial policies consistently indicate that, in response to horizontal mergers, rival firms behave as if they improve the efficiency of cash policies, which supports the prediction of the efficiency hypothesis of horizontal mergers.

One major concern of the main findings is that rivals' cash holdings and merger initiations are endogenously determined. Regardless of occurrences of horizontal mergers, it is possible that rival firms' cash holdings are essentially driven by investment opportunities. To examine if horizontal mergers induce rival firms to adjust the level of cash holdings more aligned with their investment opportunities, I construct a control group of firms exposed to withdrawn horizontal mergers. Presumably, if rivals' cash policies do not result from horizontal mergers, the treated group and the control group are expected to have similar patterns of cash holdings in years around the merger event. The results show that, for firms with lower investment opportunities, the treated group reduces cash holdings significantly following a horizontal merger while the control group does not have significant changes in cash ratios. Interestingly, for firms with more investment opportunities, both the treated group and the control group increase cash holdings following the merger, but the cash increase is significantly higher for the treated group than the control group. This finding indicates that a firm's cash holdings are indeed correlated with its investment opportunities, but a horizontal merger can increase the sensitivity of the investment-cash holding relation.

Why do rivals choose to hold more cash to fund their investment opportunities? I open the black box exploring the possibility of investment opportunities. Bates, Kahle and Stulz (2009) argue that U.S. firms are becoming increasingly R&D-intensive. Given asset intangibility, R&D investment opportunities are costly to finance, so the highly-R&D intensive firms require more cash holdings as precautionary savings. Following this spirit, I test if investment opportunities could emerge from R&D investment. I assign rival firms into terciles based on the pre-merger level of R&D ratios. Presumably, if rivals' investment opportunities come from R&D investment, it is expected that the pattern of the R&D-cash relation would be similar to that of the Tobin's Q-cash relation. Consistent with this argument, I find that the constrained firms with higher R&D intensity tend to increase cash holdings following a horizontal merger, and the magnitude is similar to that for the constrained firms with higher Tobin's Q. Similarly, the liquid firms with lower R&D intensity tend to decrease cash holdings subsequent to a horizontal merger, and the magnitude is similar to that for the liquid firms with lower Tobin's Q. Overall, these findings are consistent with the idea that rivals' investment opportunities could lie in R&D investment.

Next I separately examine horizontal mergers in different time periods to check the robustness of my main findings. One concern is that firms can utilize alternative financing sources, such as lines of credit, as substitutes to cash holdings to fund investments. If firms reduce cash holdings while engaging more in lines of credit, firms' immediate access to capital may not necessarily be affected. To address this issue, I test rivals' cash policies in response to horizontal mergers during the 2008-2009 financial crisis. Since lines of credit are hardly accessible during market downturns, we can more cleanly observe rivals' liquidity policies around horizontal mergers. The results show that constrained rivals with high Tobin's Q increase cash holdings by 19.4% relative to the average, while the liquid rivals with low Tobin's Q decrease cash holdings by 14.0% relative to the average. Quantitatively more significant, these results are consistent with the main finding that in response to a horizontal merger, rivals behave as if they improve the efficiency of cash policies.

I also examine rival firms' cash policies around horizontal mergers from 1991 to 2000, during which there was an economywide R&D boom (Brown, Fazzari and Petersen 2009). During this period, R&D investment is more likely to become firms' investment opportunities, so firms may be more likely to increase cash holdings. The results show that, except for the most liquid firms, rivals overall tend to increase cash holdings in response to a horizontal merger, which is consistent

with the idea that R&D investment develops a firm's growth opportunities. In face of a horizontal merger, rival firms have motives to hold more cash to fund the R&D investment.

Overall, this paper shows that following horizontal mergers, industry rivals with higher Tobin's Q tend to increase cash holdings, and this pattern is more pronounced for the constrained firms. On the other hand, rival firms with lower Tobin's Q tend to decrease cash holdings, and the pattern is more pronounced among the liquid firms. These findings suggest that rival firms improve the efficiency of cash policies in response to horizontal mergers, which is consistent with the efficiency hypothesis of horizontal mergers. Since the relative gains in the merging firms' market power vary under different circumstances, next I test rival firms' cash policies in scenarios where the market power effect is most likely to dominate the efficiency effect. In particular, I examine if rivals would still behave as if they improve the efficiency of cash policies in the most monopolistic markets. If they do, it implies that even in these scenarios the efficiency gains still outweigh the gains in market power for the merging firms. If they do not, then it is possible that these horizontal mergers are anticompetitive.

I examine rival firms' cash policies following mega horizontal mergers, defined as deals with the transaction value above \$650 million (the top decile). In a mega horizontal merger, the merging firms are normally leaders of an industry. The completion of a mega horizontal merger is likely to create a conglomerate dominating the industry. Interestingly, within the group of mega horizontal mergers, I find that rival firms' cash policies respond in an opposite direction to the baseline results. Rivals with high Tobin's Q decrease cash holdings while those with low Tobin's Q increase cash holdings. These patterns appear to imply that rival firms' cash policies becomes less efficient following horizontal mergers. Then I investigate rival firms' cash policies in industries at different levels of industry concentration, proxied by the Compustat HHI. I find that rivals behave as if they are improving the efficiency of cash policies only when the industries are less concentrated. There is insignificant change in rivals' cash holdings following horizontal mergers in the most concentrated industries (HHI in the top decile). To summarize, although horizontal mergers overall induce rivals to improve the efficiency of cash policies, it is still possible that the market power effect dominates a horizontal merger in the most concentrated markets.

This paper is closely related to the literature on the influence of horizontal mergers on industry competition. In theory the net effect of a horizontal merger on competition depends on relative

strengths of the market power effect versus the efficiency effect (Bain 1956; Stigler 1950, 1964; Demsetz 1973; Williamson 1975; Stiglitz 1979). Previous empirical studies mainly focus on the announcement returns of related firms (Eckbo 1983, 1985; Stillman 1983; Song and Walkling 2000; Fee and Thomas 2004; Shahrur 2005; Derrien et al 2017; Bernile and Lyandres 2018) or the price effect in certain industries (Kim and Singal 1993, Prager and Hannan 1998, Focarelli and Panetta 2003, Weinberg 2007, Erel 2011; Blonigen and Pierce 2016; Liebersohn 2018), but these studies come to mixed results and interpretations. Recent research argues that acquisitions can relieve the merging firms' financial constraints (Almeida, Campello and Hackbarth 2011; Erel, Jang and Weisbach 2015; Williamson and Yang 2016), while it remains unclear whether the improvement in liquidity provision can create sufficient efficiency gains that dominate the market power effect. Therefore, this paper addresses this issue by investigating rival firms' efficiency in cash policies. If the efficiency effect dominates the market power effect in a horizontal merger, then rivals would be more likely to improve the efficiency of their cash policies to match the merging firms' higher operating efficiency. On the other hand, if the market power effect dominates, rival firms are less likely to behave as if they improve their operating efficiencies. The main finding of this paper is that following horizontal mergers, rival firms with higher Tobin's Q tend to increase cash holdings and the effect is greater among the constrained firms, while rivals with lower Tobin's Q tend to decrease cash holdings and the effect is greater among the liquid firms. These changes in cash holdings indicate that rivals respond to horizontal mergers as if they are improving the efficiency of cash policies. Therefore, the results are consistent with the efficiency hypothesis of horizontal mergers.

This paper also contributes to the literature on cash policies. Prior literature examines the determinants and implications of corporate cash holdings (Opler et al. 1999; Pinkowitz, Stulz and Williamson 2009, 2015), while less is known about the importance of corporate liquidity in industry competition. Following Bolton and Scharfstein (1990), a firm with a strong balance sheet can utilize aggressive pricing to challenge its rivals. Fresard (2010) empirically shows that a firm's large cash reserves lead to systemic future market share gains at the expense of industry rivals. Kim (2017) finds that airlines with more cash than their rivals respond to intensified competition by pricing more aggressively, especially when there is less concern of rival retaliation. This paper examines the role of corporate liquidity through the lens of investment efficiency. Campello (2006) argues that a firm can use cash reserves to fund competitive strategies. When a horizontal merger

creates large efficiency gains for the merging firms, the non-merging rivals would have more incentives to compete by improving their operating efficiencies. One thing they can do is develop competitive advantages by financing more positive-NPV investment projects.

Finally, this paper in a sense adds to the rising strand of literature on intangible investments. Recent studies document that intangible capital has become increasingly important for the U.S. corporations (Corrado and Hulton 2010; Kahle and Stulz 2017; Grullon et al 2018). Philippon and Gutierrez (2017) estimate that the rise of intangible capital can explain one-third of the decline in U.S. private fixed investment during the last thirty years. In the meantime, given the uncertainty of the value of intangible capital, the R&D-intensive firms in the U.S. choose to hold more cash to finance the intangible investments (Pinkowitz, Stulz and Williamson 2009, 2015). This paper supports this argument by providing micro-level evidence about the relation between a firm's R&D intensity and its cash policies in response to horizontal mergers. The findings also shed light upon the role of corporate liquidity in the evolution of modern industries in the U.S.

The rest of the paper is structured as follows. Section 2 develops hypotheses on the impact of a horizontal merger on rivals' cash holdings. Section 3 introduces the sample and methodology. Section 4 reports the main results. Section 5 discusses financial constraints as the mechanism through which rivals adjust cash holdings to fund their investment opportunities. Section 6 tests rivals' cash policies over different time periods and across different industries. Section 7 concludes.

2. Hypotheses Development

Corporate liquidity affects the extent to which a firm responds to its investment opportunities. The optimal cash policies should ensure a firm to undertake all positive-NPV investment projects while rejecting all negative-NPV projects. On the one hand, liquidity can mitigate the cost of external financing (Keynes 1936; Myers and Majluf 1984). When the cost of external financing is high, firms with sufficient liquidity can still ensure the positive-NPV projects (Erel et al 2019). Otherwise, the firm may have to give up the investment opportunities (under-investment). On the other hand, Jensen (1986) argues that too much liquidity may induce agency problems because managers with less discipline from the capital market may undertake negative-NPV projects to

pursue private benefits (over-investment). Overall, the efficiency of a firm funding its investment is closely associated with the liquidity on its balance sheet.

The debate on the net effect of horizontal mergers on industry competition focuses on the relative importance of the market power effect to the efficiency effect. In this section, I borrow from the cash policies theories discussed above to derive predictions on horizontal mergers' impact on rival firms' cash holdings. Interestingly, different hypothesis would imply different rivals' cash policies in response to a horizontal merger.

The efficiency hypothesis asserts that horizontal mergers can lower the merging firms' marginal costs of production, enabling the merging firms to lower prices to the extent that cancels out the tendency of price increase due to market power. Under the efficiency hypothesis, industry rivals in an efficient market would have to compete by improving their own efficiency to match the lower marginal costs of the merging firms. Specific to the efficiency in cash policies, rival firms may reevaluate the costs and benefits of holding cash and adjust the cash policies to be aligned with their investment opportunities. More cash would be needed to ensure the positive-NPV projects while cash holdings should decrease to avoid the negative-NPV investments driven by agency problems. In particular, the efficiency hypothesis predicts that

H1: In response to horizontal mergers, rivals with investment opportunities increase cash holdings, and the effect is more pronounced among constrained firms.

H2: In response to horizontal mergers, rivals with few investment opportunities reduce cash holdings, and the effect is more pronounced among liquid firms.

Alternatively, if the market power effect dominates the efficiency effect, there is greater chance that the merging firms would raise product prices. In this case, rival firms would have less motives to improve their operating efficiencies. Thus, it is less likely to observe rivals adjust cash holdings as if they are improving the efficiency of cash policies. If any, the market power effect may make rival firms' liquidity policies even less efficient, which leads to opposite predictions on rivals' cash under the efficiency hypothesis. These effects more likely to occur among the mergers where the market power effect could be the most significant. Therefore, I hypothesize that:

H3: In highly concentrated markets, horizontal mergers do not induce rivals to adjust cash holdings more aligned with their investment opportunities.

3. Data and Methodology

This paper defines horizontal mergers and the industry rivals based on the NAICS-6 codes. In this section, I first describe how I construct my sample and then introduce the baseline model setup. The summary statistics include the liquidity policies and financial characteristics of the rivals that are exposed to the completed horizontal mergers.

3.1 Sample

To construct my sample, I first collect 218570 deals announced and completed between 1984 and 2016 from the Security Data Corporation's (SDC) Merger and Corporate Transactions Database. The sample starts in 1984 because that is the first year when all financial data in my sample is available. Using the financial data from Compustat, I exclude 2296 deals with either of the merging firms' NAICS-6 code missing in SDC. I exclude 58055 deals in financial industry (NAICS codes starting with 52), 4497 deals in utilities industry (NAICS codes starting with 22) and 1423 deals in which either the acquirer or the target is a government agency. Following Erel, Liao and Weisbach (2012), I further exclude LBOs, spinoffs, recapitalizations, self-tender offers, exchange offers, repurchases, privatizations and non-controlling acquisitions (27110 deals). And I drop the deals where the transaction value is missing (78982 deals). The selection results in 20617 horizontal mergers. The target has its majority of ownership (greater than 50%) sold to the acquirer subsequent to each transaction. Then, I construct a sample of GVKEY firms from Compustat which share the same NAICS-6 codes with the merging firms. I require that there be at least one firm in the industry besides the merging firms in the year before merger announcements, and the sample firms have non-missing data in at least one fiscal year around each merger. Finally, there are 16597 horizontal mergers from 548 industries in my sample, the top five of which are crude petroleum and natural gas extraction (10.7%), software publishers (6.7%), lessors of nonresidential buildings (5.2%), software reproducing (3.8%), and hotels (3.0%).

3.2 Methodology

I use the following specification to estimate rival firms' response to a horizontal merger:

$$\begin{aligned} Cash/Assets_{i,t} &= \beta After + Controls + Deal \times Firm\ Fixed\ Effect \\ &+ Year\ Fixed\ Effect + \varepsilon_{i,t} \end{aligned}$$

The panel regression runs from three years prior to the merger announcement to three years after the merger completion. $Cash/Assets_{i,t}$ is a continuous variable that measures a rival firm i 's liquidity, measured by the ratio of cash and cash equivalents over total assets. $After$ is a binary variable that takes on a value of one for firm years after merger completion and zero otherwise. I also control for financial characteristics that determine a firm's target cash levels (Opler, Pinkowitz, Stulz and Williamson 1999; Bates, Kahle and Stulz 2009). The control variables include firm size ($Ln(Total\ Assets)$, $Ln(Total\ Assets)^2$), industry cash flow volatility ($Industry\ sigma$), net working capital ($NWC/Assets$), operating loss ($Loss$), firm age ($IPO \leq 5\ years$), dividends ($Dividends/Assets$), stock repurchases ($PRSTKC/Assets$), capital expenditures ($CapEx/Assets$), R&D ratio ($R\&D/Assets$), acquisition expenditures ($AQC/Assets$), net equity issuance, net debt issuance and net leverage. Detailed variable definitions are described in Appendix 1. Following Bates, Kahle and Stulz (2009), R&D ratios are treated as zero if the data is missing. Considering that a rival firm can be exposed to multiple horizontal mergers, the specification includes $Deal \times Firm$ fixed effect for each sample firm, controlling for omitted deal and firm characteristics that are constant over time. $Year$ fixed effect is controlled to address the year-specific constant unobserved factors across firms. Considering that unobservable factors can be correlated within each industry, the standard errors of coefficients are clustered at the industry level. If a firm increases cash holdings subsequent to a horizontal merger, one should expect that $\beta > 0$.

(Insert Table 1 Here)

Table 1 reports the summary statistics of the key variables. All variables are winsorized at the 1% percentile and the 99% percentile. Observations with missing data are dropped. Panel A presents rivals' average financial characteristics in the three-year period before merger completion. Panel B presents rivals' average financial characteristics in the three-year period after merger completion. Overall, there does not seem to be a clear change of rivals' responses in cash holdings to horizontal mergers. Moreover, it is shown that rivals' average cash flow ratios and Tobin's Q

decrease by 9.1% and 3.5% while the cash flow volatility increase by 32.6%, suggesting horizontal mergers on average adversely affect rivals' firm performance. It is possible that rival firms with different financial fundamentals respond to horizontal mergers in opposite directions with their cash policies, resulting in little change in cash reserves when combining different groups of rivals together. To analyze the heterogeneity among rival firms, I conduct multivariate regressions to investigate the determinants of rivals' cash policies in response to a horizontal merger.

4. Estimates of Horizontal Mergers' Impact on Rivals' Cash Holdings

In this section, I first examine the overall changes in rivals' cash holdings in the three-year period around a horizontal merger. Then I sequentially add control variables into the baseline regression and discuss the factors that can explain the changes in rivals' cash reserves. In addition, I construct a control group of rivals exposed to withdrawn horizontal mergers to argue the causal impact of horizontal mergers on rivals' cash policies.

4.1 Baseline results

Following the baseline model specification described in Section 3.2, I present the estimates of rivals' changes in cash holdings in the three-year period around a horizontal merger in Table 2. The number of observations decreases from column (1) to column (6) due to data availability as I add in more control variables. The coefficient estimates hold similar when I maintain the same number of observations across all specifications.

Column (1) in Table 2 shows that rivals' cash ratios in the three years after merger completion is 0.8% higher than those before the merger. The increase in cash holdings is about 2.3% relative to the mean, 2.7% relative to the median and 2.9% relative to the standard deviation. In column (2), I add in firm-level fundamental characteristics following Bates, Kahle and Stulz (2009). The results show that rivals' cash ratios increase by 0.5% subsequent to a horizontal merger, 37.5% smaller than the coefficient in column (1). It appears that most of the difference can be explained by firm size, profitability and firm age. A one percent increase in firm size is associated with 16.2% increase in cash holdings. Negative-net income firms have 3% lower cash reserves than the

positive-net income firms, and young IPO firms tend to have 1.9% lower cash reserves. Interestingly, these results seem to be contrary to the findings in Bates, Kahle and Stulz (2009) that small, young and underperforming firms appear to hold more cash reserves. Bates, Kahle and Stulz (2009) argue that the precautionary motive for cash holdings plays an important role in explaining the increase in cash reserves. However, my finding in column (2) that the larger, older and better-performing rival firms tend to hold more cash after a merger suggests that precautionary motives may not be the reason for the changes in rivals' cash holdings.

I control for firms' payout policies and investment policies in column (3) and (4) respectively. These variables are significantly correlated with a firm's cash reserves. In column (4), rivals' cash holdings are positively correlated with their R&D expenditures. This is consistent with Bates, Kahle and Stulz (2015) that the increase in cash reserves among the U.S. firms is driven by the highly R&D-intensive U.S. firms. On the other hand, rival firms' cash ratios are negatively correlated with their expenditures on acquisition. The positive coefficient of R&D and the negative coefficient of acquisition expenditures suggest that when firms hold more cash, the funding might be allocated more towards R&D investment while less to acquisition activities, which is consistent with Li (2019) that with sufficient corporate liquidity, rivals tend to decrease PP&E investment while increasing R&D investment in response to horizontal mergers.

In column (5) of Table 2, the change in rivals' cash holdings become insignificant after I control for firms' external financing and capital structure. The estimates suggest that rival firms' increase in cash ratios are unlikely to be driven by debt financing because the coefficients of debt issuance and net leverage are negative. Instead, the increase of rivals' cash reserves appears to result from increased equity issuances. A one-standard deviation increase in equity issuance is associated with a 7.0% increase in rivals' cash ratios¹. The estimates in column (6) seem to answer us why rivals issue new equity shares to accumulate more cash. In column (6), I control for rivals' investment opportunities, proxied by Tobin's Q and the ratio of cash flow to assets. The results show that both variables are positively correlated with a firm's cash holdings. A one-standard deviation increase in a rival's cash flow ratio (or Tobin's Q) is associated with 3.5% (or 3.4%) higher cash ratios relative to the average. After I control for rival firms' investment opportunities, the estimates of

¹ In Appendix Table A1, I provide more evidence on rivals' financial policies and discuss the drivers of these policies.

rivals' cash ratios become negative, significant at the 5% level. These results suggest that rival firms' cash policies are driven by their investment opportunities. In particular, in response to a horizontal merger, rivals with more investment opportunities tend to hold more cash while the firms with fewer investment opportunities tend to decrease cash holdings. These findings are consistent with the idea that in response to a horizontal merger, rivals appear to behave as if they adjust the level of cash holdings to be better aligned with their investment opportunities.

(Insert Table 2 Here)

4.2 Investment opportunities and cash holdings

To investigate whether rival firms with different investment opportunities may adopt different policies in cash holdings, I assign the sample firms into terciles based on the three-year average of Tobin's Q before each merger. Firms in the top tercile are considered to have more investment opportunities while those in the bottom tercile are considered with fewer investment opportunities.

As presented in Table 3, in the three-year period following a horizontal merger, rival firms in the bottom tercile tend to decrease cash holdings while those in the top tercile tend to increase cash holdings (See column (1) and (5)). In column (2) and (6), I control for firms' financial policies. The change in rivals' cash holdings becomes insignificant. It appears that the opposite directions in the change between the low-Tobin's Q firms and the high-Tobin's Q firms result from their different financial policies. According to the significance of the coefficient estimates, it appears that the low-Tobin's Q rivals increase dividends payout and stock repurchases while the high-Tobin's Q rivals increase equity issuance and R&D investment. As a result, the low-Tobin's Q firms decrease cash holdings while the high-Tobin's Q firms increase cash holdings². Overall, the results in Table 3 indicate that subsequent to a horizontal merger, rival firms adjust their cash holdings in a pattern that is more aligned with their investment opportunities.

(Insert Table 3 Here)

To visualize the change of rivals' cash holdings in the three-year period around a horizontal merger, I assign rival firms into quartiles based on their average Tobin's Q in the three-year period

² In Appendix Table A1, I provide more evidence on rival firms' financial policies.

before a merger, and I compute the average cash ratios for each quartile, demeaned by industry-year. I drop the firms in the lowest quartile of average Tobin's Q because the average demeaned cash ratios in this group are persistently about -2% during the observation window, which significantly deviate from the demeaned cash ratios of other groups. The average demeaned cash ratios for firms in the second lowest quartile group is -0.2%. It is probable that firms in the lowest quartile are distressed firms with few investment opportunities. For the low-Tobin's Q firms the inefficiency of cash policies mainly arises from holding too much. Thus, I choose the firms in the second lowest quartile of Tobin's Q and observe their cash holdings in years around horizontal mergers. Also, I observe the firms in the highest quartile of Tobin's Q to observe their cash ratios. Figure 1 shows that low-Tobin's Q rivals decrease their cash holdings from three years prior to the merger till three years after the merger, while the high-Tobin's Q rivals increase cash ratios over the same period. The opposite trends in cash ratios are consistent with the notion that in response to horizontal mergers, rivals adjust their cash holdings to the extent that matches their investment opportunities.

4.3 Identification: completed vs. withdrawn horizontal mergers

One endogeneity concern is that both merger initiations and rivals' cash holdings could be driven by omitted factors. For example, as the main results show that the high-Tobin's Q firms tend to increase cash holdings while the low-Tobin's Q firms tend to decrease cash holdings, it is possible that such relations may still exist absent the occurrences of horizontal mergers. To more rigorously argue the causal impact of horizontal mergers on rivals' cash reserves, I conduct difference-in-differences tests by constructing a control group in which the rival firms are exposed to horizontal mergers that are originally announced but are later withdrawn. The treated group includes firm that are rivals exposed to completed horizontal mergers. If there are omitted factors unrelated to horizontal mergers driving rivals' cash holdings, then the changes in cash ratios should exist for both the treated group and the control group.

To construct the control group, I use nearest neighbor matching (NNM) to identify the nearest three neighboring firms with replacement for each firm in the treated group based on firm size (Ln (Total assets)) and NAICS-5 codes in the year before merger announcement. Firms in the treated group have no significant difference in size from the control group. I also require the firms in the

treated group and in the control group to be in the same tercile of the average pre-merger level of Tobin's Q. Firms in the treated group are exposed to completed horizontal mergers while the firms in the control group are exposed to withdrawn horizontal mergers. The control group cannot be exposed other completed horizontal mergers in the same year.

Table 4 shows that subsequent to a horizontal merger, rival firms that are exposed to completed horizontal mergers tend to decrease cash reserves by 6.6% ($=0.017/0.256$) relative to the average, while there is no significant change in the cash holdings of firms exposed to withdrawn horizontal mergers. This indicates that in reaction to a horizontal merger, rival firms with few investment opportunities choose to hold less cash reserves. In addition, column (3) of Table 4 shows that rivals with Tobin's Q in the top tercile tend to increase their cash reserves following both withdrawn and completed horizontal mergers. Nevertheless, the increase in cash ratios for the treated group (rivals exposed to completed horizontal mergers) is 3.2% ($=0.011/0.32$) higher than that for the control group relative to the average, significant at the 5% level. This is still consistent with the idea that in reaction to horizontal mergers, rival firms with high investment opportunities choose to increase their cash holdings. The reason for the control group's cash increase might be because the failure of a horizontal merger reflects the merging firms' inability to close the deal. This could encourage the non-merging rivals to engage more in competition by hoarding more cash reserves. Overall, the findings in the quasi-experimental tests support argument that horizontal mergers induce rival firms to adjust their cash holdings to better align corporate liquidity with the firm's investment opportunities, which is consistent with the efficiency hypothesis of horizontal mergers.

(Insert Table 4 Here)

5. Channels

The main argument in this paper is that if the efficiency gains dominate a horizontal merger, rival firms will have more motives to improve the efficiency of their cash policies by adjusting their cash reserves better aligned with the demand for funding. In this section, I explore financial constraints as the channel via which rivals make cash holdings decisions. Then I discuss why rivals increase cash holdings to finance their investment. In particular, I investigate whether rivals exploit their investment opportunities by engaging in more R&D investment.

5.1 Financial constraints

As discussed earlier, there are two types of inefficiencies in cash policies. First is that firms are constrained and they do not have enough financial resources to fund their positive-NPV projects. Second is that firm have too much free cash and the manager may engage in negative-NPV projects. To examine if financial constraints are the channel through which rivals adjust their cash holdings in reaction to a horizontal merger, I assign the rivals into terciles based on their three-year average of financial constraints before the merger announcement. The financial constraints are proxied by three measures, KZ index (Kaplan and Zingales 1997), SA index (Hadlock and Pierce 2010) and WW index (Whited and Wu 2006). Firms are considered more financially constrained if they are in the top tercile of the index and are more liquid if they are in the bottom tercile.

Table 5 show the estimates of rivals' cash holdings with different levels of financial constraints. In Panel A, a firm's financial constraints are measured with the KZ index. Column (1) shows that, in response to a horizontal merger, rivals with Tobin's Q in the bottom tercile tend to decrease cash holdings, and the effect is more pronounced for the constrained firms, both statistically and economically. On the other hand, column (3) shows that rivals with Tobin's Q in the top tercile tend to increase cash ratios and the pattern is driven by the constrained firms. Similar patterns could also be found in Panel B and C where financial constraints are measured with SA index and WW index respectively. Altogether, the findings in column (1) and (3) suggest that financial constraints are the mechanism through which rivals adjust cash policies in reaction to a horizontal merger. Specifically, when there are high investment opportunities, the constrained firms tend to increase cash holdings while when investment opportunities are low, the liquid firms tend to decrease cash holdings. These findings are consistent with the idea that rivals choose to manage their corporate liquidity more efficiently in response to horizontal mergers.

(Insert Table 5 Here)

An alternative explanation to the argument of cash policies efficiency is the target level of cash ratios. It is possible that the cash policies already has been efficient before the merger and the cash holdings have been at the target level. Then a horizontal merger may shape the landscape of an industry, which may update the target level of rivals' cash holdings. To some extent, this concern is partially alleviated in the baseline regressions since I control for the factors that are associated with a firm's target level of cash holdings following Opler et al (1999), so the change in rivals'

cash ratios are less likely to be driven by the updated target level of cash holdings. In addition, I test rivals' payout and investment policies after horizontal mergers. As discussed in Table 2 and 3, these financial policies are closely related to a firm's cash holdings. Presumably, if the level of cash holdings is optimal ex ante, firms are less likely to adjust these financial policies.

The estimates presented in Appendix Table A1 suggest that following horizontal mergers, rivals with the lowest Tobin's Q tend to increase dividends payout and stock repurchases while decreasing external financing and investments. This pattern is more pronounced among the liquid firms (See Panel A). On the other hand, rival firms with the highest Tobin's Q tend to decrease payouts while increasing external financing and investments. The effect is greater among the constrained firms (See Panel C). Combining these results, it appears that in response to horizontal mergers, rivals do not only adjust their cash reserves, but also implement relevant financial policies. If rivals' cash ratios were at the optimal, it is less likely that rivals would change their financing and investment decisions. Instead, these results suggest that the pre-merger level of rivals' cash holdings is not at its optimal. The fact that the constrained rivals with high-Tobin's Q increase investments while the liquid rivals with low-Tobin's Q rivals increase payout indicates that rivals behave as if they improve the efficiency of cash policies.

Lines of credit (or revolving credit lines) could be an alternative financing source of cash. One concern is that if rivals decrease cash reserves while engaging more in lines of credit, essentially the firms may not have reduced corporate liquidity. To address this concern, I utilize the data on lines of credit from *DealScan* database and examine rivals' issuance of credit lines subsequent to horizontal mergers. The results are in Appendix Table A2. It appears that rivals with high Tobin's Q tend to issue more lines of credit subsequent to horizontal mergers, consistent with the idea that in response to horizontal mergers, rivals have more motives to improve corporate liquidity to fund their investment opportunities. On the other hand, there is little evidence that rivals with low pre-merger Tobin's Q engage in lines of credit following horizontal mergers. Thus, the concern that firms reduce cash holdings while increasing credit lines is mitigated. Overall, these findings are consistent with the idea that rivals respond to horizontal mergers by adjusting corporate liquidity to match their investment opportunities.

5.2 R&D investment

The main results I have discussed so far indicate that investment opportunities are important drivers of rival firms' cash policies in face of a horizontal merger. To more efficiently manage cash policies, firms with more investment opportunities increase cash holdings while the ones with few investment opportunities reduce cash holdings to avoid agency costs. Next, I explore what exactly the investment opportunities can be that require firms to adjust cash ratios. According to Bates, Kahles and Stulz (2009) and Pinkowitz, Stulz and Williamson (2015), since the late 1990s the U.S. firms have increased cash holdings and this pattern is driven by highly R&D-intensive U.S. firms. Following this spirit, I examine whether rival firms' investment opportunities could lie in R&D investment. To test this, I assign my sample firms into terciles by the three-year average of R&D ratios, measured by R&D expenditures divided by lagged total assets, over the three years before the merger and the firms in the top tercile are considered more R&D-intensive. If rival firms' investment opportunities come from R&D investment, it is expected that the R&D-intensive firms tend to increase cash holdings more in reaction to a horizontal merger.

As shown in Table 6, subsequent to a horizontal merger, the R&D intensive rival firms tend to increase cash holdings and the effect is stronger among the firms relatively more constrained (See column 3) while the liquid firms with less R&D expenditures tend to reduce cash ratios (See Panel A and C for column 1). These results follow the same pattern when I assign the sample firms into terciles based on the pre-merger level of Tobin's Q, implying that rivals' investment opportunities could come from R&D investment. Given the low tangibility of R&D investment, the R&D intensive firms tend to hold more cash as precautionary savings.

(Insert Table 6 Here)

5.3 Time period

As placebo tests, I also examine rivals' responses in cash holdings following horizontal mergers during different time periods. First, I investigate the horizontal mergers announced and completed during the financial crisis (2008-2009). This test can serve two purposes. First, during economic downturns, lines of credit and debt capacity can disappear when they are most needed (Acharya, Almeida and Campello 2007; Almeida, Campello, Cunha and Weisbach 2014). Examining rivals' cash policies following horizontal mergers in this period can mitigate the concern that rival firms shift from cash holdings to lines of credit. Second, presumably if rival firms adjust cash holdings

through the channel of financial constraints, this effect should be more pronounced in the financial crisis period during which there is limited supply of external financing. The estimates of rivals' cash holdings following horizontal mergers over the financial crisis are shown in Panel A of Table 7. Column (1) shows that the liquid rivals with low premerger Tobin's Q tend to reduce cash holdings following a horizontal merger while the high-Tobin's Q rivals tend to increase cash holdings, and the effect is significantly stronger among the constrained firms (firms with SA index in the top tercile). Overall, these results are consistent with the idea that rival firms adjust their cash holdings to the extent that better matches the demand for corporate liquidity, which also mitigates the concern about firms switching to lines of credit.

(Insert Table 7 Here)

I also examine rivals' cash holdings following horizontal mergers announced and completed in the 1990s when there was an acknowledged R&D boom (Brown, Fazzari and Peterson 2009). Starting from 1991, the R&D expenditures started to increase and the trend collapsed in 2001. As I argue earlier that rival firms' investment opportunities emerge from R&D investment, it should be expected that during this period, rival firms would have more incentives to hoard more cash in response to a horizontal merger. As shown in Panel B of Table 7, subsequent to a horizontal merger over the R&D boom period, rivals with premerger Tobin's Q both in the top tercile and in the bottom tercile tend to increase cash holdings except that this effect does not exist among the liquid firms. More importantly, the cash increase is greater in magnitude among the rivals with higher Tobin's Q. Thus, the results support the idea that R&D investment can create growth opportunities for the rivals. In response to a horizontal merger, rivals hold more cash to fund R&D investment.

6. Industry structure

As discussed earlier, the net effect of a horizontal merger on competition depends on the relative importance of efficiency gains to the market power effect. This paper examines efficiency gains from the perspective of the efficiency of rival firms' cash policies. If a horizontal merger is dominated by the efficiency effect, rivals are more likely to improve the efficiency of their cash policies. Following this spirit, I examine how the changes in rivals' cash ratios vary across mergers in different industry structures. In particular, I test whether rivals still behave as if they improve

the efficiency of cash policies under circumstances where the market power effect is more likely to dominate the efficiency effect.

Table 8 presents estimates of rival firms' cash holdings following mega horizontal mergers, defined as the deals with the transaction value in the top decile of my sample. The 90% percentile of deal size is \$650 million. Following a mega horizontal merger, there expected to be a large increase in industry concentration. Interestingly, the changes of rivals' cash holdings following these mega mergers appear to be in the opposite direction to the baseline results. As shown in column (2) and (6), rivals with low premerger Tobin's Q tend to increase cash holdings while the ones with high premerger Tobin's Q tend to decrease cash holdings. These results suggest that mega horizontal mergers fail to induce rivals to adjust cash ratios more aligned with the investment opportunities. On the contrary, it appears that rivals' cash policies becomes less efficient.

(Insert Table 8 Here)

Table 9 presents estimates of rival firms' cash holdings subsequent to horizontal mergers across industries of different premerger level of HHI. The HHI index is computed based on Compustat firms for which the sales data are available. I use the Compustat-based HHI to proxy for the HHI of the NAICS-6 industry assuming the distribution of market share across all firms in the NAICS-6 industry is the same as that across all Compustat firms in the NAICS-6 industry. Then I assign the mergers into deciles based on the three-year average of the industry HHI preceding each merger. The mergers in the top HHI decile are considered in the most concentrated industries (Panel A) whereas the mergers in the bottom HHI decile are considered in the least concentrated industries (Panel C). I combine the mergers in the middle eight HHI deciles and show the estimates in Panel B. As shown in Table 9, rival firms do not have a significant change in cash holdings following horizontal mergers among the most concentrated industries (See Panel A). The increase in rivals' cash reserves is driven by mergers in the least concentrated markets (See Panel C), and the effect shows up among the rivals with higher Tobin's Q ex ante. Finally, the low-Tobin's Q rivals tend to reduce cash holdings following horizontal mergers in the middle HHI deciles. Given that in highly concentrated markets, we do not observe rivals adjust cash ratios to be more in line with investment opportunities, it is possible that in these industries the gains of the merging firms' market power dominate the gains in operating efficiencies.

(Insert Table 9 Here)

7. Conclusion

Despite the long debate over the effect of horizontal mergers on competition, empirical studies reach mixed results and interpretations. The main issue emerges from the unobservable nature of efficiencies. This paper analyzes this issue by investigating one specific type of efficiencies, the efficiency of cash policies. Intuitively, if the efficiency gains dominate the market power effect of a horizontal merger, to compete with the merging firms' higher operating efficiency, rival firms have greater motives to improve their operating efficiencies, one of which is the efficiency of cash policies. That is, firms with more investment opportunities will increase cash holdings to undertake more positive-NPV projects while firms with fewer growth opportunities tend to decrease cash holdings to avoid negative-NPV projects.

There are four main findings in this paper. First, subsequent to a horizontal merger, rival firms tend to increase cash holdings and this pattern is driven by the firms with higher Tobin's Q ex ante. Low-Tobin's Q firms tend to decrease cash holdings. Second, the increase in cash holdings is more pronounced among rivals that are more financially constrained ex ante while the decrease in cash holdings is more pronounced among liquid rivals. Combining the first and the second findings, it seems that rival firms behave as if they improve the efficiency of cash policies in response to horizontal mergers, implying that overall efficiency gains dominate horizontal mergers. Third, the cash increase is more significant among the R&D-intensive rival firms, suggesting that rivals' investment opportunities can emerge from R&D investment. Finally, I do not find rivals follow the same adjustments of cash holdings as the baseline finding following mega horizontal mergers or in highly concentrated industries, which suggests that under these circumstances, the gains of the merging firms' market power may dominate the efficiency gains of these horizontal mergers.

This paper contributes to three strands of literature. First is the empirical research on the effect of horizontal mergers on industry competition. In this paper, I investigate the efficiency of cash policies as one form of efficiencies and find results in support of the efficiency hypothesis of horizontal mergers. My paper also adds to the discussion about the role of cash policies in industry competition. The findings in this paper suggest that in an efficient market, competition can effectively discipline companies in the industry to improve operating efficiencies and lower marginal costs of production. Finally, this paper is also related to the rising strand of literature on

the rise of intangible capital in the United States over the last two decades. Within the context of horizontal mergers, this paper provides micro-level evidence on the driving force behind the increasing trend of investment in intangible capital such as R&D.

In corporate finance literature, there are many aspects of managerial decisions that are closely related to operating efficiencies, such as investments, managerial compensation and internal capital markets. It is worthwhile for future research to explore other aspects of a rival's efficiency-related policies in response to horizontal mergers and enrich the evidence of a horizontal merger's impact on industry competition.

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Figure 1 Rivals' Cash Holdings around a Horizontal Merger

This figure shows the average cash holdings of rival firms in three years around merger completion. The cash holdings are demeaned by the industry and year average. I sort firms into quartiles by the three-year average of Tobin's Q before each merger. T is considered as the year of merger completion. To capture the inefficiency of funding investments, I drop the bottom quartile firms since these are deeply distressed firms with little investment opportunity. I plot the demeaned cash holdings of the top quartile firms and the second lowest quartile firms separately.

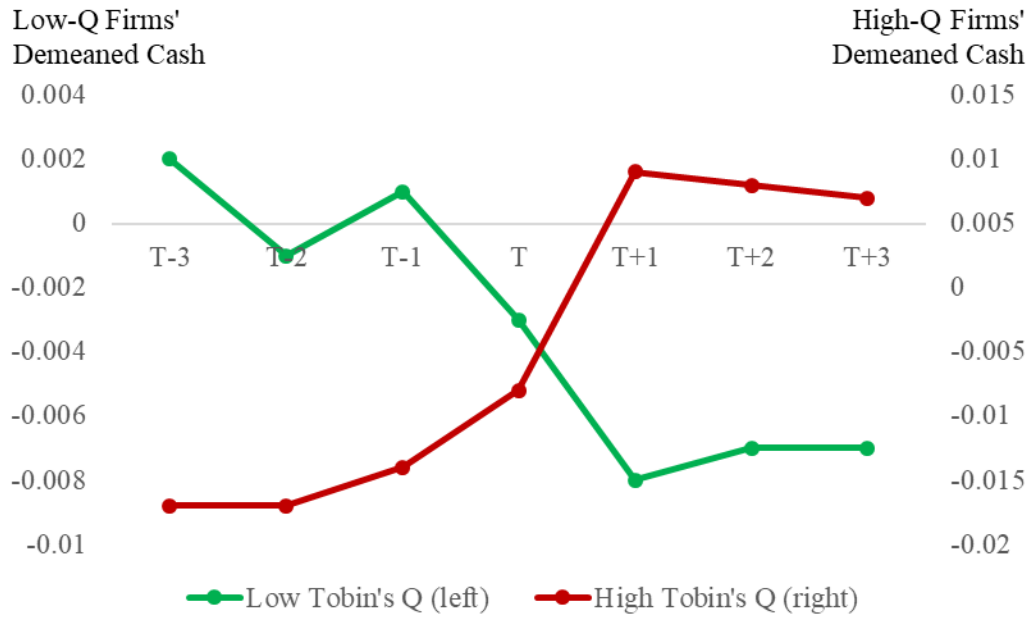


Table 1 Summary statistics

The sample includes horizontal mergers between U.S. firms from 1986 to 2016. Deals are dropped if the transaction value is missing. Panel A shows the three-year average of rival firms' financial characteristics before merger completion. Panel B shows the three-year average of rival firms' financial characteristics after merger completion. Variables about rival firm characteristics are winsorized at the 1% level. Detailed variable definitions can be found in Appendix 1.

Panel A <i>Three-year average before merger completion</i>						
	Obs.	Mean	Std. dev.	Min	Median	Max
<i>Rivals' liquidity policies</i>						
Cash holdings	272,267	0.343	0.276	0.000	0.288	0.984
Dividends	272,267	0.006	0.020	0.000	0.000	0.180
Stock repurchases	272,267	0.013	0.032	0.000	0.000	0.292
Net equity issuance	248,552	0.535	0.754	-0.292	0.201	2.911
Net debt issuance	266,743	0.063	0.159	-0.460	0.040	0.653
<i>Rivals' financial characteristics</i>						
Ln (Total Assets)	272,267	17.798	2.561	10.127	17.772	24.034
Net leverage	271,657	0.465	0.934	-0.010	0.260	9.660
Cash flow/Assets	269,363	-0.657	2.005	-17.560	-0.037	0.368
Cash flow volatility	240,953	0.683	2.232	0.006	0.107	19.325
Tobin's Q	247,056	2.992	2.366	0.595	2.261	18.096
NWC/Assets	272,267	-0.585	2.478	-25.261	-0.057	0.437
CapEx/Assets	271,100	0.078	0.109	0.000	0.037	0.682
R&D/Assets	271,100	0.282	0.462	0.000	0.115	2.869
Acquisition expenses	272,267	0.019	0.036	-0.015	0.000	0.346

Panel B <i>Three-year average after merger completion</i>						
	Obs.	Mean	Std. dev.	Min	Median	Max
<i>Rivals' liquidity policies</i>						
Cash holdings	272,303	0.343	0.287	0.000	0.274	0.984
Dividends	272,303	0.006	0.205	0.000	0.000	0.180
Stock repurchases	272,303	0.014	0.036	0.000	0.000	0.292
Net equity issuance	266,020	0.307	0.587	-0.292	0.057	2.911
Net debt issuance	270,669	0.045	0.176	-0.460	0.028	0.653
<i>Rivals' financial characteristics</i>						
Ln (Total Assets)	272,303	18.161	2.697	10.127	18.316	24.034
Net leverage	272,080	0.518	1.217	-0.010	0.234	9.660
Cash flow/Assets	268,905	-0.717	2.355	-17.560	-0.022	0.368
Cash flow volatility	269,228	0.906	2.798	0.006	0.140	19.325
Tobin's Q	259,309	2.894	2.759	0.595	2.022	18.096
NWC/Assets	272,303	-0.812	3.337	-25.261	-0.060	0.437
CapEx/Assets	272,152	0.052	0.079	0.000	0.024	0.682
R&D/Assets	272,152	0.204	0.351	0.000	0.091	2.869
Acquisition expenses	272,303	0.020	0.041	-0.015	0.000	0.346

Table 2 Rivals' cash holdings after a merger

This table shows the coefficient estimates of rivals' cash holdings from three years before merger announcement to three years after completion. The regression is modeled as follows:

$$Cash/Assets_{i,t} = \beta After + Controls + Deal \times Firm\ Fixed\ Effect + Year\ Fixed\ Effect + \varepsilon_{i,t}$$

The control variables are selected following Bates, Kahle and Stulz (2009). *After* equals one for firm years after merger completion. Deal \times firm fixed effect, and year fixed effect is controlled. Standard errors of coefficients are clustered at the industry level. T-statistics are reported in the parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

	Cash/Assets					
	(1)	(2)	(3)	(4)	(5)	(6)
After	0.008*** (4.882)	0.005*** (4.617)	0.005*** (4.590)	0.005*** (4.523)	0.001 (0.728)	-0.002** (-2.312)
Ln (Total Assets)		0.162*** (4.099)	0.161*** (4.097)	0.138*** (3.885)	0.150*** (4.027)	0.148*** (4.439)
Ln (Total Assets) ²		-0.004*** (-4.097)	-0.004*** (-4.087)	-0.004*** (-3.727)	-0.004*** (-4.014)	-0.004*** (-4.294)
Industry sigma		0.003* (1.749)	0.003* (1.758)	0.003* (1.770)	0.002* (1.667)	0.002 (1.643)
NWC/Assets		0.001 (0.504)	0.001 (0.500)	0.001 (0.784)	-0.012*** (-6.080)	-0.011*** (-5.442)
Loss		-0.030*** (-3.522)	-0.029*** (-3.456)	-0.029*** (-3.898)	-0.027*** (-4.107)	-0.026*** (-4.104)
IPO \leq 5 years		-0.019*** (-4.889)	-0.019*** (-4.925)	-0.021*** (-4.601)	-0.013*** (-3.363)	0.011* (1.661)
Dividends/Assets			0.202* (1.946)	0.196* (1.906)	0.096 (0.893)	0.222*** (3.108)
Stock repurchases			0.034 (1.559)	0.016 (0.752)	0.061*** (2.860)	0.054* (1.885)
CapEx/Assets				-0.006 (-0.178)	-0.035 (-1.387)	-0.024 (-0.844)
R&D/Assets				0.043*** (4.445)	0.023*** (3.449)	0.028** (2.293)
Acquisition				-0.390*** (-8.120)	-0.357*** (-7.303)	-0.368*** (-7.225)
Equity issuance					0.032*** (15.708)	0.023*** (8.596)
Debt issuance					-0.043*** (-7.046)	-0.039*** (-10.663)
Net leverage					-0.045*** (-9.722)	-0.041*** (-9.187)
Cash flow/Assets						0.006*** (6.072)
Tobin's Q						0.005*** (3.709)
Deal \times Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,748,698	1,744,015	1,744,015	1,744,015	1,730,470	1,511,365
Adj. R ²	0.777	0.785	0.785	0.790	0.809	0.822

Table 3 Investment opportunities and cash holdings

This table presents estimates of rivals' cash holdings among groups of different investment opportunities. Rivals are sorted into terciles based their three-year average of Tobin's Q before the merger. Column (1), (3) and (5) only control for firms' financial characteristics while Column (2), (4) and (6) also control for payout policies, investment policies and financing policies. Deal \times firm fixed effect, and year fixed effect is controlled. Standard errors of coefficients are clustered at the industry level. T-statistics are reported in the parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets					
	Bottom Tercile		Middle Tercile		Top Tercile	
	(1)	(2)	(3)	(4)	(5)	(6)
After	-0.004** (-2.167)	-0.001 (-0.450)	0.002 (1.252)	0.001* (1.770)	0.011*** (2.925)	-0.002 (-0.645)
Ln (Total Assets)	0.168*** (3.368)	0.164*** (2.731)	0.234*** (3.570)	0.202*** (3.195)	0.128*** (3.131)	0.126*** (3.341)
Ln (Total Assets) ²	-0.005*** (-3.753)	-0.005*** (-3.166)	-0.006*** (-3.487)	-0.005*** (-3.231)	-0.003*** (-2.620)	-0.003*** (-2.784)
Industry sigma	0.003* (1.701)	0.003 (1.560)	0.002 (1.106)	0.002 (1.178)	0.002** (2.256)	0.002** (2.030)
NWC/Assets	0.002 (0.691)	-0.055** (-2.368)	-0.005 (-1.340)	-0.036*** (-7.148)	0.001 (0.923)	-0.007*** (-5.320)
Loss	-0.025*** (-4.040)	-0.023*** (-4.612)	-0.036*** (-3.204)	-0.033*** (-3.668)	-0.031*** (-3.724)	-0.026*** (-3.976)
IPO \leq 5 years	-0.009 (-1.390)	-0.004 (-0.544)	-0.007 (-1.440)	-0.006 (-1.067)	-0.035*** (-4.596)	-0.023*** (-3.230)
Dividends/Assets		0.245* (1.685)		0.218** (1.973)		-0.090 (-0.920)
Stock repurchases		0.083** (2.195)		0.076** (2.063)		0.011 (0.248)
CapEx/Assets		-0.057* (-1.748)		-0.044 (-1.380)		-0.030 (-1.354)
R&D/Assets		0.018*** (5.519)		0.019*** (5.422)		0.025*** (2.745)
Acquisition		-0.311*** (-9.166)		-0.371*** (-6.552)		-0.427*** (-7.347)
Equity issuance		0.041*** (8.140)		0.035*** (9.759)		0.027*** (12.765)
Debt issuance		-0.021*** (-2.620)		-0.037*** (-4.113)		-0.049*** (-9.014)
Net leverage		-0.182*** (-3.179)		-0.116*** (-5.935)		-0.029*** (-6.170)
Deal \times Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	580,567	578,298	584,490	582,117	578,958	570,055
Adj. R ²	0.829	0.853	0.816	0.840	0.719	0.751

Table 4 Completed mergers vs. withdrawn mergers

This table reports the Difference in Differences regression results based on the sample horizontal mergers (the Treated Group) and Control Group. Control Group includes rival firms that are exposed to withdrawn horizontal mergers. The firms in the control group cannot be exposed to other completed horizontal mergers in the same year. Nearest neighbor matching is applied to find the nearest three firms for each firm in the treated group, matched by average premerger Tobin's Q and Ln(Total Assets) in the year before a merger. Deal \times firm fixed effect, and year fixed effect is controlled. Standard errors of coefficients are clustered at the industry level. T-statistics are reported in the parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
After	0.003 (0.681)	0.002 (0.293)	0.012*** (2.678)
Treated \times After	-0.017*** (-3.853)	-0.018*** (-3.852)	0.011** (2.013)
Ln (Total Assets)	0.079 (1.533)	0.133*** (3.129)	-0.099*** (-6.952)
Ln (Total Assets) ²	-0.003* (-1.986)	-0.004*** (-3.187)	0.002*** (4.598)
Industry sigma	0.095 (1.600)	-0.020 (-0.390)	-0.015 (-0.436)
NWC/Assets	-0.104*** (-8.383)	-0.116*** (-7.163)	-0.000** (-2.074)
Loss	-0.024*** (-5.471)	-0.030*** (-5.210)	-0.012*** (-4.828)
IPO \leq 5 years	0.035*** (3.825)	0.039*** (6.334)	0.022*** (3.029)
Dividends/Assets	0.272** (2.448)	0.352** (2.486)	0.279*** (2.857)
Stock repurchases	0.065 (1.400)	0.075* (1.926)	0.134*** (5.304)
CapEx/Assets	0.015*** (3.647)	0.013*** (3.787)	0.015*** (14.505)
R&D/Assets	-0.013 (-0.969)	-0.018 (-1.568)	-0.007* (-1.873)
Acquisition	-0.354*** (-17.752)	-0.347*** (-9.862)	-0.210*** (-19.212)
Equity issuance	-0.182*** (-3.899)	-0.293*** (-5.285)	-0.277*** (-13.061)
Debt issuance	-0.107*** (-4.480)	-0.144*** (-4.318)	-0.006*** (-3.599)
Net leverage	-0.275*** (-6.692)	-0.433*** (-11.900)	-0.551*** (-25.666)
Observation	23,163	23,135	23,584
Adj. R ²	0.838	0.836	0.745
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 5 Channel: pre-merger financial constraints

This table presents estimates of rivals' cash holdings across different subgroups of pre-merger level of Tobin's Q and financial constraints. Panel A measures financial constraints with KZ index following Kaplan and Zingales (1997). Panel B measures financial constraints with SA index following Hadlock and Pierce (2010). Panel C measures financial constraints with WW index following Whited and Wu (2006). A firm is considered financially (un)constrained if each measure of interest is in the (bottom) top tercile. All regressions control for Deal \times firm fixed effect, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
	<i>Panel A KZ index</i>		
After	-0.004** (-1.995)	0.002 (1.229)	-0.007 (-0.974)
After \times Low KZ	-0.031*** (-3.345)	-0.009* (-1.721)	0.006 (0.504)
After \times High KZ	0.007 (1.073)	0.014** (2.373)	0.032*** (6.590)
Observation	580,567	584,490	578,958
Adj. R ²	0.829	0.816	0.719
	<i>Panel B SA index</i>		
After	-0.004*** (-5.561)	-0.001 (-0.577)	0.017*** (3.268)
After \times Low SA	-0.003 (-1.631)	0.023*** (3.378)	-0.016** (-2.445)
After \times High SA	0.003** (2.192)	-0.001 (-0.070)	-0.006 (-0.597)
Observation	580,567	584,490	578,958
Adj. R ²	0.829	0.816	0.719
	<i>Panel C WW index</i>		
After	-0.004*** (-5.487)	0.002 (1.088)	0.010*** (3.037)
After \times Low WW	-0.007*** (-9.099)	-0.013*** (-2.802)	-0.015** (-2.627)
After \times High WW	0.019*** (12.221)	0.019*** (2.686)	0.007 (1.420)
Observation	580,567	584,490	578,958
Adj. R ²	0.829	0.816	0.719
Controls	Yes	Yes	Yes
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 6 Channel: pre-merger R&D

This table presents estimates of rivals' cash holdings across different subgroups of pre-merger level of R&D investment and financial constraints. Panel A measures financial constraints with KZ index following Kaplan and Zingales (1997). Panel B measures financial constraints with SA index following Hadlock and Pierce (2010). Panel C measures financial constraints with WW index following Whited and Wu (2006). A firm is considered financially (un)constrained if each measure of interest is in the (bottom) top tercile. All regressions control for Deal \times firm fixed effect, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

R&D/Assets	Cash/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
	<i>Panel A KZ index</i>		
After	0.003 (1.556)	-0.001 (-0.359)	0.009*** (4.731)
After \times Low KZ	-0.034*** (-6.167)	-0.011* (-1.767)	-0.005 (-0.698)
After \times High KZ	0.028*** (5.788)	0.012*** (2.656)	0.021** (2.590)
Observation	574,496	581,553	587,966
Adj. R ²	0.766	0.842	0.723
	<i>Panel B SA index</i>		
After	0.004 (1.018)	-0.001 (-0.370)	0.012*** (3.777)
After \times Low SA	0.002 (0.294)	-0.005 (-1.183)	-0.015** (-2.358)
After \times High SA	-0.004 (-0.627)	0.002 (0.397)	-0.003 (-0.297)
Observation	574,496	581,553	587,966
Adj. R ²	0.765	0.841	0.723
	<i>Panel C WW index</i>		
After	0.001 (0.253)	-0.002 (-0.444)	0.007*** (3.096)
After \times Low WW	-0.013** (-2.501)	-0.003 (-1.053)	-0.021** (-2.003)
After \times High WW	0.015* (1.799)	0.006 (0.877)	0.008** (2.047)
Observation	574,496	581,553	587,966
Adj. R ²	0.765	0.841	0.723
Controls	Yes	Yes	Yes
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 7 Rivals' financial constraints and their cash policies in different time periods

This table presents estimates of rivals' cash holdings following horizontal mergers in different time periods. Panel A includes mergers announced and completed between 2008 and 2009. Panel B includes mergers announced and completed between 1991 and 2000. KZ index is computed following Kaplan and Zingales (1997) to measure firms' pre-merger level of financial constraints. A firm is considered financially (un)constrained if each measure of interest is in the (bottom) top tercile. All regressions control for Deal \times firm fixed effect, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
<i>Panel A Financial Crisis 2008-2009</i>			
After	-0.000 (-0.055)	-0.007 (-0.993)	0.029** (3.096)
After \times Low SA	-0.047*** (-4.678)	0.012 (0.746)	-0.063** (-3.438)
After \times High SA	-0.001 (-0.034)	0.009 (0.944)	0.038*** (3.551)
Observation	51,925	52,678	51,147
Adj. R ²	0.864	0.850	0.704
<i>Panel B R&D Boom 1991-2000</i>			
After	0.018*** (3.510)	0.003 (0.937)	0.029** (2.488)
After \times Low SA	-0.030** (-2.579)	-0.000 (-0.039)	-0.054** (-2.001)
After \times High SA	-0.012 (-0.986)	0.004 (0.414)	0.009 (1.238)
Observation	124,822	123,792	123,846
Adj. R ²	0.674	0.762	0.630
Controls	Yes	Yes	Yes
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 8 Mega mergers

This table presents estimates of rivals' cash holdings following mega horizontal mergers. Mega horizontal mergers are defined as the sample mergers with transaction value in the top decile (threshold=\$650 million). Rivals are sorted into terciles based their three-year average of Tobin's Q before the merger. Column (1), (3) and (5) only control for firms' financial characteristics while Column (2), (4) and (6) also control for payout policies, investment policies and financing policies. Deal \times firm and year fixed effect is controlled. Standard errors of coefficients are clustered at the industry level. T-statistics are reported in the parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets					
	Bottom Tercile		Middle Tercile		Top Tercile	
	(1)	(2)	(3)	(4)	(5)	(6)
After	0.008** (2.190)	0.006** (2.010)	-0.000 (-0.007)	0.001 (0.450)	0.006 (1.385)	-0.008*** (-3.008)
Ln (Total Assets)	0.209*** (4.870)	0.220*** (3.639)	0.259*** (3.988)	0.232*** (3.918)	0.190*** (3.464)	0.187*** (3.863)
Ln (Total Assets) ²	-0.006*** (-4.999)	-0.006*** (-3.875)	-0.007*** (-3.963)	-0.006*** (-3.942)	-0.005*** (-2.984)	-0.005*** (-3.244)
Industry sigma	0.003 (1.568)	0.003 (1.598)	0.003 (1.358)	0.004 (1.476)	0.003* (1.912)	0.002* (1.778)
NWC/Assets	0.003 (1.278)	-0.036* (-1.739)	-0.007 (-1.109)	-0.043*** (-11.257)	-0.000 (-0.050)	-0.009*** (-3.890)
Loss	-0.027*** (-3.107)	-0.023*** (-3.561)	-0.033** (-2.361)	-0.029*** (-3.092)	-0.023** (-2.223)	-0.017** (-2.041)
IPO \leq 5 years	-0.001 (-0.176)	0.001 (0.160)	0.009** (2.315)	0.007* (1.952)	-0.030*** (-3.733)	-0.020*** (-3.051)
Dividends/Assets		0.286 (1.250)		0.358 (1.628)		-0.120 (-0.979)
Stock repurchases		0.068** (2.040)		0.105** (2.351)		-0.040 (-1.052)
CapEx/Assets		-0.048 (-1.057)		-0.036 (-1.031)		-0.010 (-0.328)
R&D/Assets		0.009** (2.316)		0.022*** (5.303)		0.017*** (3.293)
Acquisition		-0.324*** (-10.687)		-0.359*** (-6.321)		-0.403*** (-6.954)
Equity issuance		0.038*** (8.312)		0.030*** (6.885)		0.026*** (7.576)
Debt issuance		-0.026** (-2.301)		-0.042* (-1.829)		-0.054*** (-4.796)
Net leverage		-0.137*** (-2.740)		-0.125*** (-6.956)		-0.032*** (-5.401)
Deal \times Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,784	58,572	59,121	58,842	58,750	57,838
Adj. R ²	0.832	0.852	0.817	0.842	0.740	0.769

Table 9 Industry concentration

This table presents estimates of rivals' cash holdings in response to horizontal mergers across markets of different concentration levels. Industry concentration levels are measured as the three-year average of HHI index before merger announcement. Panel A includes mergers with pre-merger HHI index in the bottom decile (threshold= 595). Panel B includes mergers with the pre-merger HHI index in the middle eight deciles. Panel C includes mergers with the pre-merger HHI index in the top decile (threshold= 3488). All regressions control for Deal \times firm fixed effect, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Cash/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
	<i>Panel A Top HHI Decile</i>		
After	0.001 (0.079)	0.010 (1.061)	0.009 (0.871)
Observation	50,987	43,861	79,801
Adj. R ²	0.727	0.708	0.634
	<i>Panel B Middle HHI Deciles</i>		
After	-0.003*** (-2.714)	-0.000 (-0.281)	0.009 (1.593)
Observation	474,162	494,159	425,105
Adj. R ²	0.846	0.836	0.739
	<i>Panel C Bottom HHI Decile</i>		
After	-0.009 (-1.091)	0.011*** (2.620)	0.018*** (3.358)
Observation	55,418	46,469	74,051
Adj. R ²	0.815	0.742	0.716
Controls	Yes	Yes	Yes
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Appendix 1 Variable definitions

Variable name	Definition
HHI	Herfindahl–Hirschman Concentration Index for all U.S. publicly-traded firms with GVKEY identifiers in Compustat. To construct the index, every year I sum up incumbent firms’ squared market shares classified in the same 6-digit NAICS industry. Sales data are winsorized at the 1% and the 99% percentile.
Horizontal merger	A merger is considered as “horizontal” if, in the year before the merger announcement, the merging firms are in the same 6-digit NAICS code.
# of rivals	In the year prior to a horizontal merger announcement, the number of GVKEY firms that exist in the same 6-digit NAICS industry.
Cash/Assets	The ratio of cash and cash equivalents (CHE) over total assets.
Equity issuance	Equity sales (CSHO × PRCC_F) minus equity purchases (PRSTKC), divided by book assets (AT).
Debt issuance	Debt issuance (annual change in total liabilities, LT) minus extinguishment of debt (DTEP), divided by book assets (AT).
CapEx	The growth rate of property, plant and plant (PP&E) from year t-1 to year t.
R&D	The ratio of R&D(advertising) expenditures (XRD or CAD) over total assets (AT)
Cash flow	The sum of cash flows from operating activities (OANCF), investment activities (IVNCF) and financing activities (FINCF), divided by a firm’s total assets.
Industry sigma	The standard deviation of cash flow to assets for the previous 10 years (i.e., cash flow volatility). I require at least three observations. Then I average the firm cash flow standard deviations each year across each six-digit NAICS code.
NWC	Net working capital minus cash (ACT-LCT-CHE), divided by total assets.
Loss	A dummy variable equal to one if net income is less than zero, and zero otherwise.
MTB ratio	Book value of total assets (AT)– book value of equity (CEQ) + market value of equity (CSHO × PRCC_F)/book value of total assets (AT).
Net leverage	Total liabilities minus cash and cash equivalents (CHE), divided by total assets.
Tobin’s Q	Tobin’s Q is market value of assets (AT+CSHO*PRCC_F-CEQ-TXDB) divided by 0.9×book value of assets (AT)+0.1×market value of assets (CSHO×PRCC_F), debt is (DLC + DLTT)/AT, dividends are (DVC + DVP)/AT. Cash is CHE/AT.
Dividends	The ratio of cash dividends payout (DV) over total assets.
Stock repurchases	The ratio of purchase of common and preferred stock (PRSTKC) over total assets.
Acquisitions	Expenditures on acquisition (AQC), divided by total assets

Appendix Tables

Appendix Table A1 Rival firms' policies in payout, financing and investments

This table presents estimates of rivals' policies on payout, financing and investments from three years before merger announcement to three years after merger completion. Panel A includes rivals with the three-year pre-merger average Tobin's Q in the bottom decile. Panel B includes rivals with the three-year pre-merger average Tobin's Q in the middle tercile. Panel C includes rivals with the three-year pre-merger average Tobin's Q in the top tercile. All regressions control for Deal \times firm, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Panel A Rivals' pre-merger Tobin's Q in the bottom tercile

	Dividends	Stock repurchases	Equity issuance	Debt issuance	CapEx	R&D	Acquisition expenditure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
After	-0.001*** (-3.231)	-0.001 (-1.422)	-0.001 (-0.158)	0.002 (0.488)	-0.003*** (-3.571)	-0.017** (-2.053)	0.000 (0.080)
After \times Low SA	0.003*** (5.467)	0.006*** (2.778)	-0.037** (-2.028)	-0.034*** (-4.322)	-0.007*** (-2.636)	-0.013** (-2.200)	-0.005** (-2.034)
After \times High SA	-0.001 (-1.059)	0.000 (0.240)	0.070*** (3.773)	0.012 (0.993)	-0.002 (-0.545)	0.002 (0.144)	-0.005 (-1.236)
Ln (Total Assets)	0.004 (1.160)	0.012* (1.769)	0.093 (1.034)	-0.081 (-1.439)	-0.031* (-1.665)	-0.010 (-0.211)	-0.084*** (-4.703)
Ln (Total Assets) ²	-0.000* (-1.963)	-0.000* (-1.938)	-0.000 (-0.011)	0.005*** (2.699)	0.001* (1.948)	0.000 (0.041)	0.003*** (6.027)
Leverage	0.002** (2.225)	-0.001 (-0.823)	0.097*** (3.365)	0.077*** (5.265)	-0.003 (-0.320)	0.009 (0.822)	-0.029*** (-2.968)
ROA	0.001*** (3.182)	0.001 (1.181)	-0.024* (-1.897)	-0.008 (-0.705)	0.002 (1.616)	0.001 (0.056)	-0.005* (-1.925)
Sales Growth	-0.000* (-1.830)	-0.001*** (-5.131)	0.020** (2.512)	0.016*** (2.678)	0.007*** (2.624)	0.011** (2.335)	0.003** (2.035)
Deal \times Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	539,548	539,548	539,548	539,548	539,548	539,548	539,548
Adj. R ²	0.466	0.391	0.308	0.256	0.582	0.613	0.273

Appendix Table A1 Rival firms' policies in payout, financing and investments (continued)

Panel B Rivals' pre-merger Tobin's Q in the middle tercile							
	Dividends	Stock repurchases	Equity issuance	Debt issuance	CapEx	R&D	Acquisition expenditure
	(1)	(2)	(3)	(4)	(6)	(7)	(8)
After	-0.001** (-2.407)	-0.001 (-1.115)	-0.036*** (-6.982)	-0.006 (-1.437)	-0.003** (-1.993)	-0.017*** (-4.223)	0.001 (0.709)
After × Low SA	0.004*** (4.806)	0.006*** (2.899)	0.018 (0.724)	-0.008 (-1.230)	0.002 (0.663)	0.001 (0.116)	-0.002 (-1.114)
After × High SA	0.001 (0.638)	-0.001 (-0.756)	0.192*** (3.822)	0.027* (1.793)	0.008 (0.935)	0.002 (0.375)	0.002 (0.658)
Ln (Total Assets)	0.009*** (2.628)	0.015* (1.903)	0.276** (2.170)	-0.004 (-0.065)	0.001 (0.116)	0.078 (1.637)	-0.035*** (-5.006)
Ln (Total Assets) ²	-0.000*** (-3.389)	-0.001** (-2.100)	-0.005 (-1.600)	0.002 (1.326)	0.000 (0.380)	-0.003* (-1.871)	0.001*** (6.741)
Leverage	0.001*** (2.871)	0.001 (1.334)	0.149*** (4.207)	0.035* (1.690)	0.001 (0.121)	0.028** (2.125)	-0.020*** (-5.633)
ROA	0.001*** (2.908)	-0.000 (-0.147)	-0.030** (-2.017)	-0.033*** (-4.607)	0.003** (2.424)	-0.008 (-0.779)	-0.005*** (-6.395)
Sales Growth	-0.000 (-0.709)	-0.000*** (-2.626)	0.024* (1.802)	0.013*** (2.646)	0.008** (2.234)	0.019*** (2.653)	0.002* (1.819)
Deal × Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	543,050	543,050	543,050	543,050	543,050	543,050	543,050
Adj. R ²	0.598	0.515	0.310	0.239	0.610	0.616	0.316

Appendix Table A1 Rival firms' policies in payout, financing and investments (continued)

Panel C Rivals' pre-merger Tobin's Q in the top tercile

	Dividends	Stock repurchases	Equity issuance	Debt issuance	CapEx	R&D	Acquisition expenditure
	(1)	(2)	(3)	(4)	(6)	(7)	(8)
After	0.000 (0.243)	0.000 (0.473)	-0.025 (-1.133)	0.008*** (3.097)	-0.004 (-0.496)	0.006 (1.104)	0.000 (0.166)
After × Low SA	0.004*** (3.258)	0.003 (1.086)	-0.008 (-0.256)	-0.001 (-0.120)	0.013 (0.543)	0.014*** (2.759)	-0.001 (-0.493)
After × High SA	-0.002 (-1.613)	-0.004*** (-2.836)	0.212*** (3.304)	0.023** (2.521)	0.060** (2.020)	0.033*** (3.169)	0.002 (1.161)
Ln (Total Assets)	0.008*** (2.606)	0.001 (0.282)	-0.171 (-1.362)	0.171*** (3.700)	0.367*** (3.673)	0.153** (2.559)	-0.026*** (-4.758)
Ln (Total Assets) ²	-0.000*** (-2.811)	-0.000 (-0.427)	0.007** (2.219)	-0.004** (-2.345)	-0.010*** (-3.446)	-0.005*** (-3.257)	0.001*** (5.703)
Leverage	0.000 (0.759)	0.000 (0.500)	0.014 (1.446)	0.031*** (8.495)	-0.003 (-0.296)	0.007** (2.058)	-0.001** (-2.138)
ROA	0.000*** (2.632)	-0.000 (-0.949)	-0.048*** (-5.670)	-0.026*** (-9.588)	-0.012 (-1.309)	-0.011*** (-3.107)	-0.001*** (-3.266)
Sales Growth	-0.000 (-0.496)	-0.000* (-1.686)	0.020*** (6.907)	0.014*** (6.685)	0.023*** (3.108)	0.019*** (3.353)	0.001*** (2.886)
Deal × Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	468,499	468,499	468,499	468,499	467,147	468,499	468,499
Adj. R ²	0.665	0.544	0.422	0.284	0.267	0.626	0.332

Appendix Table A2 Rival firms' revolver credit around horizontal mergers

This table presents estimates of rivals' lines of credit across different subgroups of pre-merger level of Tobin's Q and financial constraints. The dependent variable is rivals' newly issued amount of revolver credit divided by total assets in the three years around a horizontal merger. All regressions control for Deal \times firm fixed effect, as well as year fixed effect. Standard errors of coefficients are clustered at the industry level. ***, ** and * indicate statistical significance at the 1%, 5%, 10% levels respectively. Detailed variable definitions can be found in Appendix 1.

Tobin's Q	Revolver Credit Issuance/Assets		
	Bottom Tercile	Middle Tercile	Top Tercile
	(1)	(2)	(3)
		<i>Panel A KZ index</i>	
After	0.000 (1.291)	-0.001** (-2.133)	0.001*** (3.495)
After \times Low KZ	-0.000 (-0.017)	-0.000 (-0.587)	0.002** (2.176)
After \times High KZ	0.000 (0.134)	-0.000 (-0.360)	0.001* (1.862)
Observation	580,567	584,490	578,958
Adj. R ²	0.396	0.382	0.367
		<i>Panel B SA index</i>	
After	-0.001 (-1.429)	-0.001 (-1.646)	0.001** (2.454)
After \times Low SA	0.001 (1.394)	0.001 (1.114)	-0.001** (-2.264)
After \times High SA	0.002* (1.779)	0.001 (0.867)	-0.001 (-1.241)
Observation	580,567	584,490	578,958
Adj. R ²	0.396	0.382	0.366
		<i>Panel C WW index</i>	
After	-0.000 (-0.394)	-0.000 (-1.079)	0.001*** (3.452)
After \times Low WW	0.001 (0.955)	-0.001 (-1.107)	-0.001 (-1.313)
After \times High WW	-0.003 (-1.641)	-0.001 (-1.372)	-0.001 (-1.291)
Observation	580,567	584,490	578,958
Adj. R ²	0.396	0.382	0.367
Controls	Yes	Yes	Yes
Deal \times Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes