TWO ESSAYS ON MERGERS AND ACQUISITIONS

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Two Essays on Mergers and Acquisitions

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CERTIFICATE OF ORIGINALITY

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Gong Zhaoran

Abstract

This thesis consists of two essays on mergers and acquisitions.

In the first essay, I investigate how financial constraints of target firms are relieved after acquisitions using private firm financial data. I find that although targets do not generate higher earnings after being acquired, their internal financing is still improved because they can retain higher proportions of earnings and borrow interest-free capital from their parents. Targets can also obtain more debt financing with lower interest rate, borrow more trade credit from suppliers, and collect receivables from customers more quickly. The findings suggest that improvements in both internal financing from earnings retention and intra-group debt and external financing from the debt market and suppliers contribute to the reduction in targets' financial constraints.

In the second essay, I study the impact of time zone differences among labor segments on firm productivity in a mergers and acquisitions (M&A) setting. I develop a model describing the extra labor productivity generated from cooperation between workers (i.e., synergy) and its changes around M&A. The model suggests that time zone differences lead to lower labor productivity and predicts negative market reactions to cross-time-zone M&A announcements. Using a sample of 3739 public M&A deals in the US, I find that time zone differences have a substantial negative effect on combined announcement returns. Consistent with model predictions, the negative association is stronger if the combining firms have high labor intensity or small total labor size, or if they are similar in labor size or in high technology industries. Additional tests suggest

that acquirers do not lower their offer price in cross-time-zone M&A and therefore, bear most of the costs caused by time zone differences.

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Chapter One: How Do Acquisitions Relieve Target Firms' Financial Constraints?

Abstract: I investigate how financial constraints of target firms are relieved after acquisitions using private firm financial data. I find that although targets do not generate higher earnings after being acquired, their internal financing is still improved because they can retain higher proportions of earnings and borrow interest-free capital from their parents. Targets can also obtain more debt financing with lower interest rate, borrow more trade credit from suppliers, and collect receivables from customers more quickly. The findings suggest that improvements in both internal financing from earnings retention and intra-group debt and external financing from the debt market and suppliers contribute to the reduction in targets' financial constraints.

Keywords: Financial constraints, Mergers and acquisitions, Payout policy, Intra-group borrowing, Debt financing

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1. Introduction

In a seminal study, Erel, Jang and Weisbach (2015) provide evidence that targets' financial constraints are relieved after acquisitions. However, the mechanism behind such relief remains unexplored. To fill this void, I use a novel dataset of private firm financials information to investigate how the financial constraints in target firms are relieved after acquisitions.

Empirical evidence on targets' post-takeover financing is scarce because the investigation requires financial data of target firms both before and after takeovers. However, the majority of existing studies focus on takeovers of public targets and their financial data are largely not available after acquisitions once they get delisted. Different from North America, which is the prevailing setting of previous studies, many European countries require public disclosure of financial information for both publicly listed and privately held firms. In this study, I take advantage of this disclosure requirement and use the Amadeus database, which provides data for both public and private firms in Europe, to investigate the mechanism behind the reduction in targets' financial constraints.

Previous studies argue that acquisitions can improve targets' financing through increases in internally generated cash flow (Erel, Jang and Weisbach 2015), reallocations of resources across divisions or better direct access to capital markets (Stein 2003), yet little research is done to validate such conjectures.

Companies make investments with the capital financed from the following sources: (1) cash reserves at the beginning of the year; (2) earnings retained during the year; (3)

internal borrowing from group companies; (4) external borrowing from the debt market; (5) trade credit extended by suppliers; and (6) equity issuance. When the risk of not being able to obtain enough capital from sources (2) to (6) is high, the company is financially constrained and tends to accumulate cash holdings and/or cut investments. In this study, I attempt to identify the mechanism behind the reduction in targets' financial constraints by investigating target firms' ability to finance through sources (2) to (6) respectively.

To examine targets' ability to finance their investments internally via retained earnings, I first test whether targets generate higher earnings after acquisitions. The takeover market is often referred to as "the court of last resort" (Jensen 1986) that works as an external governance mechanism to discipline poorly performing targets. The view is supported by Lang, Stulz and Walkling (1989) who find that well-managed acquirers takeover poorly-managed targets are especially value increasing. Several studies investigate the post-deal operating performance of the combined firms around acquisitions but failed to reach a consensus (e.g., Healy, Palepu and Ruback 1992; Ghosh 2001 and Powell and Stark 2005). Using plant-level data, Maksimovic and Phillips (2001) find that target plant's productivity increases after the acquisition. In this paper, I investigate the changes in target firms' earnings generation but find no evidence of significant increase after acquisitions.

Then I investigate the changes in targets' earnings retention policy. Empirical results suggest that targets have more discretion in earnings retention after the acquisitions: they retain a lower (higher) proportion of the earnings when the net income

is high (low). The results indicate that changes in retention policy provide the targets with more stable self-financing from retained earnings after acquisitions.

I also investigate intra-group borrowing as another form of internal financing. Desai, Foley and Forbes (2008) document that during currency crisis the US multinational affiliates borrow money from their parents and expand economic activity when the local firms are most constrained. In this study, I find that target firms borrow from their parents after being acquired. The borrowing amount is larger when the retained earnings is low. The results suggest that the access to internal capital market after acquisitions supplements targets' self-financing from earnings, alleviating their financial constraints.

Then, I examine whether targets have better access to the external debt market after being acquired. The impact of acquisitions on targets' debt financing has been discussed intensively in prior research. Several studies suggest that acquisitions benefit targets' bondholders. Billett, King and Mauer (2004) argue that the coinsurance effect would benefit target bondholders and document positive bond price reactions for target firm around takeover announcements. Qiu and Yu (2009) find that the market for corporate control reduces managerial slack and cost of debt. On the other hand, it is also argued that acquisitions could hurt targets' bondholders. Francis, Hasan, John and Waisman (2010) argue that shareholders' claims can be viewed as call options, and increasing cash flow variance increases the option value while also increase the default risk borne by bondholders. Cremers, Nair and Wei (2007) suggest that acquisitions could hurt the target bondholders by adding more debt to the firm.

In this paper, I investigate the changes in targets' debt issuance and cost of debt. The empirical results suggest that after acquisitions target firms increase debt issuance especially when the retained earnings is low, and their interest rate decreases. The results support the conjecture that targets' access to the external debt market is enhanced after being acquired.

I also examine targets' borrowing from suppliers and lending to customers. Previous studies suggest that accounts payable and receivable affect firms' financial constraints: Petersen and Rajan (1997) find that small firms use more trade credits when their financing from financial institutions is constrained; Murfin and Njoroge (2015) find that small suppliers cut back on their investment when their larger retailers pay them slowly. In this paper, I examine changes in targets' ability to borrow trade credit from suppliers and collect trade receivables from customers. The results suggest that after acquisitions targets increase their trade credit borrowing from suppliers and collect their accounts receivable from customers more quickly.

Finally, I examine changes of targets' equity financing around takeovers. The results do not suggest increase in targets' share issuance (or repurchase) after acquisitions. The sensitivity of share issuance to earnings declines significantly after acquisitions, suggesting that firms substitute share issuance and repurchase with intra-group transfers such as dividend payment and group debt.

In summary, the empirical results of this study suggest that enhancement in both internal financing from earnings retention and intra-group borrowing and external financing from the debt market and suppliers contribute to the reduction in targets'

financial constraints, while targets' earnings generation and equity financing do not help as much.

This paper contributes to the literature in several aspects. The major contribution is the identification of the mechanism behind the reduction in targets' financial constraints after acquisitions. Building upon Erel, Jang and Weisbach (2015), this study provides, to my knowledge, the first empirical evidence that improvements in both internal and external financing contribute to the reduction in targets' financial constraints. Moreover, the study makes detailed investigations on changes in different channels of both internal (e.g., earnings generation and retention and internal borrowing) and external financing (e.g., debt issuance, trade credit and equity issuance) and provides valuable empirical findings.

This study also adds knowledge to the internal capital market research. Acquisitions provide target firms with the access to the internal capital market. In this study, I show that target firms make use of the internal capital market after acquisitions to relieve their financial constraints.

This study also sheds light on the ownership structure and dividend policy literature. Michaely and Roberts (2012) find that wholly owned firms pay less dividend and do less dividend smoothing than dispersedly owned firms. In this study, I find consistent results that targets reduce their dividend payment and dividend smoothing after takeovers because their ownership concentrates.

The remainder of the paper proceeds as follows. Section 2 describes the sample construction process and presents descriptive statistics. Section 3 examines the changes

in targets' cash holdings and investments around acquisitions. Sections 4 investigates the impact of acquisitions on target firms' earnings generation and retention. Section 5 investigates targets' internal borrowing from their parents. Section 6 examines targets' external borrowing from the debt market. Section 7 examines changes in targets' external borrowing from suppliers and lending to customers. Section 8 investigates targets' equity financing. Section 9 addresses potential concerns and conducts robustness tests. Section 10 concludes.

2. Data and sample

The acquisition data are collected from Zephyr database and the firm financial data are obtained from Amadeus database. Both databases are operated by Bureau van Dijk (BvD). Amadeus provides financial data for both public and private firms in many European countries. I choose to use Zephyr instead of the more prevailing SDC database Zephyr shares the same firm identifier (BvD ID) with Amadeus database. Also, the coverage of private firm acquisitions is better in Zephyr (Erel, Jang and Weisbach (2015), hereafter EJW).

Amadeus provides at most 10 years of financial data for each firm. The firm financial data I obtained from Amadeus has only 9 years from 2006 to 2014. So the takeover deals in the sample are from 2007 to 2013 because I require at least one year of financial data for both before and after the completion of the takeover.

I obtain all the mergers and acquisitions targeting European firms reported on Zephyr that are completed between 2007 to 2013 (buy-outs, demerger, and share repurchase are excluded). I restrict the sample to those deals satisfying the following criteria: 1. The acquirer owns less than 50% of the target's share before the takeover and more than 99% after. 2. The target's total assets is more than one million USD before the acquisition. 3. The target is a non-financial firm (SIC code 6000-6999). 4. The financial data of target firm is available for at least one year both before and after the acquisition. 5. The target firm has been acquired only once during the sample period. 6. The target country has more than 10 deal records in the sample period.

Statistics on the acquisition sample used in this study are presented in Table 1. Statistics on the acquisition sample**Error! Reference source not found.**. The sample consists of 9847 deals with acquirers from 79 countries and targets from 26 European countries. There is no obvious trend in deal size or deal compositions. The mean (median) of targets' total assets is 74.86 (7.89) million USD On average about 60% deals are domestic and 45% are industry related (same two-digit sic codes). Both targets and acquirers are dominated by private firms, on average over 97% of targets and 70% of acquirers are private firms. The drop in deal numbers around 2009 may be driven by the global financial crisis.

I merge the M&A data from Zephyr with firm financial data from Amadeus using a unique firm indicator (BvD ID) assigned by BvD. Target firm-years with less than 10 employees or 1 million USD total assets are dropped. Observations with no cash holding data are excluded.

[Insert Table 1 here]

I require at least one target firm-year observation both before and after the deal. Following EJW, observations from the completion year are excluded. All accounting variables are trimmed at 1% level except that leverage ratio is trimmed between zero and one. The descriptive statistics for target firm financials are presented in Table 2.

[Insert Table 2 here]

The target companies in my sample are much smaller than most previous studies because most of them are unlisted companies. A medium sized target has only 9.3 million USD total assets. The mean (median) of target cash holdings is 12% (5.5%) of total assets. The average asset growth is 9.4%, and about 40% of it is from fixed asset investment. The annual retained earnings and non-interest-bearing liability issuance contribute to more than two-thirds of the asset growth. External debt issuance and trade credit increases take up the remaining one-third, both average above 1%. Since private companies account for over 97% of the targets in the sample, the mean share issuance is only 0.1% of lagged total assets, which is negligible compared with other financing sources.

3. Takeovers' impact on targets' cash holdings and investments

EJW use targets' cash holding policy to measure the financial constraints.[1] They find that after takeovers, targets' cash holding decreases, investments increase and the cash flow sensitivities of cash and investments decline. EJW interpret the results as a reduction in targets' financial constraints. Because Amadeus keeps data for only a maximum of 10 years rolling-window, I do not have the exact same sample period as EJW. In this section, I redo the analysis in EJW with the data from 2006-2014.

3.1 Cash holdings of target firms

First, I redo the tests on targets' cash holdings. Following EJW, I estimate the following two specifications:

$$\begin{aligned} Cash\ Holdings = {} & \alpha + \beta_1 AFTER + \beta_2 Cash\ Flow \\ & + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \end{aligned} \tag{1}$$

$$\begin{aligned} \Delta Cash\ Holdings = {} & \alpha + \beta_1 AFTER + \beta_2 Cash\ Flow + \beta_3 AFTER \times Cash\ Flow \\ & + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \end{aligned} \tag{2}$$

where *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition and *Cash Flow* is the target firms' cash flow scaled by total assets. Following EJW, I control for both firm-specific characteristics (size, leverage, sales growth, and number of employees) and country-level variables (GDP growth, stock market capitalization to GDP and private credit to GDP). In all estimations in this paper, I include target firm fixed-effects and year fixed-effects to control for omitted firm

[1] See Erel, Jang and Weisbach (2015) for discussions on measures for financial constraints.

characteristics and changes in macroeconomic conditions. Standard errors are corrected for clustering at the target firm level.

The estimates are presented in Table 3. Columns (1) and (2) shows the results for specification (1) in which the dependent variable is the cash holdings of target firms, calculated as cash and cash equivalents divided by total assets. The coefficient estimates on *AFTER* in columns (1) and (2) are negative and significantly different from zero, indicating that targets hold less cash after takeovers.

EJW interpret the decline in target cash holdings as a result of targets' financial constraints being relieved after takeovers. They conduct additional analysis on acquirers' cash holdings and find significant decreases after takeovers, ruling out the alternative explanation that targets' cash holdings decrease because acquirers, as the new parent companies, hold cash for the targets after takeovers. I conduct similar tests on acquirers' cash holdings and find similar results (not tabulated) to EJW.

[Insert Table 3 here]

Columns (3) and (4) present results of specification (2). The dependent variable is the changes in target cash holdings. The positive coefficients on *Cash Flow* and the negative coefficients on *AFTER*×*Cash Flow* with similar absolute value suggest that targets are financially constrained before the takeover, but become unconstrained after. The results are similar to those in EJW.

3.2 Investments of target firms

Then I redo the tests on targets' investments as in EJW by estimating the following specification:

$$Investments = \alpha + \beta_1 AFTER + \beta_2 Cash\ Flow + \beta_2 AFTER \times Cash\ Flow + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \quad (3)$$

Because Amadeus does not provide data for capital expenditure, I use changes in tangible fixed assets plus depreciation as a proxy for investments. The estimates are presented in Table 4. The significant and positive coefficients on $AFTER$ in columns (1) and (2) indicate an increase in targets' investments after the takeovers. In additional untabulated tests, I also find increases in targets' sales growth and asset growth after acquisitions. Taken together, the results indicate that targets benefit from acquisitions and have more investment and higher growth after being taken over.

In columns (3) and (4) the coefficient estimates on *Cash Flow* and $AFTER \times Cash\ Flow$ have similar magnitude but different signs, suggesting that targets' investments become insensitive to cash flows and their financial constraints are almost eliminated after the acquisitions. The results are similar to those in EJW.

[Insert Table 4 here]

In summary, the results in Table 3 and 4 and their interpretations are consistent with EJW, indicating a relief of targets' financial constraints after takeovers.

4. Takeovers' impact on targets' self-financing from retained earnings

According to the pecking order theory (Myers 1984; Myers and Majluf 1984), retained earnings is the most preferred source of financing.

4.1 Targets' earnings generation

In this section, I investigate whether targets generate higher earnings to finance their investments internally after acquisitions. It is often argued that bad performing companies are disciplined by the takeover market and their operation will improve after being acquired. Partly because of the unavailability of targets' post-takeover financial data in the US, to my knowledge, no study tests the conjecture directly by examining targets' post-takeover operating performance. However, many prior studies investigate the changes in targets operating performance indirectly. Agrawal and Jaffe (2003) analyze targets' pre-takeover operating performance and do not find evidence that targets perform poorly before acquisitions. Several studies investigate the operating performance of the combined firm and the empirical results are mixed (e.g., Healy, Palepu and Ruback 1992; Ghosh 2001 and Powell and Stark 2005). Other studies use plant-level data and investigate the post-takeover productivity of target plants. Maksimovic and Phillips (2001) find that the majority of target plants' productivity increases after the transactions.

I estimate the following specification:

$$Net\ Income = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \quad (4)$$

where *Net Income* is the net income of target firms deflated by lagged total assets. I controlled for target firm characteristics such as size and leverage and macroeconomic conditions such as country-level GDP growth and year fixed effects. Target firm fixed effects are included and standard errors are adjusted for clustering at target firm level.

[Insert Table 5 here]

The results are presented in Table 5. The coefficient estimates on *AFTER* are negative in both columns. The estimate is significant at 5% level in column (1) but insignificant in column (2). The results do not suggest that targets generate significantly higher earnings after being acquired.

4.2 Targets' earnings retention

Although targets do not seem to generate higher earnings after being acquired, they can still enhance their self-financing by adjusting their earnings retention policy. After the takeovers, targets become wholly owned subsidiaries of the acquirers and their dividend payments become internal transfers within the corporations.[2] In this section, I investigate whether targets adjust their earnings retention policy after the takeovers by estimating the following specification:

[2] Though some acquirers own less than 100% of targets' shares after completion, I only include full takeovers in the sample of this study.

$$Retained\ Earnings = \alpha + \beta_1 AFTER + \beta_2 Net\ Income + \beta_3 AFTER \times Net\ Income + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \quad (5)$$

where *Retained Earnings* is the change in target firm's cumulative retained earnings deflated by lagged total assets.

To capture possible changes in targets' retention policy, I include the interaction of *AFTER* and *Net Income*. The coefficient on *Net Income* represents the net income sensitivity of retained earnings before acquisitions and the coefficient on $AFTER \times Net\ Income$ indicates the changes in the sensitivity after acquisitions.

[Insert Table 6 here]

The results are presented Table 6. I do not control for *Net Income* in column (1), and the insignificant coefficient on $AFTER$ suggests no significant changes in target firms' retained earnings after acquisitions. In column (2), I control for *Net Income* but not $AFTER \times Net\ Income$. The coefficient on $AFTER$ is positive and significant at 10% level, indicating that controlling for net income, target firms' retained earnings increases after the acquisitions, suggesting an increased retention ratio.

Column (3) presents the results for equation (5). The coefficient estimate on $AFTER$ is significantly positive and the one on $AFTER \times Net\ Income$ is significantly negative. The results suggest that the increase in targets' retained earnings is larger when the net income is low, indicating that targets have more discretion in making retention decisions basing on the sufficiency of their earnings generated: when the net

income is low, targets retain a higher proportion of the earnings and vice versa. Therefore, targets' self-financing from retained earnings is less sensitive to their operating performance and hence more stable.

In column (4), I allow the net income sensitivity of retained earnings to differ for positive and negative net incomes and also before and after the takeovers. *Net Income* (+*ve*) [*Net Income* (-*ve*)] equals *Net Income* if *Net Income* is positive (negative) and zero otherwise. The coefficients on *Net Income* (+*ve*) and *Net Income* (-*ve*) indicate the sensitivities for positive and negative net incomes before acquisitions and the coefficients on *AFTER* ×*Net Income* (+*ve*) and *AFTER*×*Net Income* (-*ve*) represent the changes in sensitivity after acquisitions. The coefficient on *AFTER* ×*Net Income* (+*ve*) is significantly positive but the coefficient on *AFTER*×*Net Income* (-*ve*) is insignificant. The results indicate that the net income sensitivity of retained earnings declines only for positive net income. This is because the theoretical "retention ratio" for operating loss is 100% regardless of the takeovers.

The results on retained earnings suggest that although targets do not generate significantly higher earnings after the takeovers, they can still obtain more sufficient and also more stable internal financing by adjusting their retention policy. The results are consistent with Michaely and Roberts (2012) that wholly owned firms pay less dividend and smooth dividend less than dispersedly owned firms.

As Demirgüç-Kunt and Maksimovic (1998) point out, conflicts of interest and informational asymmetries between corporate insiders and investors constrain firms in their ability to fund investment projects. Michaely and Roberts (2012) suggest that

dispersedly owned firms are subject to this problem. Before acquisitions, targets' ownerships are relatively dispersed and their shareholders, fearing getting expropriated or suffering losses in firm value depreciation, require consistent dividend payments, putting an extra burden on targets' self-financing and constrain their investment. After being acquired, targets' ownership concentrates, and both conflicts of interest and information asymmetry problem are alleviated. The new controlling shareholders (i.e., the acquirer) no longer require consistent dividend payments, instead, they give priority to targets' investments. After the takeovers, targets are able to make retention decisions based on their investment opportunities and capital sufficiency instead of passively relying on the remaining operating cash flows after consistent dividend payments to finance their investments.

5. Takeovers' impact on targets' internal borrowing from parent companies

Firms may borrow from their group firms to finance their investments. Desai, Foley and Forbes (2008) find that parents of the US affiliates directly lend money to their affiliates to fund their investments and growth when the affiliates face financial constraints during the currency crisis. I this section, I examine whether target firms finance their investments through borrowing from their parents after acquisitions.

5.1 Issuance of non-interest-bearing liabilities

First, I investigate whether targets borrow more non-interest-bearing liabilities after acquisitions. Non-interest-bearing liabilities is measured as total liabilities minus debt, trade credit payables, and provisions. I test the following specification:

$$\Delta Non\text{-}interest\ Liabilities = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \quad (6)$$

I control for both firm-level and country-level factors including firm size, performance, and leverage. The results are presented in column (1) of Table 7.

[Insert Table 7 here]

The coefficient estimate on *AFTER* is positive, suggesting that targets increase their issuance of non-interest-bearing liabilities after acquisitions. The increase is both statistically and economically significant. The coefficient estimates suggest an increase of about 0.77% of lagged total assets.

5.2 Sensitivity of non-interest-bearing liabilities to retained earnings

Then I investigate the role of interest-free borrowing as a substitute for self-financing by testing the following specification:

$$\begin{aligned}\Delta \textit{Non-interest Liabilities} = {} & \alpha + \beta_1 \textit{AFTER} + \beta_2 \textit{Retained Earnings} \\ & + \beta_3 \textit{AFTER} \times \textit{Retained Earnings} \\ & + \beta_k \textit{Controls} + \textit{Target firm FE} + \textit{Year FE} + \varepsilon. \end{aligned} \quad (7)$$

In equation (7), I add *Retained Earnings* as a key independent variable and allow its coefficient to change after acquisitions. The coefficient on $AFTER \times Retained\ Earnings$ represents the change in the sensitivity of non-interest liability issuance to retained earnings after acquisitions.

It is difficult to predict the association between retained earnings and the issuance of non-interest-bearing liabilities. Cross-sectionally, one would expect a positive association because retained earnings is highly correlated with operating performance and well-performing companies have less default risk and hence can borrow more capital for free. On the other hand, controlling firm default risk, the association could be negative because firms need to borrow more capital for investments if their self-financing is less sufficient.

The results are presented in column (2) of Table 7. The coefficient estimate of *Retained Earnings* is significantly positive, suggesting the positive association is stronger. But the coefficient estimate on $AFTER \times Retained\ Earnings$ is negative and significant, suggesting either the default risk effect decreases or self-financing sufficiency effect increases or both. The decrease in the sensitivity of non-interest-

bearing liabilities on retained earnings suggests that after acquisitions target firms can borrow more interest-free capital to make up for the lack of financing from retained earnings.

5.3 Non-interest-bearing liabilities and group debt borrowed from the acquirer

To validate that the increase in non-interest-bearing liabilities is driven by targets borrowing from their parents after acquisitions, for the firm-years after acquisitions, I calculate group debt using the information from both consolidated and unconsolidated financial statements of acquirers and test the following specifications:

$$\begin{aligned} Group\ Debt = \alpha + \beta_1 Non\text{-}interest\ Liabilities + \beta_2 Total\ Debt \\ + \beta_3 Payable + Firm\ FE + \varepsilon, \end{aligned} \tag{8}$$

$$\begin{aligned} \Delta Group\ Debt = \alpha + \beta_1 \Delta Non\text{-}interest\ Liabilities + \beta_2 \Delta Total\ Debt \\ + \beta_3 \Delta Payable + Firm\ FE + \varepsilon. \end{aligned} \tag{9}$$

The details of *Group Debt* construction is in Appendix II. The results are presented in Table 8. In column (1), both coefficient estimates on *Non-interest Liabilities* and *Total Debt* are positive and significant. Because *Group Debt* consists of targets' other current assets such as short-term investments by construction, which may be correlated with targets' liabilities, the positive coefficients could be driven by targets short-term investments in the dependent variable. To rule out the alternative explanation, in column (2) I use an alternative group debt measure—*Group Debt* (Acq FS) as the dependent variable, which is constructed using data from acquirers' financial statements only. The

coefficient estimate on *Total Debt* drops sharply and becomes insignificant while the one on *Non-interest Liabilities* remains significant.

In columns (3) and (4), I use the changes instead of the level of *Group Debt* as the dependent variable. In column (3) the dependent variable is Δ*Group Debt* and the coefficient on Δ*Non-interest Liabilities* is significantly positive while other coefficients are insignificant. In column (4), the dependent variable is Δ*Group Debt* (Acq FS) and again, only the coefficient on Δ*Non-interest Liabilities* is significant.

[Insert Table 8 here]

The magnitude of the coefficients on *Non-interest Liabilities* and Δ*Non-interest Liabilities* ranges from 0.35-0.58, indicating that the capital borrowed from acquirers is a major component of targets' non-interest-bearing liabilities after acquisitions. The insignificant coefficients on *Total Debt* in column (2) and Δ*Total Debt* in columns (3) and (4) suggest that acquirers often do not charge interests on the capital they lend to their subsidiaries.

The results in section 5 suggest that targets can borrow from their parents to finance the investments. The intra-group borrowing alleviates targets' financial constraints as it provides targets with more capital, especially when self-financing from retained earnings is insufficient due to poor operating performance. The results are consistent

with the findings in EJW's subsample analysis that the reduction in financial constraints is more salient for independent targets'.

6. Takeovers' impact on targets' external debt financing

In this section, I investigate whether takeovers enhance targets' ability to finance from the external debt market. In particular, I examine changes in target firms' debt issuance, the sensitivity of debt issuance to retained earnings and cost of debt after acquisitions.

6.1 Changes in targets' debt issuance

To investigate the changes in targets ability to finance from the debt market, I first test whether targets issue more debt after acquisitions by estimating the following specification:

$$Debt\ Issuance = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \quad (10)$$

The dependent variable is the debt issuance of target firms, calculated as the changes in target firms' total debt deflated by lagged total assets. I control for both firm-level and country-level factors that may affect the debt issuance. For firm-level control variables, besides firm size, performance and leverage, I also control for the intangibility and interest coverage.

[Insert Table 9 here]

The results are presented in column (1) of Table 9. The significantly positive coefficient estimate on *AFTER* suggest that target firms increase their debt issuance

after takeovers. The increase is estimated to be 2.4% of lagged total assets, which is economically substantial given that the mean of targets' debt issuance is only 1.1% before the takeovers.

6.2 Sensitivity of debt issuance to retained earnings

Companies may resort to the external debt market for capital when they are not able to generate through earnings to finance the investments through operating activities. Therefore, if targets' access to the debt market is enhanced, they are able to issue more debt when their retained-earnings is low. To investigate the changes in targets' debt issuance-retained earnings sensitivity, I test the following specification:

$$\begin{aligned} Debt\ Issuance = {} & \alpha + \beta_1 AFTER + \beta_2 Retained\ Earnings \\ & + \beta_3 AFTER \times Retained\ Earnings \\ & + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \end{aligned} \tag{11}$$

Similar to specification (7), I include *Retained Earnings* and its interaction with *AFTER* in the regression. The coefficient on $AFTER \times Retained\ Earnings$ represents the changes in the sensitivity after acquisitions. The results are presented in column (2) of Table 9. The coefficient estimate of $AFTER \times Retained\ Earnings$ is significantly negative, indicating a stronger negative association between debt issuance and retained earnings after acquisitions.

In summary, the results in Table 9 not only suggest an increase in targets' debt issuance after acquisitions, but also indicate that the increase is larger if the target could not obtain sufficient financing from earnings retention.

6.3 Targets' cost of debt

In this section, I test whether targets' cost of debt decreases after acquisitions. I use interest rate to measure cost of debt as in Pittman and Fortin (2004) and Chaney, Faccio and Parsley (2011). Interest rate is calculated as the interest expense over total debt. Observations with interest rate estimates higher than 20% plus the country-year short-term interest rate are excluded. I do not use bond yield or loan spread to measure cost of debt though they are better metrics than interest rate because most private target firms in my sample are too small to issue bond or borrow syndicate loans.

I test the following specification:

$$Cost\ of\ Debt = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \quad (12)$$

I control for the firm-level variables documented to have impact on the cost of debt such as size, leverage, intangibility, performance, debt maturity and interest coverage ratio in previous studies (e.g., Chaney, Faccio and Parsley 2011, Guedhami and Pittman 2008, and Pittman and Fortin 2004) and country-level variables such as the interest rates, inflation, GDP growth, market capitalization to GDP and private credit to GDP.

[Insert Table 10 here]

The results are presented in column (1) of Table 10. The coefficient estimate on $AFTER$ is significantly negative, suggesting that cost of debt of target firms is lowered after the takeovers. The decrease in targets' interest rate is estimated to be 0.41%—a substantial magnitude comparing with the sample mean (median) of 5.3% (4.9%). The

observation count is only 15,223 because total debt is missing or zero for about half of the observations. In column (2), I use total liabilities as an alternative deflator of interest expense to calculate interest rate. The coefficient estimate is about half of that in column (1) but remains significant negative.

An alternative interpretation is that acquirers lend capital to their targets and charge below-market interest, lowering the average cost of debt of target firms. Besides the fact that charging interests on internal transfers brings unnecessary complexity, this explanation is not supported by the results in section 5.3 which suggest no association between targets' total debt and the group debt they borrowed from acquirers.

7. Takeovers' impact on targets' trade credit

7.1 Targets' trade credit payable

Trade credit payables extended by suppliers is a major source of financing, especially for smaller companies. Petersen and Rajan (1997) find that small firms use more trade credits when their borrowing from financial institutions is constrained.

Section 6 presents results suggesting improvement in targets' access to the external debt is enhanced after acquisitions. One explanation is that financial institutions lower their estimate of target's default risk once the target becomes a wholly owned subsidiary of the acquirer which is usually larger and financially healthy. If so, suppliers may also lower their estimates of target's default risk and provide better trade credit terms. In this case, targets could have higher trade credit payable issuance and longer payable turnover period. Since payable turnover period is not available for most companies because cost of goods sold data is not available, I only examine the changes in trade credit issuance by testing the following specification:

$$\Delta Payable = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \quad (13)$$

where $\Delta Payable$ is the change in debts to suppliers and contractors (creditor) scaled by lagged total assets.

The results are presented in column (1) of Table 11. The coefficient estimate on $AFTER$ is positive and significant at 5% level, suggesting an increase in target firms' trade credit financing from suppliers by 0.55% of lagged total asset. The magnitude is economically significant, considering the average $\Delta Payable$ is only 1.1%.

7.2 Targets' trade credit receivable

Trade credit receivable also affects firms' financial constraints. Murfin and Njoroge (2015) find that small companies have lower investment level if they receive slower payments from their larger retailers. Therefore, target companies' financial constraints would be relieved if they collect payments from their retailers more quickly after acquisitions. I test the following specification:

$$Receivable\ Days = \alpha + \beta_1 AFTER + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon, \quad (14)$$

where *Receivable Days* is the logarithm of one plus targets' trade credit receivables scaled by total sales and multiplied by 360.

The results are presented in column (2) of Table 11. The coefficient estimate on *AFTER* is -0.06 and statistically significant. Because *Receivable Days* is in logarithm, the coefficient suggests a 6% decrease in average length of time for targets to get payments from their customers.

The results suggest that target firms borrow more from their suppliers to finance their working capital investment and receive payments from their customers more quickly.

8. Takeovers' impact on targets' equity financing

The descriptive statistics do not suggest share issuance is a major source of financing for private targets. Nevertheless, I conduct tests on the following specification to investigate whether targets' equity financing policy changes after acquisitions.

$$\begin{aligned} Share\ Issuance = \alpha + \beta_1 AFTER + \beta_2 Net\ Income + \beta_3 AFTER \times Net\ Income \\ + \beta_k Controls + Target\ firm\ FE + Year\ FE + \varepsilon. \end{aligned} \quad (15)$$

The results are presented in Table 12. The coefficient estimate on *AFTER* is close to zero and only marginally significant in column (1). The coefficient becomes insignificant in column (2) once I allow the coefficient on $Net\ Income$ to change after acquisitions. The coefficient estimate on $AFTER \times Net\ Income$ is significantly positive and the magnitude is close to that on $Net\ Income$. The results do not suggest significant changes in the level of share issuance in target firms after acquisitions However, the results still indicate some adjustments in targets' equity financing policy: targets' share issuance becomes significantly less sensitive to net income after acquisitions.

The results are consistent with previous results in Table 6 and Table 7, suggest that after acquisitions when facing gaps between investment needs and earnings generated from operation, targets significantly reduce their usage of share issuance and share repurchase as financing or payout methods and substitute them with intra-group transfers such as dividend payment and group debt and external borrowing.

9. Potential concerns and robustness tests

There are several potential concerns regarding the results presented before. In this section, I address these concerns and conduct robustness tests that help to alleviate them.

9.1 Unbalanced observations before and after acquisitions

Because Amadeus provides only at most 10 years of financial data for each firm, the sample I construct has an "unbalanced" structure regarding the number of observations before and after acquisitions. For acquisitions that are completed in early years of the sample, there are more post-takeover observations for these deals; for takeovers completed in later years, there are more pre-takeover observations. To make sure that the unbalanced structure does not cause serious bias to the results, I redo the tests in a subsample of firm-years no more than three years away from the completion of the takeovers. The results are similar to those presented before and indicate that the unbalanced sample structure does not seem to cause severe bias.[3]

9.2 Clustering of observations for UK targets

Observations with targets from the UK account for 22% of the sample. To eliminate the concern that the results are driven by observations from the UK and not applicable to other countries, I redo the tests for a subsample excluding target firms from the UK. The results remain similar, suggesting that they are not driven by target firms from the UK.

[3] All results in this section are not tabulated but are available upon requests.

9.3 Reallocation of targets' assets

EJW point out that although the targets keep the same name and unique identifier in the database after being acquired, the assets of these subsidiaries may change due to asset reallocation by parents after the takeovers. Although such errors are not likely to be systematic, I still conduct subsample analysis to make sure that the results are not driven by these errors.

Following EJW's method, I re-estimate the equations in a sample excluding observations from the year immediately after the takeovers because they are more likely to be associated with assets reallocations and changes in book value due to accounting changes. The results remain similar.

In general, the subsample analysis results suggest that the main results are not driven by asset reallocation and the conclusions of the study hold.

10. Conclusion

It is argued that improvements in target firms' financial efficiency create value in acquisitions. Erel, Jang and Weisbach (2015) provide empirical evidence that target firms' financial constraints are relieved after acquisitions. However, the underlying mechanism remains unexplored. In this study, I attempt to fill in this gap and examine how target financial constraints are relieved after acquisitions.

First, I examine changes in target firms' internal financing, starting with targets ability to generate earnings. The empirical results do not suggest that targets generate significantly higher earnings after acquisition.

Then I investigate the changes in targets' earnings retention policy around acquisitions. This is particularly worthy of investigation because it not only affects targets' internal financing and financial constraints but also reflects the impact of ownership changes on targets' investment policy. I find that after takeovers targets do less dividend smoothing: when the earnings are low (higher), they retain higher (lower) proportions for investment and turn in lower (higher) proportions as dividend. The results suggest that target firms obtain more stable financing from earnings after being acquired, indicating that as their ownerships concentrate, target firms prioritize their investment needs and smooth dividend less.

I also investigate whether target firms borrow capital from their parent firms after acquisitions and test results show supporting evidence: target firms borrow interest-free capital from their parents, especially when their self-financing from retained earnings is low.

The empirical results on targets' internal financing suggest that though target firms do not generate higher earnings, changes in their earnings retention policy and internal borrowing from parent companies help relieve their financial constraints.

I also investigate the changes in targets access to external financing from the debt market and suppliers. Tests on targets' debt financing suggest that targets issue more debt after takeovers, especially when their internal financing from retained earnings is low. Moreover, their cost of debt decreases. The results suggest that acquisitions enhance targets' access to the external debt market so they can obtain more and cheaper financing when needed.

Because trade credit extended by suppliers is also an important financing channel, especially to small companies (Petersen and Rajan 1997), I examine changes in targets accounts payable and find that target companies increase borrowing from their suppliers after takeovers. Murfin and Njoroge (2015) find that small companies have lower investment level if they receive slower payments from their larger retailers. I find that target firms collect receivables more quickly after the takeovers.

Lastly, I examine targets' equity financing after takeovers. The empirical results do not suggest that targets issue significantly more shares after being acquired, but indicate a significant decrease in share issuance-earnings sensitivity, indicating that target firm substitute share issuance and repurchase with intra-group transactions such as dividend payment and internal borrowing.

In conclusion, the results suggest that more stable internal financing due to changes in earnings retention policies and intra-group borrowing, together with enhanced

external financing from the debt market and suppliers lead to reductions in targets' financial constraints after acquisitions. The results are robust to potential data problems.

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Appendix I

This table contains descriptions of the variables used in the analyses.

Firm-year variables	Description (Amadeus variable codes in parentheses)
Cash Holding	Cash and cash equivalents (CASH) / Total assets
Gross Investment	[Tangible fixed assets (TFAS) − lagged tangible fixed assets + Depreciation (DEPR)] / Total assets
EBIT	EBIT (OPPL) / Total assets
Cash Flow	Cash flow (CF) / Total assets
Net Income	Net income (PL) / Total assets
Total Liabilities	Current liabilities (CULI) + Non-current liabilities (NCLI)
Total Debt	Long-term debt (LTDB) + Short-term debt (LOAN)
Total Non-interest Liabilities	Total liabilities − Total debt − Creditor (CRED)
Retained Earnings	[Other shareholders funds (OSFD) − lagged other shareholders funds] / Lagged total assets
ΔNon-interest Liabilities	[Total non-interest debt − lagged total non-interest debt] / Lagged total assets
Group Debt	See Appendix II
Debt Issuance	[Total debt − lagged total debt] / Lagged total assets
Cost of Debt	2×Interest paid (INTE) / Total debt
Payable	Debts to suppliers and contractors (CRED)
ΔPayable	[Payable − lagged Payable] / Lagged total assets
Receivable days	Log[Debtor (DEBT)×360 / Total sales + 1]
Share Issuance	[Capital (CAPI) − lagged capital] / Lagged total assets
Leverage	Total liabilities / Total assets
Tangibility	Fixed assets / Total assets
Interest Coverage	EBITDA / Interest paid[4]
Debt Maturity	Non-current liabilities / Total liabilities
Short-term Investment	Other current assets (OCAS) − Cash and cash equivalents
Deal level variables	**Description**
Domestic Deals	A deal is domestic if the acquirer and the target are from the same nation
Related Deals	A deal is related deals if the acquirer and the target have the same two-digit SIC codes
Country level variables	**Description**
GDP Growth	Annual percentage nominal growth rate of GDP in local currencies (Source: World Bank)

[4] Following Kaplan and Zingales (1997), I set the interest coverage ratio to 100 if the coverage exceeds 100 or the interest payment is negative. The ratio is set to 0 if EBITDA is negative.

Private Credit/GDP	Private credit by deposit money banks and other financial institutions to GDP (Source: World Bank)
Market Cap/GDP	Value of listed shares to GDP[5] (Source: World Bank)
Inflation	Annual inflation based on consumer prices (Source: World Bank)
GDP per Capita	The natural logarithm of GDP per capita in constant 2005 USD (Source: World Bank)
Short-term Interest Rates	Short-term interest rates (Source: OECD)
Long-term Interest Rates	Long-term interest rates (Source: OECD)

[5] Because after 2012 the World Bank stops updating the Market Cap/GDP data, I fill in the data for 2013 and 2014 with the number for 2012 for each country.

Appendix II Group Debt construction

Amadeus provides a variable in the balance sheet named "Other Current Assets" (*OCAS*), which consists of receivables from group companies (*GR*), short-term investments of money (*SI*) and cash and cash equivalent (*CASH*). Based on this variable definition, I have the following:

$$OCAS - CASH = SI + GR. \tag{A1}$$

Suppose the acquirer belongs to a corporate group, and other group companies is denoted as OG. I denote the consolidated acquirer after acquisitions as AC, the unconsolidated acquirer as AU, the target company as T and other subsidiaries of the acquirer as OS. Hence, the corporate group consists of OG and AC, and AC consists of AU, T, and OS.

We have:

$$\begin{aligned} &OCAS\ (\mathrm{AU}) - CASH\ (\mathrm{AU}) + OCAS\ (\mathrm{T}) - CASH\ (\mathrm{T}) - OCAS\ (\mathrm{AC}) - CASH\ (\mathrm{AC}) \\ &= SI\ (\mathrm{AU}) + GR\ (\mathrm{AU}) + SI\ (\mathrm{T}) + GR\ (\mathrm{T}) - SI\ (\mathrm{AC}) - GR\ (\mathrm{AC}) \end{aligned} \tag{A2}$$

Additionally, we know:

$$SI\ (\mathrm{AC}) = SI\ (\mathrm{AU}) + SI\ (\mathrm{T}) + SI\ (\mathrm{OS}) \tag{A3}$$

From (A2) and (A3), we have:

$$\begin{aligned} &OCAS\ (\mathrm{AU}) - CASH\ (\mathrm{AU}) + OCAS\ (\mathrm{T}) - CASH\ (\mathrm{T}) - OCAS\ (\mathrm{AC}) - CASH\ (\mathrm{AC}) \\ &= GR\ (\mathrm{AU}) + GR\ (\mathrm{T}) - GR\ (\mathrm{AC}) - SI\ (\mathrm{OS}). \end{aligned} \tag{A4}$$

I denote the group receivables of A to collect from B as $GR\ (\mathrm{A\_B})$. From (A4), I have:

$$\begin{aligned} &OCAS\ (\mathrm{AU}) - CASH\ (\mathrm{AU}) + OCAS\ (\mathrm{T}) - CASH\ (\mathrm{T}) - OCAS\ (\mathrm{AC}) - CASH\ (\mathrm{AC}) \\ &= GR\ (\mathrm{AU\_T}) + GR\ (\mathrm{AU\_OS}) + GR\ (\mathrm{T\_AU}) + GR\ (\mathrm{T\_OS}) - GR\ (\mathrm{AC\_OG}) - SI\ (\mathrm{OS}). \end{aligned} \tag{A5}$$

The variable of interest is $GR\ (\mathrm{AU\_T})$ on the right-hand side of equation (A5), which measures the amount of capital that acquirers lend to their targets after the acquisition.

Other items on the right-hand side of equation (A5) are noise terms. In an ideal case where the target firm is the only subsidiary of the acquirer and the acquirer does not belong to any corporate group (i.e., there is no OS or OG), and the acquirer is less financially constrained than the target (i.e., $GR\ (\mathrm{T\_AU}) = 0$)

we have:

$$GR\ (\text{AU\_T}) = OCAS\ (\text{AU}) - CASH\ (\text{AU}) + OCAS\ (\text{T}) - CASH\ (\text{T}) \\ -OCAS\ (\text{AC}) - CASH\ (\text{AC}). \tag{A6}$$

To measure the intra-group debt the target borrowed from the acquirer, I construct a variable *Group Debt* as:

$$Group\ Debt = OCAS\ (\text{AU}) - CASH\ (\text{AU}) + OCAS\ (\text{T}) - CASH\ (\text{T}) \\ -OCAS\ (\text{AC}) + CASH\ (\text{AC}). \tag{A7}$$

I also construct an alternative group debt measure using information from acquirers' financial statements only:

$$Group\ Debt\ (\text{Acq FS}) = OCAS\ (\text{AU}) - CASH\ (\text{AU}) - OCAS\ (\text{AC}) + CASH\ (\text{AC}). \tag{A8}$$

Table 1. Statistics on the acquisition sample

This table presents statistics on acquisitions targeting European firms from 2007 to 2013 reported by Zephyr database. Target (acquirer) is labeled as a public firm if it is listed or delisted. A deal is domestic if the acquirer and the target are from the same nation. A deal is related deals if the acquirer and the target have the same two-digit SIC codes.

Deal completion year	No. of deals	Domestic deals (%)	Industry related deals (%)	Public acquirers (%)	Public targets (%)	Targets' Total assets before the takeovers (in millions)	
						Mean	Median
2007	1645	63.53	46.02	36.23	2.25	62.56	8.18
2008	1685	62.26	44.75	33.53	2.43	60.67	7.65
2009	1152	64.24	44.01	26.13	3.04	188.46	8.44
2010	1421	62.14	45.04	28.08	1.97	53.04	7.49
2011	1467	58.15	48.33	26.79	2.39	73.20	8.05
2012	1429	58.57	47.87	26.10	3.01	47.71	7.76
2013	1048	58.68	46.95	25.95	2.00	61.04	7.49
Total	9847	61.16	46.14	29.44	2.44	74.86	7.89

Table 2. Descriptive statistics on target firms' financial variables

This table displays the descriptive statistics on financial data of target firms. The definitions of the variables are provided in Appendix I.

Variable	Mean	Median	Std. Dev.	Obs.
Total Assets (in millions)	97.586	9.272	1336.633	60,572
Leverage	0.586	0.613	0.249	60,503
Cash Holding	0.120	0.055	0.152	59,362
Cash Flow	0.092	0.080	0.122	43,111
EBIT	0.075	0.059	0.138	51,340
Net Income	0.052	0.039	0.120	51,202
Interest Rate	0.053	0.049	0.034	23,393
Assets Growth	0.094	0.036	0.338	48,948
Gross Investment	0.040	0.021	0.069	38,104
Retained Earnings	0.032	0.015	0.146	48,484
ΔNon-interest Liabilities	0.027	0.003	0.175	46,374
Debt Issuance	0.012	0.000	0.132	45,894
ΔPayable	0.011	0.000	0.094	46,842
Receivable Days (in level)	67.747	52.218	69.158	49,410
Share Issuance	0.001	0.000	0.030	48,484

Table 3. Effects of acquisitions on target firms' cash holdings

This table presents estimates of equations predicting target firms' cash holdings. The dependent variable in columns (1) to (3) is the cash holdings of target firms, normalized by total assets. The dependent variable in columns (2) and (4) is the change in target's cash holdings, normalized by total assets. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. *Cash Flow* is operating cash flow over total assets. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Cash Holdings		Δ Cash Holdings	
	(1)	(2)	(3)	(4)
AFTER	-0.0251***	-0.0181***	-0.0085***	-0.0062*
	(0.002)	(0.004)	(0.003)	(0.003)
Cash Flow		0.0813***	0.0975***	0.0801***
		(0.016)	(0.012)	(0.015)
AFTER×Cash Flow			-0.0618***	-0.0608***
			(0.015)	(0.018)
Log(Total Assets)	-0.0032	0.0215	0.0200	0.0289
	(0.013)	(0.027)	(0.015)	(0.018)
Log(Total Assets)^2	-0.0006	-0.0011	-0.0010	-0.0012
	(0.001)	(0.001)	(0.001)	(0.001)
Private Credit/GDP	-0.0001	-0.0003**	-0.0001	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Market Cap/GDP	-0.0002***	-0.0002***	-0.0001	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
GDP Growth	-0.0007**	-0.0004	-0.0002	-0.0006
	(0.000)	(0.001)	(0.001)	(0.001)
Leverage		-0.0765***		-0.0082
		(0.011)		(0.007)
Sales Growth		0.0057*		0.0061**
		(0.003)		(0.003)
Log(Number of Employees)		-0.0094**		-0.0024
		(0.004)		(0.003)
Constant	0.2287***	0.1522	-0.0954	-0.1330
	(0.067)	(0.139)	(0.076)	(0.095)
Observations	55242	17034	23631	16756
Adjusted R2	0.544	0.565	-0.047	-0.054
Target Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 4. Effects of acquisitions on target firms' investments

This table presents estimates of equations predicting target firms' investments. The dependent variable is the Gross Investment of target firms, normalized by total assets. Gross Investment is calculated as tangible fixed assets – lagged tangible fixed assets + depreciation. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. *Cash Flow* is operating cash flow over total assets. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)	(3)	(4)
AFTER	0.0078***	0.0057***	0.0095***	0.0080***
	(0.002)	(0.002)	(0.002)	(0.002)
Cash Flow		0.0151*	0.0304***	0.0276***
		(0.008)	(0.008)	(0.010)
AFTER×Cash Flow			-0.0268***	-0.0257**
			(0.010)	(0.012)
Log(Total Assets)	0.0158	0.0081	0.0230**	0.0097
	(0.010)	(0.014)	(0.011)	(0.014)
Log(Total Assets)^2	-0.0005	-0.0002	-0.0007	-0.0003
	(0.001)	(0.001)	(0.001)	(0.001)
Private Credit/GDP	-0.0002***	-0.0003***	-0.0002***	-0.0003***
	(0.000)	(0.000)	(0.000)	(0.000)
Market Cap/GDP	0.0002***	0.0002***	0.0002***	0.0002***
	(0.000)	(0.000)	(0.000)	(0.000)
GDP Growth	0.0019***	0.0019***	0.0020***	0.0019***
	(0.000)	(0.001)	(0.000)	(0.001)
Leverage		0.0210***		0.0203***
		(0.005)		(0.005)
Sales Growth		0.0134***		0.0133***
		(0.002)		(0.002)
Log(Number of Employees)		0.0078***		0.0081***
		(0.003)		(0.003)
Constant	-0.0299	-0.0400	-0.0910*	-0.0520
	(0.048)	(0.071)	(0.055)	(0.071)
Observations	27171	16747	24331	16747
Adjusted R2	0.282	0.291	0.287	0.291
Target Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 5. Effects of acquisitions on target firms' earnings generation

This table presents estimates of equations predicting target firms' earnings generation. The dependent variable is the net income of target firms, scaled by lagged total assets. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. The definitions for other variables are provided in Appendix I. Target firm and year fixed effect are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)
AFTER	-0.0058**	-0.0032
	(0.003)	(0.003)
Log(Total Assets)	0.0724***	0.0692***
	(0.017)	(0.020)
Log(Total Assets)^2	-0.0026***	-0.0024**
	(0.001)	(0.001)
Leverage	-0.1754***	-0.1904***
	(0.008)	(0.009)
GDP Growth	0.0014***	0.0002
	(0.000)	(0.000)
Sales Growth		0.0622***
		(0.003)
Log(Number of Employees)		-0.0205***
		(0.004)
Constant	-0.2443***	-0.1503
	(0.088)	(0.105)
Observations	31944	21291
Adjusted R^2	0.428	0.467
Target Firm FE	Yes	Yes
Year FE	Yes	Yes

Table 6. Effects of acquisitions on target firms' earnings retention

This table presents estimates of equations predicting target firms' earnings retentions. The dependent variable is targets' annual Retained Earnings, calculated as the change in Other Shareholders Funds deflated by lagged total assets. *AFTER* is a dummy variable that takes a value of one after the takeover. *Net Income* is the net income deflated by lagged total assets. *Net Income* (*+ve*) [*Net Income* (*-ve*)] equals *Net Income* if the *Net Income* is positive (negative) and zero otherwise. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)	(3)	(4)
AFTER	-0.0042	0.0053*	0.0114***	0.0151***
	(0.004)	(0.003)	(0.003)	(0.003)
Net Income		0.7826***	0.8247***	
		(0.012)	(0.015)	
AFTER×Net Income			-0.0966***	
			(0.022)	
Net Income (+ve)				0.8582***
				(0.018)
Net Income (-ve)				0.7063***
				(0.040)
AFTER×Net Income (+ve)				-0.1188***
				(0.029)
AFTER×Net Income (-ve)				-0.0002
				(0.050)
Log(Total Assets)	0.1166***	0.0426***	0.0491***	0.0502***
	(0.019)	(0.016)	(0.016)	(0.016)
Log(Total Assets)^2	-0.0041***	-0.0008	-0.0010	-0.0011
	(0.001)	(0.001)	(0.001)	(0.001)
GDP Growth	0.0011*	0.0006	0.0006	0.0006
	(0.001)	(0.001)	(0.001)	(0.001)
Private Credit/GDP	-0.0007***	-0.0005***	-0.0006***	-0.0006***
	(0.000)	(0.000)	(0.000)	(0.000)
Market Cap/GDP	0.0007***	0.0005***	0.0005***	0.0005***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.5946***	-0.2924***	-0.3372***	-0.3495***
	(0.095)	(0.081)	(0.081)	(0.081)
Observations	35880	28737	28737	28737
Adjusted R^2	0.129	0.450	0.451	0.452
Target Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 7. Effects of acquisitions on changes in target firms' non-interest-bearing liabilities

This table presents estimates of the equation predicting changes in target firms' non-interest-bearing liabilities. The dependent variable is the changes in targets' Non-interest-bearing liabilities deflated by lagged total assets. *AFTER* is a dummy variable that takes a value of one after the takeover. Retained Earnings is calculated as the change in Other Shareholders Funds deflated by lagged total assets. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)
AFTER	0.0062**	0.0083***
	(0.003)	(0.003)
Retained Earnings		0.0510***
		(0.009)
AFTER×Retained Earnings		-0.0330***
		(0.013)
Leverage	0.1308***	0.1400***
	(0.006)	(0.006)
Log(Total Assets)	0.0441***	0.0518***
	(0.013)	(0.014)
Log(Total Assets)^2	-0.0013*	-0.0017**
	(0.001)	(0.001)
Interest Coverage	0.0003***	0.0002***
	(0.000)	(0.000)
Tangibility	-0.0277***	-0.0283***
	(0.007)	(0.007)
Private Credit/GDP	0.0000	-0.0000
	(0.000)	(0.000)
Market Cap/GDP	0.0005***	0.0004***
	(0.000)	(0.000)
GDP Growth	0.0002	0.0001
	(0.000)	(0.000)
Constant	-0.3670***	-0.4069***
	(0.068)	(0.070)
Observations	29987	29072
Adjusted R^2	0.070	0.074
Target Firm FE	Yes	Yes
Year FE	Yes	Yes

Table 8. Group debt and targets' non-interest-bearing liabilities

This table presents the association between group debt and subcategories of targets' liabilities. The dependent variables are presented at the top of each column. *Group Debt* is calculated using data from both consolidated and unconsolidated financial statements of acquiring companies and the detailed definition is discussed in Appendix II. The definitions for other variables are provided in Appendix I. All variables are deflated by the total assets of the combined firm. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Group Debt	Group Debt (Acq FS)	ΔGroup Debt	ΔGroup Debt (Acq FS)
	(1)	(2)	(3)	(4)
Non-interest Liabilities	0.5852***	0.3526***		
	(0.153)	(0.118)		
Total Debt	0.2981***	0.0354		
	(0.112)	(0.102)		
Payable	-0.0522	-0.2343		
	(0.199)	(0.195)		
ΔNon-interest Liabilities			0.5942***	0.3673***
			(0.143)	(0.130)
ΔTotal Debt			-0.0570	-0.0551
			(0.225)	(0.145)
ΔPayable			-0.1713	-0.1497
			(0.273)	(0.253)
Constant	2.9678***	2.4871***	0.0541***	0.0180**
	(0.549)	(0.430)	(0.010)	(0.007)
Observations	4431	4407	3705	3745
Adjusted R^2	0.678	0.686	0.005	0.009
Target Firm FE	Yes	Yes	Yes	Yes

Table 9. Effects of acquisitions on target firms' debt issuance

This table presents estimates of equations predicting target firms' debt issuance. The dependent variable is target firms' debt issuance, calculated as changes in targets' total debt deflated by lagged total assets. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. Retained Earnings is calculated as the change in Other Shareholders Funds deflated by lagged total assets. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)
AFTER	0.0236***	0.0247***
	(0.003)	(0.003)
Retained Earnings		-0.0142
		(0.010)
AFTER×Retained Earnings		-0.0361**
		(0.015)
Leverage	0.1376***	0.1274***
	(0.008)	(0.008)
Log(Total Assets)	0.0380**	0.0381**
	(0.017)	(0.018)
Log(Total Assets)^2	0.0000	0.0002
	(0.001)	(0.001)
Interest Coverage	-0.0000	0.0000
	(0.000)	(0.000)
Tangibility	-0.0024	-0.0044
	(0.009)	(0.010)
Private Credit/GDP	-0.0004***	-0.0004***
	(0.000)	(0.000)
Market Cap/GDP	0.0005***	0.0006***
	(0.000)	(0.000)
GDP Growth	0.0024***	0.0024***
	(0.001)	(0.001)
Constant	-0.4295***	-0.4455***
	(0.082)	(0.087)
Observations	33233	32065
Adjusted R^2	0.045	0.045
Firm FE	Yes	Yes
Year FE	Yes	Yes

Table 10. Effects of acquisitions on target firms' cost of debt

This table presents estimates of equations predicting target firms' cost of debt. The dependent variable is target firms' cost of debt, calculated as interest expense divided by total debts in column (1) and total liabilities in column (2). *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Interest Expense/Total Debt (1)	Interest Expense/Total Liabilities (2)
AFTER	-0.0041***	-0.0021***
	(0.001)	(0.000)
EBIT	0.0183***	-0.0012
	(0.004)	(0.001)
Tangibility	0.0089***	0.0127***
	(0.003)	(0.001)
Leverage	-0.0087***	0.0008
	(0.003)	(0.001)
Debt Maturity	-0.0132***	0.0105***
	(0.002)	(0.001)
$\text{Interest Coverage}_{t-1}$	-0.0001***	-0.0000***
	(0.000)	(0.000)
Log(Total Assets)	-0.0133**	-0.0069**
	(0.006)	(0.003)
$\text{Log(Total Assets)}^2$	0.0005*	0.0003**
	(0.000)	(0.000)
GDP Growth	-0.0011***	-0.0003***
	(0.000)	(0.000)
Inflation (CPI)	-0.0009***	0.0001
	(0.000)	(0.000)
Short-term Interest Rates	0.0043***	0.0016***
	(0.000)	(0.000)
Long-term Interest Rates	0.0006*	-0.0000
	(0.000)	(0.000)
Private Credit/GDP	-0.0001**	-0.0000***
	(0.000)	(0.000)
Market Cap/GDP	0.0001***	0.0000***
	(0.000)	(0.000)
Constant	0.1425***	0.0529***
	(0.034)	(0.014)
Observations	15223	31906
Adjusted R2	0.435	0.539
Firm FE	Yes	Yes
Year FE	Yes	Yes

Table 11. Effects of acquisitions on target firms' trade credit

This table presents estimates of equations predicting target firms' trade credit. The dependent variable is targets' trade credit payable issuance in column (1), calculated as the change in accounts payable deflated by lagged total assets; and targets' receivable days in column (2), calculated as the logarithm of one plus targets' trade credit receivables scaled by total sales and multiplied by 360. *AFTER* is a dummy variable that takes a value of one after the takeover. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	ΔPayable	Receivable Days
	(1)	(2)
AFTER	0.0055**	-0.0632***
	(0.003)	(0.022)
EBIT	0.0598***	-0.2521***
	(0.008)	(0.057)
Leverage	0.0959***	0.3835***
	(0.006)	(0.061)
Log(Total Assets)	0.0537***	0.3173**
	(0.015)	(0.145)
Log(Total Assets)^2	-0.0014*	-0.0007
	(0.001)	(0.007)
Tangibility	-0.0534***	
	(0.006)	
Private Credit/GDP	-0.0002***	0.0035***
	(0.000)	(0.001)
Market Cap/GDP	0.0000	-0.0046***
	(0.000)	(0.001)
GDP Growth	0.0010**	-0.0118***
	(0.001)	(0.003)
Constant	-0.3591***	0.9758
	(0.074)	(0.720)
Observations	27911	27171
Adjusted R^2	0.052	0.670
Firm FE	Yes	Yes
Year FE	Yes	Yes

Table 12. Effects of acquisitions on target firms' equity issuance

This table presents estimates of equations predicting target firms' share issuance. The dependent variable is targets' share issuance, calculated as the change in shareholders' capital deflated by lagged total assets. *AFTER* is a dummy variable that takes a value of one after the takeover. *Net Income* is the net income deflated by lagged total assets. The definitions for other variables are provided in Appendix I. Target firm and year fixed effects are included. Standard errors are adjusted for clustering at the target-firm level and presented in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	(1)	(2)
AFTER	0.0012*	0.0005
	(0.001)	(0.001)
Net Income	-0.0108***	-0.0155***
	(0.002)	(0.003)
AFTER×Net Income		0.0112***
		(0.004)
Log(Total Assets)	-0.0031	-0.0039
	(0.004)	(0.004)
Log(Total Assets)^2	0.0004*	0.0004**
	(0.000)	(0.000)
Leverage	-0.0069***	-0.0064***
	(0.002)	(0.002)
Private Credit/GDP	-0.0001***	-0.0001***
	(0.000)	(0.000)
Market Cap/GDP	0.0001***	0.0001***
	(0.000)	(0.000)
GDP Growth	0.0012***	0.0012***
	(0.000)	(0.000)
Constant	0.0000	0.0053
	(0.020)	(0.020)
Observations	28437	28437
Adjusted R^2	0.093	0.093
Target Firm FE	Yes	Yes
Year FE	Yes	Yes

Equation Chapter (Next) Section 1

Chapter Two: Time Zone Difference and Employee Coordination: Evidence from Mergers and Acquisitions

Abstract

I study the impact of time zone differences (TZDs) among firm segments on employee coordination in a mergers and acquisitions (M&A) setting. A model describing the synergy generated from real-time cooperation among employees suggests that TZDs impede employee coordination and reduce productivity. The model predicts negative market reactions to cross-time-zone M&A announcements. Using a sample of 3228 public M&A deals in the US, I find that the TZDs between acquirers and targets have a substantial negative effect on combined firm announcement returns: A one-hour TZD is associated with a decrease of 0.52-0.62% in the announcement return of the combined firm. Neither geographic distance nor cultural difference drives the negative effect. Consistent with the model predictions, the negative effect is stronger if the combining firms have high labor intensity or small employee numbers, or if they are similar in labor size or are in high-technology industries. I also find that, after cross-time-zone M&A, firms experience significant decline in operating performance and are more likely to conduct employee layoffs. Firms that conduct layoffs can recover their performance. Additional tests suggest that acquirers do not lower their offer price in cross-time-zone M&A and therefore, bear most of the costs caused by TZDs.

Keywords: Time zone difference, Employee cooperation, Layoffs, Mergers and acquisitions

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1. Introduction

Time zone differences (TZDs) affect business activities. Prior studies suggest that TZDs between investors and stock exchanges create frictions in trading (e.g., Portes and Rey 2005; Hailing, Pagano, Randl and Zechner 2008; Teo 2009). Zaheer and Zaheer (2001) argue that customers take TZDs into consideration when choosing their banks. Gulamhussen, Hennart and Pinheiro (2016) suggest that TZDs impede communication between banks' headquarters and their foreign subsidiaries, and hence affect the monitoring of those subsidiaries. It is also documented that TZDs have negative effects on foreign direct investment (e.g., Stein and Daude 2007) and international trade (e.g., Anderson 2014; Bista and Tomasik 2017; Christen 2017).

In this paper, I examine the effect of TZDs on employee coordination for cross-time-zone companies. Real-time cooperation among individuals creates synergy. Employees in different time zones work in different hours, and real-time cooperation can only be achieved within their overlapping work hours. TZDs shorten this time window and consequently reduce the synergy generated. I conjecture that TZDs among labor segments negatively affect a firm's employee productivity.

However, to empirically test this conjecture is challenging because productivity measures (e.g., Total Factor Productivity) and segment level information on time zones, geographic locations and employment are generally unavailable for non-manufacturing industries, in which more synergy is expected from real-time employee cooperation.

Mergers and acquisitions (M&A) provide a suitable setting. M&A transactions often involve companies from different time zones and they enable employees of two

previously separate entities to collaborate. The expected synergy from such collaboration can be observed through market reactions to M&A announcements.

A simple model predicts that the TZDs between acquirers and targets have a negative effect on M&A announcement returns. The model also predicts that the negative effect is stronger if the combining firms have high labor intensity or small employee numbers, or if they are similar in labor size or are in high-technology industries. To test the predictions, I construct a sample of 3228 public M&A deals in the US completed during the period 1990-2016 and use the cumulative abnormal returns (CAR) of the combined companies around the M&A announcements as a proxy for expected synergy.

Consistent with the model prediction, I find a negative association between combined CAR and TZDs after controlling for geographic distance. The association is both statistically significant and economically substantial: A one-hour TZD is estimated to be associated with a CAR decrease of 0.52-0.62% for the combined firm. The result is robust to alternative announcement windows and multiple control variables including geographic distance and cultural differences. Subsample analysis results also support other model predictions that the negative effect is stronger if the combining firms have high labor intensity or small employee numbers, or if they are similar in labor size or are in high-technology industries.

Results of tests on post-deal operating performance suggest that firms combined in cross-time-zone M&A experience significant declines in operating performance after

deal completions. Such firms are more likely to conduct layoffs, which often are associated with recoveries in performance later.

Additional tests indicate that acquires do not adjust the offer price when making cross-time-zone M&A and their shareholders bear most of the costs caused by the TZD.

The study contributes to three lines of literature. First, this research contributes to the literature on the economic effects of TZDs by showing that TZDs hinder cooperation among employees and directly reduce their productivity.

Second, the study adds to the literature on labor productivity and M&A. Maksimovic and Phillips (2001) find significant increases in productivity after plants are sold to another company. Li (2013) shows that such productivity increases come from more efficient use of capital and labor, and that changes in productivity help explain combined CAR. This study shows that TZDs are associated with combined CAR, reflecting changes in productivity around M&A.

Third, the paper expands the research on M&A integration and identifies TZDs as a determinant of M&A outcome. Prior studies examine several sources of integration costs in M&A such as geographic distance, employee protection, culture and industry differences,[6] but few focus on the impact of TZDs on M&A activities. Gulamhussen, Hennart and Pinheiro (2016) study the effect of TZDs on cross-border M&A in the banking industry from the communication costs perspective. They find that TZDs among countries are negatively associated with both the probability and the value

[6] See, e.g., Uysal, Kedia and Panchapagesan (2008); Ahern, Daminelli and Fracassi (2012); Erel, Liao and Weisbach (2012); John, Knyazeva and Knyazeva (2015).

creation of cross-border M&A in the banking industry. To my knowledge, this is the first study to present evidence that TZDs incur integration costs in M&A through hindering the real-time cooperation among employees.

The remainder of the paper proceeds as follows. Section 2 describes the model construction and hypotheses development. Section 3 describes the sample construction process and presents descriptive statistics. Section 4 presents and discusses the results of the tests on the hypotheses. Section 5 investigates the post-deal operating performance of combined firms. Section 6 examines layoffs of combined firms and their effect on performance. Section 7 presents additional tests on the cost sharing between acquirers and targets. Section 8 conducts robustness tests. Section 9 concludes.

2. Model and hypotheses development

2.1 A simple model

2.11 Cooperation and synergy

Consider a company employee *i* who has two options: (1) work independently, and his productivity (P_i) is $P_{i,i}$, or (2) cooperate with a coworker *j* in the company, and his productivity is $P_{i,j}$:

$$P_i = \begin{cases} P_{i,i} & \text{if } i \text{ works independently} \\ P_{i,j} & \text{if } i \text{ cooperates with } j \end{cases}. \quad (1)$$

If *i* chooses the second option and cooperates with *j*, their total productivity may increase in the form of synergy:

$$P_{i,j} + P_{j,i} = P_{i,i} + P_{j,j} + Syn_{i,j}, \quad (2)$$

where $Syn_{i,j}$ is the synergy generated from the cooperation between *i* and *j*.

Additionally, $Syn_{i,i} = 0$ and $Syn_{i,j} = Syn_{j,i}$.

2.12 Productivity maximization

Now consider a company with *N* employees. There is synergy matrix that consists of the synergy of all hypothetical employee-pairs within the company:

$$\begin{bmatrix} Syn_{1,1} & Syn_{2,1} & \cdots & Syn_{N,1} \\ Syn_{1,2} & Syn_{2,2} & \cdots & Syn_{N,2} \\ \vdots & \vdots & \ddots & \vdots \\ Syn_{1,N} & Syn_{2,N} & \cdots & Syn_{N,N} \end{bmatrix} \quad (3)$$

The company gathers information about the synergy matrix and makes pairing arrangements to maximize its total employee productivity:

$$\begin{aligned} LP &= \max \sum_{i=1}^{N} P_i \\ &= \sum_{i=1}^{N} P_{i,\tilde{i}} \\ &= \sum_{i=1}^{N} P_{i,i} + \frac{1}{2} \times \sum_{i=1}^{N} Syn_{i,\tilde{i}}, \end{aligned} \tag{4}$$

where LP is the maximized total employee productivity, N is the total number of employees and $\tilde{i}$ indicates the coworker paired with employee i.

The maximization procedure suggests:

$$\frac{\partial \mathrm{E}\left(Syn_{i,\tilde{i}}\right)}{\partial N} > 0. \tag{5}$$

2.13 Employee productivity and mergers and acquisitions

Now consider an acquiring company, whose maximized total employee productivity is

$$LP_{acq} = \sum_{i=1}^{N_{acq}} P_{i,i} + \frac{1}{2} \times \sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{acq}}, \tag{6}$$

and a target company whose maximized total employee productivity is

$$LP_{tar} = \sum_{i=1}^{N_{tar}} P_{i,i} + \frac{1}{2} \times \sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{tar}}, \tag{7}$$

where $\tilde{i}_{acq}$ ($\tilde{i}_{tar}$) represents the coworker paired with employee i within the acquiring (target) firm.

After the acquisition is complete, employees of the acquirer can cooperate with coworkers in the target company. The combined company may adjust the pairing arrangements to increase maximized total productivity. If the acquirer and the target are located in the same time zone, the total employee productivity of the combined company is:

$$LP_{com} = \sum_{i=1}^{N_{acq}} P_{i,i} + \sum_{i=1}^{N_{tar}} P_{i,i} + \frac{1}{2} \times \left(\sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{com}} + \sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{com}} \right), \qquad (8)$$

where $\tilde{i}_{com}$ represents the coworker paired with employee *i* in the combined company.

Now suppose that the acquirer and the target are located in different time zones, with a TZD of D hours. That TZD leads to imperfect employee integration: every work day, there will be D hours during which employees of only one of the combining companies are at work. During those hours, the employees at work can only cooperate with coworkers in their own time zone.

For example, suppose the target is located in Los Angeles and the acquirer is in New York, and the employees of both companies work from 9:00 to 17:00 (local time) every day. Because there is a three-hour TZD, the office hour is 9:00-17:00 (Eastern Time) in New York but 6:00-14:00 (Eastern Time) in Los Angeles. Hence, the two merging companies have only five overlapping office hours. This means that after the acquisition, the two combining companies work cooperatively as a whole for five hours every workday, but independently for the remaining three.

With a *D*-hour TZD between the acquirer and the target, the maximized employee productivity of the combined company is:

$$
\begin{aligned}
LP_{com} &= (1-D/8)\times\left[\sum_{i=1}^{N_{acq}} P_{i,i} + \sum_{i=1}^{N_{tar}} P_{i,i} + 1/2\times\left(\sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{com}} + \sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{com}}\right)\right] \\
&\quad + D/8\times\left(\sum_{i=1}^{N_{acq}} P_{i,i} + 1/2\times\sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{acq}} + \sum_{i=1}^{N_{tar}} P_{i,i} + 1/2\times\sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{tar}}\right) \\
&= LP_{acq} + LP_{tar} \\
&\quad + \left(1-\frac{D}{8}\right)\times\frac{1}{2}\times\left[\sum_{i=1}^{N_{acq}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{acq}}\right) + \sum_{i=1}^{N_{tar}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{tar}}\right)\right]. \qquad (9)
\end{aligned}
$$

Thus, the change in maximized total employee productivity (ΔLP) after the acquisition is:

$$
\begin{aligned}
\Delta LP &= LP_{com} - LP_{acq} - LP_{tar} \\
&= \left(1-\frac{D}{8}\right)\times\frac{1}{2}\times\left[\sum_{i=1}^{N_{acq}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{acq}}\right) + \sum_{i=1}^{N_{tar}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{tar}}\right)\right]. \qquad (10)
\end{aligned}
$$

I denote the average increase of employee synergy in the combined company as $\overline{\Delta Syn}$:

$$
\overline{\Delta Syn} = \frac{1}{2}\times\frac{\sum_{i=1}^{N_{acq}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{acq}}\right) + \sum_{i=1}^{N_{tar}}\left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{tar}}\right)}{N_{com}}. \qquad (11)
$$

2.2 Hypotheses development

2.21 Hypothesis H1

Intuitively, M&A can increase employee productivity because they provide employees with the option to cooperate with new coworkers. Such option has value, which will be discounted if there is a TZD between the two combining companies. Therefore, I expect the time difference to have a negative effect on employee productivity.

Taking the derivative of ΔLP with respect to D in (10), we have:

$$\frac{\partial \Delta LP}{\partial D} = -\frac{1}{8} \times \frac{1}{2} \times \left[\sum_{i=1}^{N_{acq}} \left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{acq}} \right) + \sum_{i=1}^{N_{tar}} \left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{tar}} \right) \right]. \quad (12)$$

Because $\sum_{i=1}^{N_{acq}} \left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{acq}} \right) > 0$ and $\sum_{i=1}^{N_{tar}} \left(Syn_{i,\tilde{i}_{com}} - Syn_{i,\tilde{i}_{tar}} \right) > 0$, we have

$$\frac{\partial \Delta LP}{\partial D} < 0. \quad (13)$$

I use combined CAR as a proxy for expected changes in total productivity (*TP*):

$$CAR = \mathrm{R}\left[\mathrm{E}\left(\Delta TP / TP \right) \right], \ \mathrm{R}' > 0. \quad (14)$$

The total productivity comprises employee productivity (*LP*) and capital productivity (*CP*):

$$TP = LP + CP, \ \Delta TP = \Delta LP + \Delta CP. \quad (15)$$

Therefore,

$$CAR = \mathrm{R}\left[\mathrm{E}\left(\Delta LP / TP \right) + \mathrm{E}\left(\Delta CP / TP \right) \right]. \quad (16)$$

Taking the derivative of *CAR* with respect to *D*, we have:

$$\frac{\partial CAR}{\partial D} = \mathrm{R}' \times \left[\frac{\partial \mathrm{E}\left(\Delta LP \right)}{TP \times \partial D} + \frac{\partial \mathrm{E}\left(\Delta CP \right)}{TP \times \partial D} \right]. \quad (17)$$

Because machines can run beyond office hours without incurring additional costs, I do not expect capital productivity to be affected by the TZD (i.e., $\frac{\partial \mathrm{E}\left(\Delta CP / TP \right)}{\partial D} = 0$). Therefore,

$$\frac{\partial CAR}{\partial D} = \frac{\mathrm{R}'}{TP} \times \frac{\partial \mathrm{E}\left(\Delta LP \right)}{\partial D} < 0. \quad (18)$$

I propose Hypothesis H1:

H1. Combined CAR are negatively associated with the TZD between the acquirer and the target.

2.22 Hypothesis H2a

Because the market value of labor-intensive companies is more sensitive to changes in employee productivity, and because TZDs affect employee productivity only, I expect the market reactions to cross-time-zone M&A to be more negative if the merging companies are labor intensive.

From (11), (12) and (18) we have

$$\begin{aligned}\frac{\partial CAR}{\partial D} &= -\frac{1}{8}\times\frac{\mathrm{R}'}{TP}\times\frac{1}{2}\times\mathrm{E}\left[\sum_{i=1}^{N_{acq}}\left(Syn_{i,\tilde{i}_{com}}-Syn_{i,\tilde{i}_{acq}}\right)+\sum_{i=1}^{N_{tar}}\left(Syn_{i,\tilde{i}_{com}}-Syn_{i,\tilde{i}_{tar}}\right)\right] \\ &= -\frac{\mathrm{R}'}{8}\times\frac{N_{com}}{TP}\times\mathrm{E}\left(\overline{\Delta Syn}\right).\end{aligned} \tag{19}$$

Equation (19) suggests that the negative effect ($\frac{\partial CAR}{\partial D}$) is the product of a negative constant ($-\mathrm{R}'/8$), the labor intensity (N_{com}/TP) and the expected synergy increase per employee [$\mathrm{E}\left(\overline{\Delta Syn}\right)$].

H2a. Controlling for $\mathrm{E}\left(\overline{\Delta Syn}\right)$, the negative association in Hypothesis H1 is stronger in labor-intensive companies (high N_{com}/TP).

2.23 Hypothesis H2b

The total number of employees affects $\mathrm{E}\left(\overline{\Delta Syn}\right)$. As discussed above, the company gathers information about the synergy matrix in (3). As N increases, it becomes more difficult for the company to gather all the information in the synergy matrix, and ultimately the company can only get hold of part of the information. Hence,

$$\frac{\partial}{\partial N}\left[\frac{\partial \mathrm{E}\left(Syn_{i,\tilde{i}}\right)}{\partial N}\right]<0, \tag{20}$$

and

$$\frac{\partial \mathrm{E}\left(\overline{\Delta Syn}\right)}{\partial N_{com}}<0. \tag{21}$$

Therefore, holding N_{com}/TP and N_{acq}/N_{tar} fixed, we have

$$\frac{\partial}{\partial N_{com}}\left(\frac{\partial CAR}{\partial D}\right)>0. \tag{22}$$

H2b. Holding N_{com}/TP and N_{acq}/N_{tar} fixed, the negative association in Hypothesis H1 is stronger if the combined company's number of employees N_{com} is small.

2.24 Hypothesis H2c

The labor distribution between the two combining companies affects $\mathrm{E}\left(\overline{\Delta Syn}\right)$. Suppose the acquirer's number of employees decreases by *n* and the target's increases by the same number. Because the total number of employees remains unchanged, we have:

$$\mathrm{E}\left(\sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{com}} + \sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{com}}\right) = \mathrm{E}\left(\sum_{i=1}^{N_{acq}-n} Syn_{i,\tilde{i}_{com}} + \sum_{i=1}^{N_{tar}+n} Syn_{i,\tilde{i}_{com}}\right). \quad (23)$$

From (5) and (20) we have:

$$\left[\begin{array}{l}\mathrm{E}\left(\sum_{i=1}^{N_{acq}} Syn_{i,\tilde{i}_{acq}}\right) \\ -\mathrm{E}\left(\sum_{i=1}^{N_{acq}-n} Syn_{i,\tilde{i}_{acq}}\right)\end{array}\right] - \left[\begin{array}{l}\mathrm{E}\left(\sum_{i=1}^{N_{tar}+n} Syn_{i,\tilde{i}_{tar}}\right) \\ -\mathrm{E}\left(\sum_{i=1}^{N_{tar}} Syn_{i,\tilde{i}_{tar}}\right)\end{array}\right] \begin{cases} > 0 \text{ if } N_{acq} - n \geq N_{tar} + n \\ < 0 \text{ if } N_{acq} \leq N_{tar} \\ = 0 \text{ if } N_{acq} = N_{tar} + n \end{cases}. \quad (24)$$

Hence,

$$\mathrm{E}\left(\overline{\Delta Syn}^{*}\right) - \mathrm{E}\left(\overline{\Delta Syn}\right) \begin{cases} > 0 \text{ if } N_{acq} - n \geq N_{tar} + n \\ < 0 \text{ if } N_{acq} \leq N_{tar} \\ = 0 \text{ if } N_{acq} = N_{tar} + n \end{cases}, \quad (25)$$

where $\mathrm{E}\left(\overline{\Delta Syn}^{*}\right)$ represents the average increase in employee synergy in the combined company after the employee redistribution.

Equation (25) is equivalent to

$$\frac{\partial \mathrm{E}\left(\overline{\Delta Syn}\right)}{\partial\left[\min(N_{acq}, N_{tar})/N_{com}\right]} > 0. \quad (26)$$

From (19), we have

$$\frac{\partial\left(\frac{\partial CAR}{\partial D}\right)}{\partial\left[\min(N_{acq}, N_{tar})/N_{com}\right]} < 0. \quad (27)$$

H2c. Controlling for N_{com}/TP and N_{com}, the negative association in Hypothesis H1 is stronger if $\min(N_{acq}, N_{tar})/N_{com}$ is large.

2.25 Hypothesis H2d

Employee cooperation in low-value-added industries is very different from that in high-tech industries. In low-value-added industries (e.g., agriculture, mining, and manufacturing), it is more often the case that employees are substitutes for, rather than complements to, each other. Hence, the expected synergy among employees is lower in low-value-added industries than in high-tech industries. Moreover, the cooperation synergy in low-value-added industries, if any, decreases drastically in the physical distance among workers. Therefore, I expect $\mathrm{E}\left(\overline{\Delta Syn}\right)$ to be larger in high-tech industries than in low-value-added industries.

H2d. The negative association in Hypothesis H1 is stronger if the combined company is in high-tech industries.

3. Data, sample and key variables

3.1 Data and sample

The M&A data are from the Security Data Company (SDC) Platinum database. The initial sample consists of all completed public M&A deals in the US from 1990 to 2016. The stock price and accounting data are from the Center for Research in Security Prices (CRSP) and Compustat database. Zip codes of company headquarters provided by SDC and Compustat are matched to their corresponding time zone, longitude, and latitude information.

The deals in the final sample satisfy all of the following criteria:

1. The stock price information is available for both the acquirer and the target.
2. The time zone, latitude, and longitude information are available for both the acquirer and the target.
3. The number of employees is available and is larger than 10 for both the acquirer and the target.
4. Both the acquirer and the target are headquartered in the contiguous US (i.e., Alaska and Hawaii are excluded).
5. The acquirer has not made any other acquisition within 6 months prior to the announcement of the deal.

The final sample consists of 3228 deals. Table 1 shows the sample composition. Panel A presents the sample composition and the means of combined CAR, TZD, and geographic distance by time period. Approximately 60% the deals in the sample are from 1995-2004, which is consistent with the merger wave documented in previous

studies (e.g., Maksimovic, Phillips and Yang 2013; Ahern and Harford 2014). There is no obvious trend in TZD or geographic distance between acquirers and targets across time.

[Insert Table 1 here]

Panel B shows the sample composition by the time zones of acquirers and targets. In 1804 deals, the acquirer and the target are from the same time zone, and in 1040 cases both are from the Eastern Time Zone. About half of the merging companies are from the Eastern Time Zone. Most of the remaining companies are from either the Central or the Pacific Time Zone. Only 265 deals involve companies from the Mountain Time Zone.

Figures 1.1 and 1.2 present the geographic distributions of acquirers and targets. Most companies headquarter in or near metropolises, especially in the Pacific and Mountain Time Zones. In general, the geographic locations of acquirers and targets are dispersed both horizontally and vertically. The figures also show the intensiveness of cross-time-zone M&A activity. As can be observed, companies in the West coast are more likely to engage in cross-time-zone deals.

[Insert Figure 1 here]

3.2 Descriptive statistics

Table 2 reports the summary statistics. Panel A presents the statistics of the three-day (-1, +1) CAR around the deal announcements, calculated using the market model estimated with the return data for 200 trading days, ending 10 days before the announcement date. The combined CAR are the weighted-average CAR for the acquirer and the target. The weights are the market value six trading days before the announcement date. The targets' weights are adjusted for the acquirers' toeholds. During the three-day announcement period, combined firms on average have a CAR of 1.71%. Acquirers on average experience a small drop in stock price, leading to a mean CAR of −1.22%. Target companies earn significantly positive announcement CAR, with a mean of 21.63%. The statistics suggest that although the deals in the sample create shareholder value on average, the targets obtain most of the profits, whereas acquirers typically incur a loss.

[Insert Table 2 here]

Panel B reports statistics on the TZD and the geographic distance between the acquirer and the target. The mean TZD is 0.81 hour. The acquirer and the target are from different time zones in 1424 deals, which accounts for 44% of the sample. The mean and median of geographic distance between the acquirer and the target are 1287 km and 871 km, respectively.

Panel C presents statistics on firm financials. Tobin's Q and return on assets (ROA) are winsorized at the 1% level. Leverage is winsorized between 0 and 1. A median

acquirer is approximately nine (seven) times the size of a median target in terms of both market value (total employees). Compared with acquirers, target companies have lower Tobin's Q and ROA but similar leverage.

Deal characteristics are presented in Panel D. On average, 38.7% of the consideration is paid in cash and 52.1% in stock. The acquirer and the target are from different industries in one-third of the deals. Tender offers comprise 16.7% of the deals and friendly deals make up 99.1%. Only 4.3% of the deals have more than one bidder, and 2.9% are mergers of equals. In 93% of the deals, the acquirer and the target are from different cities, and in 72.2% of the deals, they are from different states.

4. Empirical results of hypotheses tests

4.1 Results for Hypothesis H1

To test Hypothesis H1, I conduct the following regression test:

$$Combined\ CAR=\alpha+\beta_1 Time\ diff+\beta_2 \text{Log}(distance)+\beta_k Controls+Year\ FE+\varepsilon. \quad (28)$$

The logarithm of the great circle distance between the headquarters of the acquirer and that of the target is included in the regression to control for the distance effect. I expect the coefficient estimate on *Time diff* to be negative.

[Insert Table 3 here]

Table 3 presents the regression results. Throughout this paper, I include announcement year fixed-effects, and adjust the standard errors for clustering at the acquirer level. In column (1), I only include *Time diff*, Log(*distance*), firm size controls and year fixed-effects in the regression. In column (2), I add a set of deal-level control variables, including two geographic-proximity measures: *Cross-state* and *Cross-city*. I also control for the differences in social trust, individualism and hierarchy between acquirer and target states, because cultural differences are documented to affect synergy gains in M&A deals (Chakrabarti, Gupta-Mukherjee and Jayaraman 2009; Ahern, Daminelli and Fracassi 2012). In column (3), I additionally control for the acquirers' and targets' Tobin's Q, leverage, and ROA in the year prior to the deal. Consistent with previous studies, the coefficient estimates on control variables suggest that combined

CAR are positively associated with target size, cash payment, tender offers, and acquirer ROA, and are negatively associated with acquirer size, stock payments, friendly deals, and targets' Tobin's Q. The coefficients of other control variables are not significant.

In all specifications, the coefficients on *Time diff* are negative and statistically significant. The estimates are also economically large. The coefficients suggest that a one-hour TZD is associated with a decline of approximately 0.52-0.62% in combined CAR. The impact is substantial, considering the average (median) three-day CAR in the sample is only 1.71% (1.00%).

Previous studies suggest that geographic proximity positively affects block acquisition probability and outcomes (Kang and Kim 2008), acquirer returns in domestic M&A in the US (Uysal, Kedia and Panchapagesan 2008) and the likelihood of cross-border M&A (Erel, Liao and Weisbach 2012). In Table 3, the coefficient estimates on Log(*distance*) are positive in all three columns. This is likely because I include *Time diff* in the regressions and the sample period starts from 1990. I confirm a significant negative association between geographic distance and combined announcement return in an extended sample period of 1980-2016. This is consistent with Carmel and Espinosa (2011)'s view that after the Internet came along, the negative effect of geographic distance decreases, whereas TZDs starts to play a more important role.

In general, the results in Table 3 support Hypothesis H1 that combined CAR are negatively associated with the TZD between the acquirer and the target.

4.2 Testing Hypotheses H2a through H2d

Some may argue that the negative association between combined CAR and TZDs is caused by hindered cooperation between the acquirer's management and that of the target, rather than between the two companies' rank and file employees. This alternative explanation is consistent with Hypothesis H1 but not Hypotheses H2a through H2d.

In this section, for each of the Hypotheses H2a through H2d, I identify deals in which the negative association is expected to amplify and construct a dummy variable *High_Impact* (*Low_Impact*) that equals one (zero) for those deals and zero (one) otherwise. I test the following specification:

$$\begin{aligned} Combined\ CAR = a + b_1 Time\ diff' \ High\_Impact + b_2 Time\ diff' \ Low\_Impact \\ + b_3 High\_Impact + b_4 \text{Log}(distance) + b_k Controls + Year\ FE + e. \end{aligned} \quad (29)$$

4.21 Results for Hypothesis H2a

Hypothesis H2a suggests that the negative association in Hypothesis H1 is stronger when N_{com}/TP is high. Using total sales as a proxy for total productivity, I set *High_Impact* (*Low_Impact*) to one if the ratio of the total number of employees to total sales of the combined firm is above (below) the sample median and zero otherwise, and test specification (29).

The results are in column (1) of Table 4. The estimates of β_1 on *Time diff* × *High_Impact* and β_2 on *Time diff* × *Low_Impact* are both negative, but only β_1 is significant. The magnitude of β_1 is more than two times that of β_2. The results support

Hypothesis H2a that the negative association in Hypothesis H1 is stronger when the combined company is labor intensive.

[Insert Table 4 here]

4.22 Results for Hypothesis H2b

Hypothesis H2b predicts the negative association in Hypothesis H1 to be stronger when the total number of employees is small. To test this hypothesis, I set *High_Impact* (*Low_Impact*) to one if the combined company's total number of employees is below (above) the sample median, and zero otherwise, and test specification (29).

The results are in column (2) of Table 4. The coefficient estimate of β_1 on *Time diff* × *High_Impact* is significantly negative, but β_2 on *Time diff* × *Low_Impact* is insignificant. The results support Hypothesis H2b that the negative impact in H1 is stronger when the total number of employees is small.

An alternative explanation would be that the number of employees is a proxy for geographic diversification: Companies with large employee numbers are likely to have more geographic segments. In this case, the TZD between the headquarters of the acquirer and the target may not be a reliable estimate of the actual TZDs among all segments of the combining companies. The noise in TZD measurement may be the reason for the insignificant results. To test this alternative explanation, I use the number

of geographic segments from Compustat Historical Segment as a proxy for geographic diversification. However, I find no evidence supporting this alternative explanation.[7]

4.23 Results for Hypothesis H2c

As proposed in Hypothesis H2c, the negative association in Hypothesis H1 is stronger when $\min(N_{acq}, N_{tar})/N_{com}$ is large, controlling for *TP* and N_{com}. To test this hypothesis, I set *High_Impact* (*Low_Impact*) to one if $\min(N_{acq}, N_{tar})/N_{com}$ is above (below) the sample median, and zero otherwise, and test specification (29).

The results are in column (3) of Table 4. The estimate of β_1 on *Time diff* × *High_Impact* is negative and significant, and the estimate of β_2 on *Time diff* × *Low_Impact* is negative but insignificant. The results support Hypothesis H2c that the negative impact of TZD on employee productivity is stronger if employees are distributed evenly between the acquirer and the target. The logic behind is straightforward: Most employees' best feasible coworker will be in the same segment if the labor force is concentrated in one of the two merging companies, in which case the negative effect of TZD on employee productivity would be marginal.

4.24 Results for Hypothesis H2d

Masulis, Wang and Xie (2007) suggest that it is difficult for high-technology companies to integrate after M&A because human capital and intellectual property are often lost due to employee turnover after the takeover. Whereas Masulis, Wang and Xie

[7] The results are not tabulated but available upon request.

(2007) argue that employee turnover causes value destruction in high-tech mergers, I conjecture that difficulties in employee cooperation due to TZDs have a similar effect. To test this hypothesis, I set *High_Impact* (*Low_Impact*) to one (zero) if either the acquirer or the target is from high-technology industries and zero (one) otherwise. Following John, Knyazeva and Knyazeva (2015), high technology industries are identified as those with two-digit SIC codes 28, 35, 36, 73, and 87.[8]

Again, I test the regression as in specification (29), and the results are in column (4) of Table 4. The estimate of β_1 on *Time diff* × *High_Impact* is negative and significant, and the estimate of β_2 on *Time diff* × *Low_Impact* is negative but insignificant. The results support Hypothesis H2d that the negative impact of TZDs on employee productivity is stronger if the acquirer or the target is from high-technology industries, in which employee cooperation is expected to generate higher synergy.

Collectively, I find supporting results for all five hypotheses. The results in Section 4.1 suggest a negative association between combined CAR and TZDs, which is not driven by the geographic distance effect. Section 4.2 additionally confirms that the negative association is caused by lower realized synergy from cooperation between the two companies' rank and file employees, not their management.

[8] The results are similar if I use the high-technology industries definition in Masulis, Wang and Xie (2007).

5. Post-deal operating performance of combined companies

A natural question that arises is whether the negative market reactions to cross-time-zone M&A announcements are driven by shareholder overreactions or are reflections of expectations of future firm performance.

To answer this question, I analyze the post-deal operating performance of the combined company after deal completion. Operating performance is measured by industry-adjusted ROA, calculated as earnings before interest and tax (EBIT) over assets minus its industry (three-digit SIC) median.[9]

First, I compare the mean of post-deal operating performance by the TZD, and Figure 2 presents the results. In Figure 2, all ROA are net of the ROA of year 0, which is the deal completion year. The figure suggests that one year after deal completions, the firms that are combined in those deals and have two or three hours of TZDs experience significant decline in their ROA. The drop is as large as 2.5% for firms combined with a three-hour TZD (3-hr firms) and more than 1.5% for 2-hr firms. Then, in the following years, their performance rebounds. That recovery is faster for 3-hr firms, whose performances are already fully recovered in year +3. The recovery seems slower for 2-hr firms, which on average achieve full recovery in year +5.

[Insert Figure 2 here]

[9] The results are similar if ROA is calculated as operating income before depreciation over total assets.

Then I conduct regression analyses in specification (28) but replace the dependent variable with the post-deal operating performance. The results are presented in Panel A of Table 5. In column (1), the dependent variable is the change in ROA from year 0 to +1. The coefficient estimate on *Time diff* is significantly negative, and its economic magnitude is also substantial: Each one-hour TZD is associated with a drop of 0.52% in ROA.

[Insert Table 5 here]

In columns (2) and (3) of Panel A in Table 5, the dependent variables are the one-year changes in ROA from year +1 to +2 and from year +2 to +3, respectively. The coefficient estimates on *Time diff* are both positive and significantly different from zero. The positive coefficients suggest that after a significant decline in year +1, the operating performance of companies combined in cross-time-zone deals rebounds quickly in years +2 and +3.

The results in Panel A of Table 5 are consistent with Figure 2, indicating that the firms combined in cross-time-zone deals experience substantial but transitory deterioration in their operating performance in the first year after deal completion, and that performance recovers in the second and third year.

Then I conduct similar tests as in Table 4 but replace the dependent variable with the change in ROA from year 0 to +1. The results are presented in Panel B of Table 5. In columns (1), (2) and (4), the coefficient estimates on *Time diff* × *High_Impact* are

significantly negative, and those on *Time diff* × *Low_Impact* are negative but insignificant. In column (3), both coefficient estimates on *Time diff* × *High_Impact* and *Time diff* × *Low_Impact* are significantly negative. In general, the results in Panel B of Table 5 indicate that the cross-time-zone deals receiving stronger negative market reactions are also associated with larger operating performance deterioration for the combined firms in year +1. The results support the notion that the negative market reactions to cross-time-zone M&A announcements are reflections of shareholders' expectations of firms' future performance deterioration.

6. Post-deal employee layoffs

As is discussed in the previous section, the operating performance of firms combined in cross-time-zone deals recovers quickly after an initial drop in the first year following deal completions. The quick recovery suggests that corresponding measures may have been taken by those firms to mitigate the employee inefficiency caused by TZDs.

To validate this conjecture, I investigate the layoffs conducted by the combined company after deal completions. Following Atanassov and Kim (2009), layoffs are measured with a dummy variable that equals one if the number of employees decreases by more than 20% in a given year and zero otherwise.[10]

First, I calculate the percentage of firms conducting layoffs after deal completions for each TZD group. Figure 3 shows the results for layoffs that occur in the first, second and third year after deal completions. As can be seen, for 0-hr and 1-hr firms, on average less than 6% of them undertake layoffs each year, whereas each year more than 7% of the 2-hr and 8% of 3-hr firms have layoffs. Specifically, in year +2, more than 10% of 3-hr firms have layoffs.

[Insert Figure 3 here]

Next, I conduct logit regression tests using layoffs as the dependent variable and independent variables in specification (28). Panel A of Table 6 presents the results. The

[10] The results are similar if I use 25% as the cutoff.

dependent variables are layoffs occurring in year +1, +2 and +3, in columns (1) through (3), respectively. Deal characteristics control variables are included in the regressions, but their coefficient estimates are not presented for brevity. The coefficient estimates on *Time diff* are positive in all three columns but are significantly different from zero only in column (1) and in column (2). The results suggest that firms combined across larger TZDs are more likely to undertake layoffs, especially in the second year after their deal completion.

Then I conduct similar tests as in Table 4 and Panel B of Table 5. The dependent variable equals one if the combined firm has a layoff during year +1 to +3, and zero otherwise. The results are presented in Panel B of Table 6. In columns (1) to (3), the coefficient estimates on *Time diff* × *High_Impact* are significantly positive, and those on *Time diff* × *Low_Impact* are positive but insignificant. The results indicate that combined firms that are expected to be strongly affected by TZDs are more likely to conduct layoffs after the deals. In column (4), the coefficient estimate on *Time diff* × *Low_Impact* is significantly positive and the one on *Time diff* × *High_Impact* is positive but insignificant. The results suggest that human capital are more valuable and less replaceable in high-technology firms, and that these firms are less likely to conduct layoffs even though they are expected to have more severe employee coordination problem after cross-time-zone M&A.

[Insert Table 6 here]

Results in Figure 3 and Table 6 provide evidence that cross-time-zone M&A lead to more frequent layoffs. To investigate whether post-deal layoffs effectively reverse the declining operating performance, I test the following specification:

$$\begin{aligned}\Delta ROA=&\alpha+\beta_1 Time\ diff+\beta_2 Time\ diff\times Layoffs+\beta_3 Layoffs\\&+\beta_4\,\mathrm{Log}(distance)+\beta_k Controls+Year\ FE+\varepsilon.\end{aligned}\tag{30}$$

In this specification, the coefficient on *Layoffs* indicates the average effect of layoffs on firm performance, whereas the coefficient on *Time diff* × *Layoffs* indicates the incremental effect of layoffs on firm performance for firms with TZDs.

Table 7 presents the results. In column (1), the dependent variable is the changes in industry-adjusted ROA of the combined firm from year +1 to year +2, and *Layoffs* equals one if the combined firm conducts a layoff in either year +1 or +2 and zero otherwise. Firm size and deal characteristics control variables are included in the regressions, but their coefficient estimates are not presented for brevity. The coefficient estimates on *Time diff* × *Layoffs* and *Time diff* are both positive and significant, whereas the coefficient estimate on *Layoffs* is significant. The coefficient estimate on *Time diff* × *Layoffs* is about three times the size of that on *Time diff*, indicating that a firm's operating performance recovers much faster in year +2 if the firm conducts a layoff in year +1 or +2. In column (2), the dependent variable is the changes in industry-adjusted ROA of the combined firm from year +1 to year +3. *Layoffs* equals one if the combined firm conducts a layoff in year +1, +2, or +3, and zero otherwise. The results are similar to those in column (1), suggesting that layoffs are associated with faster operating performance recovery after cross-time-zone deals.

[Insert Table 7 here]

The results in this section, combined with those in Section 6, provide the following insights: 1. Combined firms with large TZDs experience significant deterioration in their operating performance in the first year after deal completions; 2. Such firms undertake post-deal employee layoffs more frequently than do firms with no TZD; and 3. The layoffs are associated with larger performance recovery for the firms.

7. Additional analysis: Who bears the costs?

The results in Section 4 indicate that the market reacts negatively to mergers of two companies in different time zones, suggesting that there are labor inefficiency costs caused by difficulties in cross-time-zone cooperation. In this section, I investigate how the costs are shared by the acquirer and the target by examining their announcement returns separately.

First, I examine the association between acquirer announcement returns and TZDs. I use the three-day CAR of the acquiring companies as the dependent variable and test specification (28).

The results are presented in Panel A of Table 8. I use the same control variables as in Table 3 but for brevity, the coefficient estimates of firm and deal level controls are not presented. The coefficient estimates on *Time diff* are all negative and significant, suggesting that TZDs also have a negative effect on the acquirers' CAR.

[Insert Table 8 here]

Next, I test the same specification as in (28) but replace the dependent variable with the target firms' three-day CAR. The results are shown in Panel B of Table 8. The coefficient estimates on *Time diff* are negative but not significant in all three columns.

Then I repeat the tests using offer premiums as the dependent variable. Offer premium is calculated as the offer price divided by the target's share price 42 trading days before the announcement of the deal. The results are in Panel C. As is the case

with those in Panel B, the coefficient estimates on *Time diff* are negative but not significant in all three columns.

Taken together, the results in Table 8 suggest that the costs of labor inefficiency caused by TZDs are borne mainly by the acquirers. The targets' shareholders do not seem to suffer negative market reactions in cross-time-zone mergers. The results suggest that acquirers do not lower their offering price in cross-time-zone acquisitions, thereby causing negative market returns on the acquiring firms' stocks but not on the target firm stocks.

One explanation for acquirers' overpayment is that they either overlook the labor inefficiency caused by TZDs or they overestimate their ability to overcome such inefficiency. Another explanation would be that cross-time-zone M&A are often made by acquirers with entrenched management, who understand the low synergy associated with TZDs but pursue such deals regardless. This explanation is consistent with the findings of Harford, Humphery-Jenner and Powell (2012) that entrenched managers choose low-synergy deals and cause value destruction.

8. Robustness tests: alternative time window for the calculation of announcement returns

I use the five days (-2, +2) around the deal announcements as an alternative time window to calculate the CAR, and I use it as the dependent variable to test the specifications in Table 3 and Table 4. The results are presented in Table 9.

[Insert Table 9 here]

In Panel A, the coefficient estimates on *Time diff* are all negative. The estimates are significant in columns (1) and (2) but insignificant in column (3). In Panel B, the coefficient estimates on *Time diff* × *High_Impact* are significantly negative in all four columns, and those on *Time diff* × *Low_Impact* are negative but not significant. In general, the results in Table 3 and 4 remain robust to the alternative time window.

9. Conclusions

In this paper, I investigate the impact of time zone differences (TZDs) between labor segments on firm productivity. By exploiting mergers and acquisitions (M&A) as a quasi-experiment, I provide the first empirical evidence that TZDs among labor segments has a substantial economic impact on employee productivity.

TZDs hinders real-time cooperation among employees. The employee productivity of a company suffers when it has labor segments located in different time zones. A simple model predicts that the TZD between the acquirers and the targets is negatively associated with combined announcement returns of M&A deals. Using a sample of 3228 deals in the US, I find empirical results that are consistent with the model's prediction. Multiple controls and subsample analyses suggest that the negative effect is driven neither by the geographic distance between the acquirer and the target, nor by hindered management cooperation across time zones.

In addition, I find that newly combined firms that have large TZDs experience significant operating performance declines after the deal. Such firms are more likely to conduct layoffs, which are associated with performance recovery.

The paper offers a caveat regarding corporate expansion across time zones. As empirical results suggest, in cross-time-zone M&A, acquirers overpay their targets for the synergy that cannot be fully realized because of the TZD, and in so doing they destroy shareholder value.

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Appendix I. Variable definition

Variables	Definitions	Data sources
Cumulative abnormal return (CAR)	Cumulative abnormal return using the market model estimated using the return data for 200 trading days ending 10 days before the announcement date.	CRSP
Combined CAR	Weighted average CAR for the acquirer and the target. The weights are the market value six trading days before the announcement date. The target's weight is adjusted for the acquirer's toehold.	CRSP
Offer premium	Offer price divided by target's share price 42 days before the announcement date.	SDC, CRSP
Return on assets (ROA)	Earnings before interest and tax over book value of assets.	Compustat
Layoffs	Dummy variable: one if the number of employees decreases by more than 20%, zero otherwise.	Compustat
Time zone difference	The absolute value of time zone difference between the headquarters of the acquirer and the target.	SDC, Compustat
Geographic distance	The great circle distance between the headquarters of the acquirer and the target.	SDC, Compustat
Employee number	Number of employees (Compustat data item 29 × 1000)	Compustat
Market value (MV)	Number of shares outstanding × market price six trading days before the announcement date	CRSP
Total assets	Book value of total assets.	Compustat
Tobin's Q	Market value of assets over book value of assets.	Compustat
Leverage	Book value of debt over book value of assets.	Compustat
% paid in cash	The percentage of consideration paid in cash.	SDC
% paid in stock	The percentage of consideration paid in stock.	SDC
Cross-industry	Dummy variable: one if the acquirer and the target have different two-digit SIC codes.	SDC
Tender offer	Dummy variable: one for tender offers, zero otherwise.	SDC
Friendly deal	Dummy variable: one for friendly deals, zero otherwise.	SDC
Competing deal	Dummy variable: one if there are competing bidders, zero otherwise.	SDC

Merger of equals	Dummy variable: one for merger of equals, zero otherwise.	SDC
Cross-state	Dummy variable: one if the acquirer and the target are in the same state, zero otherwise.	SDC
Cross-city	Dummy variable: one if the acquirer and the target are in the same city, zero otherwise.	SDC
|Trust|	The absolute value of the difference in trust between the states in which the acquirer and the target are located.	World Value Survey
|Hierarchy|	The absolute value of the difference in hierarchy between the states in which the acquirer and the target are located.	World Value Survey
|Individualism|	The absolute value of the difference in individualism between the states in which the acquirer and the target are located.	World Value Survey

Figure 1. Geographic locations of acquirers and targets

This figure presents the geographic locations of acquirers and targets' headquarters. The marker size indicates the activeness of M&A deals in the city. Large circles indicate more M&A deals in the city. The marker color indicates the level of average time zone difference of deals associated with the city. Red, orange and yellow correspond to high, medium and low levels, respectively.

Figure 1.1. Acquirer headquarter locations

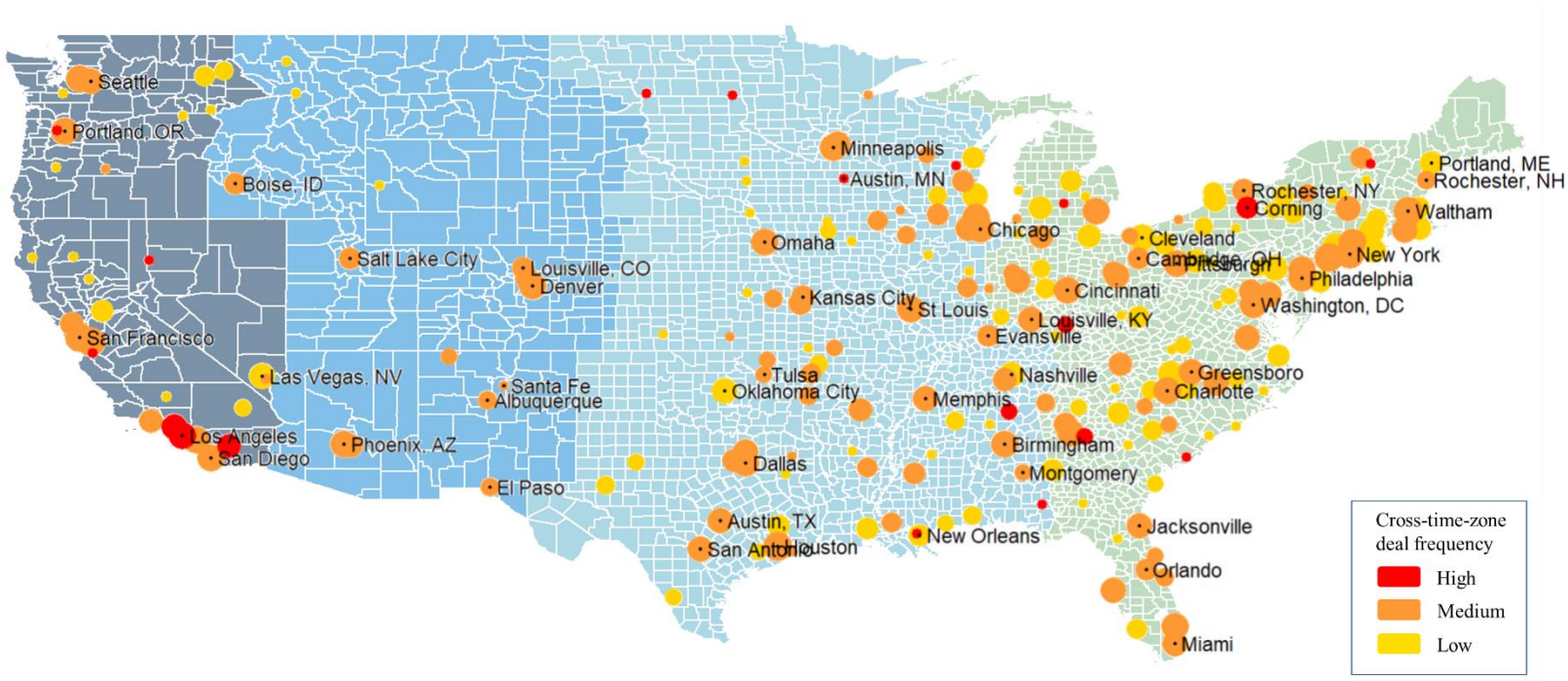

Figure 1.2. Target headquarter locations

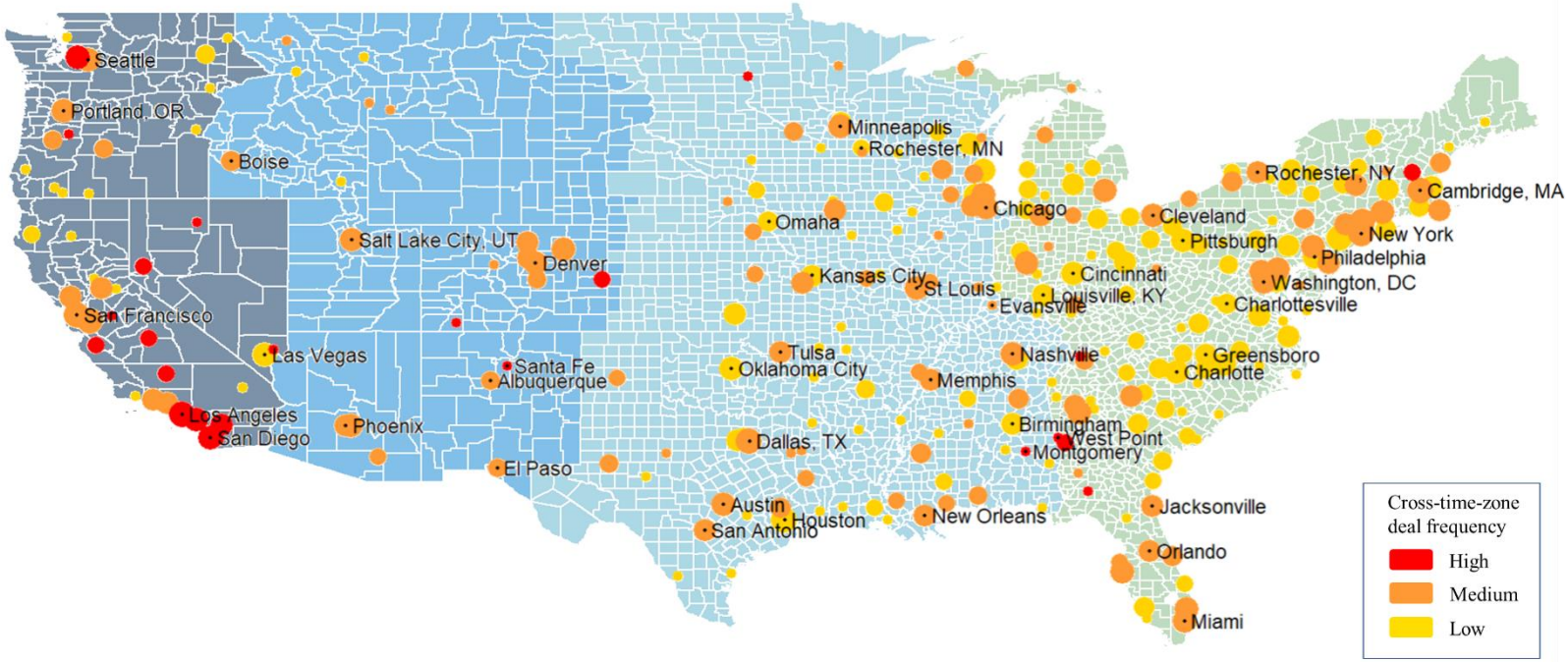

Figure 2. Combined firm return on assets after deal completions, by time zone differences

This figure presents the mean of industry-adjusted return on assets (net of year 0) of the combined company from deal completion to six years after the deal, by the time zone difference between the headquarters of the acquirer and the target.

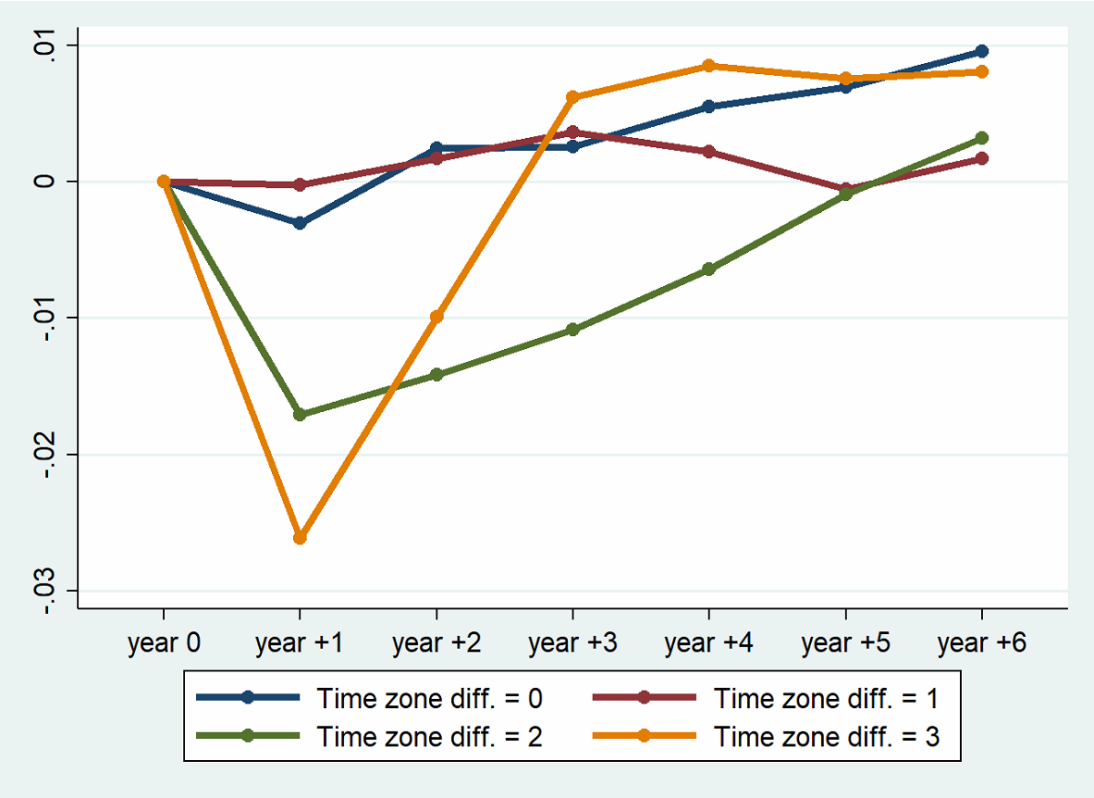

Figure 3. Layoffs after deal completions, by time zone differences

This figure presents the percentage of layoffs that happened during the first, second and third year after deal completions, by the time zone difference between the headquarters of the acquirer and the target.

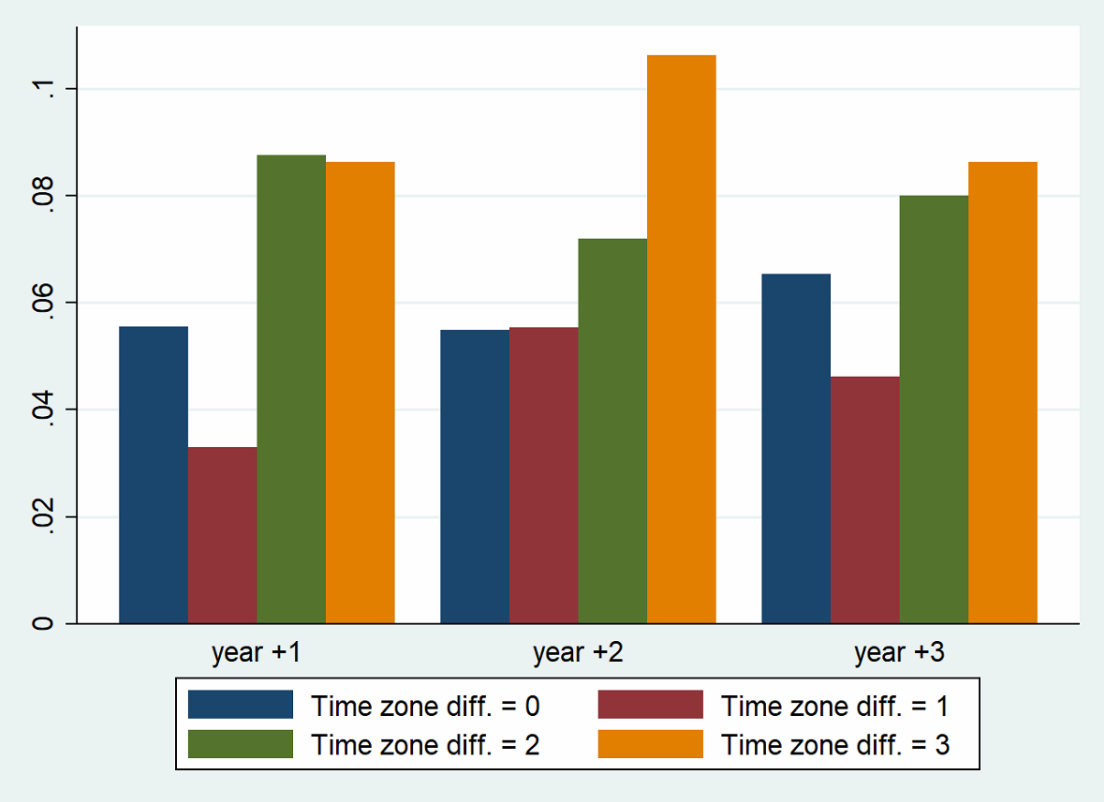

Table 1. Sample composition

Panel A. Number of deals, and the means of time zone differences, geographic distance and combined cumulative abnormal returns for each period

Cumulative abnormal returns (CAR) are from the market model, estimated using the return data for 200 trading days ending 10 days before the announcement date. Combined CAR is the weighted average CAR for the acquirer and the target. The weights are the market value six trading days before the announcement date. Targets' weights are adjusted for the acquirers' toehold. Time zone difference is the absolute value of the time zone difference between the headquarters of the acquirer and the target. Log(distance) is the logarithm of the great circle distance between the headquarters of the acquirer and the target.

Period	Number of deals	Percentage in sample	Time zone difference (hours)	Geographic distance (km)	Combined CAR (-1, +1) (%)
1990-1994	316	9.79%	0.79	1282.13	1.73
1995-1999	1100	34.08%	0.84	1331.39	1.56
2000-2004	795	24.63%	0.83	1287.62	0.44
2005-2009	505	15.64%	0.77	1229.40	1.95
2010-2016	512	15.86%	0.78	1247.36	3.76
Total/Mean	3228	100.00%	0.81	1285.50	1.71

Panel B. Number of deals by time zones of the acquirer and the target

Acquirer time zone	Target time zone				Total
	Eastern (UTC-5)	Central (UTC-6)	Mountain (UTC-7)	Pacific (UTC-8)	
Eastern (UTC-5)	1040	239	61	266	1606
Central (UTC-6)	289	376	46	125	836
Mountain (UTC-7)	34	29	25	37	125
Pacific (UTC-8)	182	83	33	363	661
Total	1545	727	165	791	3228

Table 2. Descriptive statistics

This table presents observations the numbers, means, medians and standard deviations of variables. Cumulative abnormal returns (CAR) are from the market model estimated using the return data for 200 trading days ending 10 days before the announcement date. Combined CAR is the weighted average CAR for the acquirer and the target. The weights are the market value six trading days before the announcement date. Targets' weights are adjusted for the acquirers' toehold. The offer premium is the offer price divided by the target's share price 42 days before the announcement date. Time zone difference is the absolute value of the time zone difference between the headquarters of the acquirer and the target. Log(distance) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I.

Panel A. Cumulative abnormal return (CAR) and offer premium (%)	N	Mean	Median	Std. dev.
Combined CAR (-1, 1)	3228	1.711	1.001	8.010
Acquirer CAR (-1, 1)	3228	-1.217	-0.877	8.784
Target CAR (-1, 1)	3228	22.626	18.041	27.548
Offer premium	3083	44.004	36.924	43.870
Panel B. Time zone differences and distance	N	Mean	Median	Std. dev.
Time zone difference (hour)	3228	0.813	0	1.083
Geographic distance (in thousands km)	3228	1.287	0.871	1.319
Panel C. Company financials[11]	N	Mean	Median	Std. dev.
Acquirer market value (in millions)	3228	13145.8	1784.6	37440.8
Target market value (in millions)	3228	1275.9	194.1	4507.0
Acquirer employee number (in thousands)	3228	20.428	3.700	46.141
Target employee number (in thousands)	3228	3.625	0.575	11.385
Acquirer Tobin's Q	3178	2.667	1.588	5.060
Target Tobin's Q	3106	2.032	1.358	2.557
Acquirer leverage	3178	0.588	0.586	0.250
Target leverage	3106	0.564	0.574	0.272
Acquirer ROA	3089	0.070	0.076	0.116
Target ROA	2865	0.005	0.048	0.199
Panel D. Deal characteristics	N	Mean	Median	Std. dev.
% paid in cash	3228	38.736	10.023	43.763
% paid in stock	3228	52.104	58.782	44.517
High-tech	3228	0.413	0	0.492

[11] Company financials are from the year before deal announcements.

Cross-industry	3228	0.333	0	0.471
Tender offer	3228	0.167	0	0.373
Friendly deal	3228	0.991	1	0.096
Competing deal	3228	0.043	0	0.202
Merger of equals	3228	0.029	0	0.168
Cross-state	3228	0.722	1	0.448
Cross-city	3228	0.930	1	0.256
|Trust|	3228	0.049	0.027	0.058
|Hierarchy|	3228	0.029	0.021	0.037
|Individualism|	3228	0.033	0.015	0.045

Table 3. Combined firm announcement returns and time zone differences

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The dependent variable is the three-day (-1, +1) cumulative abnormal return (%) of the combined company around the M&A announcement. Cumulative abnormal returns (CAR) are from the market model estimated using the return data 200 trading days ending 10 days before the announcement date. Combined CAR is the weighted average CAR for the acquirer and the target. The weights are the market value six trading days before the announcement date. Targets' weights are adjusted for the acquirers' toehold. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Variable	(1)	(2)	(3)
Time diff	-0.619***	-0.591***	-0.522**
	(-3.477)	(-3.097)	(-2.546)
Log(distance)	0.215**	0.155	0.123
	(2.456)	(1.176)	(0.830)
Log(acquirer MV)	-0.900***	-1.192***	-1.176***
	(-8.319)	(-10.483)	(-8.886)
Log(target MV)	0.341***	0.619***	0.616***
	(3.369)	(5.828)	(4.550)
% paid in cash		0.020***	0.024***
		(3.366)	(3.593)
% paid in stock		-0.022***	-0.017***
		(-3.689)	(-2.646)
Cross-industry		0.103	0.132
		(0.360)	(0.426)
Tender offer		0.625	0.782*
		(1.590)	(1.879)
Friendly deal		-2.024	-1.969
		(-1.553)	(-1.435)
Competing deal		-0.069	-0.005
		(-0.109)	(-0.008)
Merger of equals		0.689	0.310
		(0.630)	(0.245)
Cross-state		0.310	0.387
		(0.668)	(0.706)
Cross-city		-0.831	-0.799
		(-1.168)	(-1.000)

|Trust|		-3.400 (-0.843)	-1.701 (-0.391)
|Hierarchy|		-2.080 (-0.399)	-2.653 (-0.469)
|Individualism|		5.654 (1.205)	4.038 (0.823)
Acquirer Tobin's Q			-0.353 (-0.846)
Target Tobin's Q			-0.563 (-1.510)
Acquirer leverage			0.031 (1.410)
Target leverage			-0.005 (-0.447)
Acquirer ROA			1.673* (1.845)
Target ROA			-0.282 (-0.389)
Constant	4.362*** (3.508)	8.454*** (4.621)	7.302*** (3.533)
Observations	3228	3228	2800
Adjusted R^2	0.060	0.110	0.116
Year FE	Yes	Yes	Yes

Table 4. Combined firm announcement returns and time zone differences interacted with dummy variables

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The dependent variable is the three-day (-1, +1) cumulative abnormal return (%) of the combined company around the M&A announcement. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. In column (1), *High_Impact* equals one if the ratio of total employee number to total sales of the combined firm is above the sample median, and zero otherwise. In column (2), *High_Impact* equals one if the total number of employees of the combined company is below the sample median, and zero otherwise. In column (3), *High_Impact* equals one if $\min(N_{acq}, N_{tar})/N_{com}$ is above the sample median, and zero otherwise. In column (4), *High_Impact* equals one if the acquirer or the target is from high-technology industries (two-digit SIC codes 28, 35, 36, 73, and 87), and zero otherwise. *Low_Impact* equals one minus *High_Impact*. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)
	High_Impact=			
Variable	High labor intensity	Small employee number	High labor balance	High-tech industries
Time diff×High_Impact	-0.829***	-0.945***	-1.005***	-0.821***
	(-3.364)	(-3.488)	(-3.542)	(-3.231)
Time diff×Low_Impact	-0.329	-0.161	-0.244	-0.250
	(-1.534)	(-0.837)	(-1.311)	(-1.192)
High_Impact	0.145	0.148	0.154	0.155
	(1.098)	(1.122)	(1.169)	(1.178)
Log(distance)	0.232	-0.810*	1.282***	-0.441
	(0.657)	(-1.903)	(3.394)	(-1.147)
Log(acquirer MV)	-1.208***	-1.397***	-1.080***	-1.171***
	(-10.496)	(-10.484)	(-8.054)	(-10.072)
Log(target MV)	0.621***	0.597***	0.521***	0.577***
	(5.792)	(5.542)	(4.354)	(5.321)
% paid in cash	0.020***	0.022***	0.021***	0.022***
	(3.250)	(3.577)	(3.519)	(3.664)
% paid in stock	-0.023***	-0.018***	-0.022***	-0.020***
	(-3.761)	(-2.945)	(-3.678)	(-3.315)
Cross-industry	0.083	-0.013	0.095	0.277
	(0.288)	(-0.046)	(0.332)	(0.940)
Tender offer	0.673*	0.642	0.605	0.715*
	(1.714)	(1.642)	(1.541)	(1.808)
Friendly deal	-1.991	-1.931	-2.022	-2.250*
	(-1.520)	(-1.487)	(-1.594)	(-1.745)

Competing deal	-0.126 (-0.198)	-0.169 (-0.271)	-0.154 (-0.242)	-0.173 (-0.275)
Merger of equals	0.666 (0.608)	0.467 (0.426)	0.521 (0.474)	0.680 (0.622)
Cross-state	0.332 (0.714)	0.304 (0.656)	0.360 (0.773)	0.302 (0.649)
Cross-city	-0.812 (-1.141)	-0.788 (-1.114)	-0.814 (-1.146)	-0.824 (-1.158)
|Trust|	-3.695 (-0.915)	-3.958 (-0.979)	-3.576 (-0.888)	-3.674 (-0.911)
|Hierarchy|	-1.601 (-0.306)	-1.838 (-0.354)	-1.803 (-0.346)	-1.528 (-0.295)
|Individualism|	5.885 (1.252)	5.831 (1.246)	5.965 (1.275)	5.248 (1.123)
Constant	8.568*** (4.549)	10.008*** (5.151)	7.374*** (4.014)	8.477*** (4.669)
Observations	3225	3228	3228	3228
Adjusted R^2	0.111	0.117	0.114	0.114
Year FE	Yes	Yes	Yes	Yes

Table 5. Post-deal operating performance of the combined company and time zone differences

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The dependent variable is the change in industry-adjusted (three-digit SIC) return on assets (ROA) of the combined company. Year 0 is the deal completion year. ROA is calculated as earnings before interest and tax over assets. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. In column (1) of Panel B, *High_Impact* equals one if the ratio of total employee number to total sales of the combined firm is above the sample median, and zero otherwise. In column (2) of Panel B, *High_Impact* equals one if the total number of employees of the combined company is below the sample median, and zero otherwise. In column (3) of Panel B, *High_Impact* equals one if $\min(N_{acq}, N_{tar})/N_{com}$ is above the sample median, and zero otherwise. In column (4) of Panel B, *High_Impact* equals one if the acquirer or the target is from high-technology industries (two-digit SIC codes 28, 35, 36, 73, and 87), and zero otherwise. *Low_Impact* equals one minus *High_Impact*. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I. In Panel B, deal characteristics control variables are included but their coefficient estimates are not presented for brevity. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A. Change in return on assets and time zone differences

	(1)	(2)	(3)
		ΔROA (%)	
Variable	From year 0 to +1	From year +1 to +2	From year +2 to +3
Time diff	-0.524***	0.477***	0.404***
	(-2.681)	(2.784)	(2.706)
Log(distance)	-0.035	-0.131	0.092
	(-0.276)	(-1.077)	(0.906)
Log(acquirer MV)	0.097	-0.334***	-0.080
	(1.129)	(-4.226)	(-1.250)
Log(target MV)	0.098	0.279***	0.109
	(1.064)	(3.231)	(1.577)
% paid in cash	-0.005	0.007	-0.001
	(-0.935)	(1.401)	(-0.156)
% paid in stock	-0.019***	0.008	0.000
	(-3.434)	(1.455)	(0.072)
Cross-industry	0.068	0.041	-0.020
	(0.238)	(0.157)	(-0.089)
Tender offer	-0.359	-0.809**	0.346
	(-1.117)	(-2.488)	(1.205)
Friendly deal	1.415	-1.427**	-0.943
	(0.948)	(-2.094)	(-0.992)
Competing deal	0.770	-0.505	-0.757*

	(1.452)	(-1.009)	(-1.709)
Merger of equals	1.023	-0.672	0.941
	(1.561)	(-0.877)	(1.416)
Cross-state	-0.053	0.125	-0.178
	(-0.119)	(0.290)	(-0.498)
Cross-city	1.152*	0.421	0.349
	(1.735)	(0.654)	(0.592)
|Trust|	0.665	-0.294	1.208
	(0.168)	(-0.083)	(0.340)
|Hierarchy|	4.753	-4.747	-3.093
	(0.967)	(-1.027)	(-0.715)
|Individualism|	2.030	-0.447	-2.733
	(0.464)	(-0.115)	(-0.725)
Constant	-5.161**	2.426**	0.711
	(-2.404)	(1.976)	(0.437)
Observations	2887	2632	2402
Adjusted R^2	0.030	0.013	0.018
Year FE	Yes	Yes	Yes

Panel B. Changes in return on assets from year 0 to +1 and time zone differences interacted with dummy variables

	(1)	(2)	(3)	(4)
	ΔROA (%) from year 0 to +1			
	High_Impact=			
Variable	High labor intensity	Small employee number	High labor balance	High-tech industries
Time diff×High_Impact	-0.745***	-0.698**	-0.518*	-0.620**
	(-2.872)	(-2.403)	(-1.842)	(-2.252)
Time diff×Low_Impact	-0.282	-0.289	-0.519**	-0.273
	(-1.310)	(-1.579)	(-2.529)	(-1.415)
High_Impact	-0.028	-0.045	-0.036	-0.043
	(-0.226)	(-0.359)	(-0.284)	(-0.346)
Log(distance)	0.019	-0.767*	-0.551	-1.189***
	(0.055)	(-1.851)	(-1.590)	(-3.144)
Log(acquirer MV)	0.063	-0.056	0.000	0.139
	(0.701)	(-0.558)	(0.003)	(1.588)
Log(target MV)	0.110	0.077	0.180*	0.032
	(1.192)	(0.812)	(1.709)	(0.340)

Constant	-4.912** (-2.163)	-3.918* (-1.799)	-4.542** (-2.114)	-5.033** (-2.369)
Observations	2884	2887	2887	2887
Adjusted R^2	0.031	0.034	0.030	0.040
Deal characteristics	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 6. Post-deal layoffs, and time zone differences

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The logistic regression model is used in this table. In Panel A, the dependent variable is the layoffs in the combined company in years +1, +2 and +3, in columns (1), (2) and (3), respectively. Year 0 is the deal completion year. *Layoffs* is an indicator variable that equals one if the number of employees decreases by more than 20% during the year and zero otherwise. In Panel B, the dependent variable equals one if the combined firm has a layoff during year +1 to +3 and zero otherwise. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. In column (1) of Panel B, *High_Impact* equals one if the ratio of total employee number to total sales of the combined firm is above the sample median, and zero otherwise. In column (2) of Panel B, *High_Impact* equals one if the total number of employees of the combined company is below the sample median, and zero otherwise. In column (3) of Panel B, *High_Impact* equals one if $\min(N_{acq}, N_{tar})/N_{com}$ is above the sample median, and zero otherwise. In column (4) of Panel B, *High_Impact* equals one if the acquirer or the target is from high-technology industries (two-digit SIC codes 28, 35, 36, 73, and 87), and zero otherwise. *Low_Impact* equals one minus *High_Impact*. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Deal characteristics control variables are included but their coefficient estimates are not presented for brevity. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A.

	(1)	(2)	(3)
		Layoffs	
Variable	Year +1	Year +2	Year +3
Time diff	0.208*	0.265**	0.121
	(1.706)	(2.329)	(1.009)
Log(distance)	0.006	-0.023	0.042
	(0.066)	(-0.254)	(0.428)
Log(acquirer MV)	-0.210***	-0.183***	-0.321***
	(-3.934)	(-3.308)	(-5.217)
Log(target MV)	0.021	0.093	0.162**
	(0.316)	(1.472)	(2.338)
Constant	-2.767**	-2.833***	-2.794
	(-2.089)	(-3.289)	(-1.620)
Observations	2755	2591	2351
Pseudo R^2	0.081	0.072	0.070
Deal characteristics	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Panel B. Layoffs and time zone differences interacted with dummy variables

	(1)	(2)	(3)	(4)
		Layoffs in year +1 to +3		

Variable	High_Impact= High labor intensity	Small employee number	High labor balance	High-tech industries
Time diff×High_Impact	0.227***	0.192**	0.181*	0.039
	(2.615)	(2.088)	(1.946)	(0.440)
Time diff×Low_Impact	0.054	0.098	0.123	0.250***
	(0.508)	(1.004)	(1.328)	(2.633)
High_Impact	0.014	0.019	0.019	0.021
	(0.220)	(0.301)	(0.298)	(0.342)
Log(distance)	-0.023	-0.011	-0.110	0.655***
	(-0.147)	(-0.057)	(-0.659)	(4.112)
Log(acquirer MV)	-0.227***	-0.223***	-0.245***	-0.249***
	(-5.220)	(-4.957)	(-4.856)	(-5.983)
Log(target MV)	0.087*	0.082*	0.091*	0.100**
	(1.821)	(1.685)	(1.656)	(2.081)
Constant	-1.959**	-1.919**	-1.773*	-1.999**
	(-2.043)	(-1.987)	(-1.849)	(-2.057)
Observations	2914	2916	2916	2916
Pseudo R^2	0.068	0.066	0.066	0.074
Deal characteristics	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 7. Post-deal layoffs and operating performance recovery

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). In column (1) the dependent variable is the change in industry-adjusted (three-digit SIC) return on assets (ROA) (%) of the combined company from year +1 to year +2, where year 0 is the deal completion year. In column (2) the dependent variable is the change in industry-adjusted ROA of the combined company from year +1 to year +3. ROA is calculated as earnings before interest and tax over assets. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. *Layoffs* is an indicator variable that equals one if the combined company experiences a layoff (decreases in employee number by more than 20%) in either year +1 or +2 in column (1), and in year +1, +2 or +3 in column (2), and zero otherwise. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Deal characteristics control variables are included but their coefficient estimates are not presented for brevity. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1)	(2)
	ΔROA (%)	
Variable	From year +1 to +2	From year +1 to +3
Time diff	0.330*	0.628***
	(1.921)	(2.633)
Time diff×Layoffs	1.103**	1.701**
	(1.984)	(2.278)
Layoffs	0.899	0.359
	(1.168)	(0.415)
Log(distance)	-0.143	-0.068
	(-1.170)	(-0.401)
Log(acquirer MV)	-0.289***	-0.338***
	(-3.635)	(-2.912)
Log(target MV)	0.251***	0.401***
	(2.919)	(3.207)
Constant	2.373*	3.011
	(1.955)	(1.285)
Observations	2591	2377
Adjusted R^2	0.026	0.032
Deal characteristics	Yes	Yes
Year FE	Yes	Yes

Table 8. Acquirer and target announcement return, offer premium and time zone difference

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The dependent variable in Panel A is the three-day (-1, +1) cumulative abnormal return (%) of the acquiring firms around the M&A announcement. The dependent variable in Panel B is the three-day (-1, +1) cumulative abnormal return (%) of the target firms around the M&A announcement. The dependent variable in Panel C is the offer premium (%), calculated as the offer price divided by the target's share price 42 trading days before deal announcement. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I. Control variables included are presented at the bottom. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A. Acquirer announcement returns and time zone differences

	(1)	(2)	(3)
Variable	Acquirer CAR (-1, +1) (%)		
Time diff	-0.586*** (-2.800)	-0.542** (-2.447)	-0.447** (-2.066)
Log(distance)	0.202** (1.967)	0.202 (1.384)	0.214 (1.343)
Log(acquirer MV)	0.065 (0.481)	-0.102 (-0.752)	-0.098 (-0.714)
Log(target MV)	-0.591*** (-5.871)	-0.459*** (-4.355)	-0.370*** (-2.692)
Constant	-0.644 (-0.430)	1.649 (0.886)	-0.577 (-0.277)
Observations	3228	3228	2800
Adjusted R^2	0.029	0.063	0.082
Deal characteristics	No	Yes	Yes
Firm financials	No	No	Yes
Year FE	Yes	Yes	Yes

Panel B. Target announcement returns and time zone differences

Variable	(1)	(2)	(3)
	Target CAR (-1, +1) (%)		
Time diff	-0.891 (-1.571)	-0.737 (-1.138)	-0.668 (-0.923)
Log(distance)	0.480* (1.785)	0.342 (0.768)	0.068 (0.132)

Log(acquirer MV)	4.539*** (11.650)	3.763*** (9.494)	3.907*** (8.728)
Log(target MV)	-6.240*** (-14.168)	-5.466*** (-11.740)	-5.733*** (-11.605)
Constant	18.442*** (3.773)	28.597*** (4.784)	32.122*** (4.918)
Observations	3228	3228	2800
Adjusted R^2	0.136	0.164	0.166
Deal characteristics	No	Yes	Yes
Firm financials	No	No	Yes
Year FE	Yes	Yes	Yes

Panel C. Offer premium and time zone differences

Variable	(1)	(2)	(3)
	Offer premium (%)		
Time diff	-0.056 (-0.057)	0.262 (0.240)	-0.376 (-0.319)
Log(distance)	0.290 (0.672)	0.627 (0.856)	0.409 (0.502)
Log(acquirer MV)	4.661*** (8.252)	4.104*** (7.082)	3.595*** (5.096)
Log(target MV)	-7.305*** (-12.193)	-6.588*** (-10.446)	-6.410*** (-8.675)
Constant	48.379*** (5.263)	54.549*** (4.979)	57.191*** (4.748)
Observations	3083	3083	2667
Adjusted R^2	0.083	0.098	0.104
Deal characteristics	No	Yes	Yes
Firm financials	No	No	Yes
Year FE	Yes	Yes	Yes

Table 9. Alternative time window for announcement return calculation

The sample consists of 3228 public mergers and acquisitions (M&A) in the US completed between 1990 and 2016 (from SDC). The dependent variable is the five-day (-2, +2) cumulative abnormal return (%) of the combined company around the M&A announcement. *Time diff* is the absolute value of the time zone difference between the headquarters of the acquirer and the target. In column (1) of panel B, *High_Impact* equals one if the ratio of total number of employees to total sales of the combined firm is above the sample median, and zero otherwise. In column (2) of panel B, *High_Impact* equals one if the total number of employees of the combined company is below the sample median and zero otherwise. In column (3) of panel B, *High_Impact* equals one if $\min(N_{acq}, N_{tar})/N_{com}$ is above the sample median and zero otherwise. In column (4) of panel B, *High_Impact* equals one if the acquirer or target is from high high-technology industries (two-digit SIC codes 28, 35, 36, 73, and 87) and zero otherwise. *Low_Impact* equals one minus *High_Impact*. Log(*distance*) is the logarithm of the great circle distance between the headquarters of the acquirer and the target. Other variables are defined in Appendix I. Control variables included are presented at the bottom. Announcement year fixed effects are included. Standard errors are adjusted for clustering on acquirers, and *t*-statistics are presented in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A. Combined announcement returns (-2, +2) and time zone differences

Variable	(1)	(2)	(3)
Time diff	-0.558***	-0.492**	-0.360
	(-2.805)	(-2.270)	(-1.552)
Log(distance)	0.165*	-0.001	-0.123
	(1.676)	(-0.008)	(-0.736)
Log(acquirer MV)	-0.949***	-1.248***	-1.257***
	(-7.839)	(-9.867)	(-8.596)
Log(target MV)	0.344***	0.623***	0.585***
	(3.048)	(5.238)	(3.852)
Constant	5.011***	9.210***	8.352***
	(3.549)	(4.593)	(3.652)
Observations	3228	3228	2800
Adjusted R^2	0.052	0.092	0.096
Deal characteristics	No	Yes	Yes
Firm financials	No	No	Yes
Year FE	Yes	Yes	Yes

Panel B. Combined announcement returns (-2, +2) and time zone differences interacted with dummy variables

	(1)	(2)	(3)	(4)
	High_Impact=			
Variable	High labor intensity	Small employee number	High labor balance	High-tech industries
Time diff×High_Impact	-0.859***	-0.809***	-0.833***	-0.671**

	(-3.103)	(-2.631)	(-2.616)	(-2.297)
Time diff×Low_Impact	-0.115 (-0.469)	-0.067 (-0.306)	-0.209 (-0.981)	-0.191 (-0.816)
High_Impact	-0.001 (-0.010)	-0.013 (-0.087)	-0.002 (-0.011)	-0.002 (-0.016)
Log(distance)	0.047 (0.120)	-1.298*** (-2.779)	1.186*** (2.746)	-0.638 (-1.467)
Log(acquirer MV)	-1.289*** (-10.071)	-1.511*** (-10.314)	-1.132*** (-7.397)	-1.222*** (-9.430)
Log(target MV)	0.619*** (5.173)	0.585*** (4.867)	0.522*** (3.828)	0.577*** (4.765)
Constant	9.726*** (4.728)	11.354*** (5.265)	8.171*** (4.001)	9.275*** (4.644)
Observations	3225	3228	3228	3228
Adjusted R^2	0.095	0.100	0.094	0.095
Deal characteristics	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes