

Do Acquisitions Relieve Target Firms' Financial Constraints?

ISIL EREL, YEEJIN JANG, and MICHAEL S. WEISBACH*

ABSTRACT

Managers often claim that target firms are financially constrained prior to being acquired and that these constraints are eased following the acquisition. Using a large sample of European acquisitions, we document that the level of cash that target firms hold, the sensitivity of cash to cash flow, and the sensitivity of investment to cash flow all decline, while investment increases following the acquisition. These effects are stronger in deals that are more likely to be associated with financing improvements. Our findings suggest that acquisitions relieve financial frictions in target firms, especially when the target firm is relatively small.

IN A WORLD WITH imperfect capital markets, firms sometimes face financial constraints and have to forgo valuable investment opportunities. For firms in this situation, an acquisition can potentially mitigate such constraints if the acquirer's access to capital enables the target to undertake an increased number of positive net present value investments. Being part of a larger organization subsequent to an acquisition can improve financing through better direct access to capital markets, and also by the possibility of a reallocation of capital across divisions (see, e.g., Stein (2003)). Accordingly, practitioners often justify acquisitions by claiming that acquirers can better expand the target's operations because of both their internally generated cash flow and their ability to raise capital externally.¹ Yet despite the enormous literature on mergers

*Isil Erel is with Ohio State University, Yeejin Jang is with Purdue University, and Michael S. Weisbach is with Ohio State University, NBER, and SIFR. Isil Erel and Michael Weisbach are Fellows of the National Center for the Middle Market at the Fisher College of Business, Ohio State University, and acknowledge the Center's support for this research. We thank Heitor Almeida, Bo Becker, Murillo Campello, Panagiotis Dontis Charitos, Serdar Dinc, Mara Faccio, Joan Farre-Mensa, Antonio Galvao, Shan Ge, Cam Harvey, Jerry Hoberg, Byoung-Hyoun Hwang, Andrew Karolyi, Sandy Klasa, David McLean, Berk Sensoy, René Stulz, Tracy Wang, Jun Yang, two referees, an Associate Editor, as well as seminar participants at Amsterdam, Boston College, Brandeis, Cornell, Michigan, Minnesota, Nanyang Technical University, National University of Singapore, Northeastern, Ohio State, Singapore Management University, Purdue, European Winter Finance Summit 2013, UBC Winter Finance Conference, FIRS 2013 Conference, and the 2013 Multinational Finance Society Conference for helpful suggestions. We received excellent research assistance from Jongsik Park.

¹For example, the *Financial Times* reported that AstraZeneca and Glaxo SmithKline were looking to acquire smaller biotech companies during the financial crisis because they were better

DOI: 10.1111/jofi.12155

and acquisitions, the extent to which acquisitions lower financial constraints is unknown.

One potential reason financial constraints in target firms have not been evaluated empirically is that the implications of financial constraints concern the financial policies of the target firm and the way in which they change following the acquisition. Evaluating these predictions requires financial data on target firms before and after the acquisition. In the United States, such data are not publicly available. However, most European countries require disclosure of financial data for subsidiaries, so it is possible to observe the financial statements of targets both before and after they are acquired, as long as the target remains an independent subsidiary following the acquisition.

Because of this disclosure requirement, we are able to construct a sample of 5,187 European acquisitions occurring from 2001 to 2008, each of which became a wholly owned subsidiary subsequent to the acquisition. This sample contains both domestic (63%) and cross-border (37%) deals, and acquisitions by both public (36%) and private (64%) firms. Most of the targets (97.4%) are private firms; 71.6% are independent firms, while the remaining targets are subsidiaries of other firms prior to the acquisition. We measure the target firms' cash and investment policies before and after the acquisition, and evaluate the extent to which the acquisition led to improved access to capital.

To assess whether financial constraints are mitigated by acquisitions requires that one can measure constraints in a particular target firm both before and after being acquired. While there are many ways to measure financial constraints, particularly useful ones come from observing managers' own actions regarding their financial position. When access to capital markets is imperfect, value maximization will lead managers to adopt financial policies that ensure that the most important investments continue to be financed. One such policy is to hold more cash on the balance sheet, so cash holdings should be higher when managers believe they face greater financial constraints.² In addition, the literature argues that, when faced with financial constraints, the effect of a firm's incremental cash flow on both investment and cash holdings should be higher (see Fazzari, Hubbard, and Petersen (1988) and Almeida, Campello, and Weisbach (2004)).³ Therefore, a decline in the target's cash holdings, investment–cash flow sensitivity, and cash–cash flow sensitivity following an acquisition would suggest that the target's financial constraints are reduced when a target is acquired.

able to fund those companies' investments than potential targets could do on their own. (*Financial Times*, September 25, 2009)

² This argument dates to Keynes (1936) and has been developed and confirmed empirically in a recent literature beginning with Opler et al. (1999). For a practitioner's take on this argument, see Passov (2003), who argues that precautionary considerations are relevant even for large companies like Pfizer, which at the time this article was written had a AAA bond rating.

³ The issue of measuring financial constraints is controversial and each measure has limitations, which are discussed below in Section I.E. Our approach is to use alternative measures in the hope that any concerns about one measure are alleviated by the fact that using other measures leads to similar results.

Using the above measures, we evaluate the extent to which target firms are financially constrained prior to being acquired, and the extent to which these constraints are reduced subsequent to the acquisition. The results suggest that target firms are indeed constrained prior to the acquisition, and that the constraints are lessened after the firms are acquired. In particular, we find that cash holdings, normalized by assets, decline by approximately 1.5% for an average target firm after being acquired. The sensitivity of cash to cash flow declines significantly from 10.4% to close to zero, which implies that the target firm goes from being constrained to unconstrained (see Almeida, Campello, and Weisbach (2004)). Finally, there is a statistically significant decline in the sensitivity of investment to cash flow, with the magnitude of the postacquisition sensitivity being less than half of that before the acquisition. All of these results are consistent with the view that acquisitions mitigate financial constraints, potentially providing a source of value by enabling target firms to improve their investment policy.

An implication of the financing view of acquisitions is that investment should rise following the acquisition. The results suggest that investment does increase for target firms in our sample. Controlling for other factors, investment as a fraction of total assets increases by 1.56% to 2% following the acquisition, which is a substantial effect given that the mean (median) investment ratio is 6.4% (3.4%) for targets before the acquisition.

If the estimated declines in cash holdings and the sensitivities of investment and cash to cash flow reflect the easing of financial constraints because of the acquisition, then these declines should be larger following acquisitions that are more likely to increase the ability of firms to finance investment. For example, the decline in cash holdings and sensitivities should be larger following acquisitions of independent firms than following acquisitions of subsidiaries of other firms. Consistent with this prediction, we find that, for independent targets, their cash-to-asset ratio decreases by 1.8%, the cash flow sensitivity of cash decreases by 8.2%, and the cash flow sensitivity of investment decreases by 5.2%. Each of these declines is statistically significantly different from zero. We do not find significant changes in the cash-to-asset ratio or either sensitivity when the target firm is a subsidiary of another firm. Overall, these findings are consistent with independent targets being more financially constrained than subsidiary targets prior to being acquired.

Furthermore, we expect these declines to be larger when targets are smaller. Consistent with this logic, the reduction in cash-to-asset ratio is statistically significant only for the subsample of the smaller targets, with an estimated decline of 2.4% for the bottom tercile of firms ranked by asset size. The cash flow sensitivities of cash and investment also decline by 7.3% and 7.8%, respectively, after the acquisition for this subsample of firms. For the largest tercile of firms, there are no significant declines for any of these variables. We note that the smallest tercile contains very small firms, with a median asset size of just \$2.6 million. Thus, the reduction in financial constraints appears to be most important for very small targets.

Overall, the results suggest that managers of acquired firms change their financial policies in a manner consistent with their becoming less financially constrained following the acquisition. Target firms hold less cash, they save less cash out of incremental cash flows, their investment tends to be less correlated with cash flows, and they increase the quantity of their investments after they are acquired. These effects are larger when the target is most likely to be constrained prior to the acquisition. Presumably, the parent's cash flows and access to capital markets allow the target firm to manage its financial position more efficiently.

This paper contributes to a long line of research on the motives for mergers and acquisitions. Early work in this area documents value increases associated with mergers, taking the form of stock price increases as well as improved earnings for the combined firm relative to pre-merger levels.⁴ Subsequent work focuses on the sources of their gains. For a long time, the presumed source was efficiency gains. But the existence of efficiency gains was not empirically verified until plant-level data on production efficiency were available.⁵ In addition, the literature has documented relatively small transfers to shareholders from other stakeholders such as employees, the government, and consumers.⁶ In terms of sources of gains arising from inefficiencies, the dramatic stock price increases of the 1990s prompted much work on price inefficiency as a motive.⁷ Yet there has been surprisingly little work on the role of improvements in financing efficiencies as a source of merger gains.⁸

Our paper is also related to the literature on the way firms transfer resources within firms through internal capital markets. Stein (1997) argues that, even if access to capital markets does not improve by combining divisions into firms, investment efficiency can be improved by reallocating investment across divisions. Since there are likely to be improvements in direct capital access when firms are combined, the overall effect of combining firms on investment

⁴ See Jensen and Ruback (1983) for a survey of the early merger event studies, and Healy, Palepu, and Ruback (1992), who document that accounting performance increases following mergers of large public firms.

⁵ See especially Schoar (2002) and Maksimovic, Phillips, and Prabhala (2011) for evidence on post-merger plant-level efficiency improvements. Hoberg and Phillips (2010) also document evidence of product market synergies through a text-based analysis of product market language in 10-K filings.

⁶ See Shleifer and Summers (1988) and Pontiff, Shleifer, and Weisbach (1990) for discussion and evidence of transfers from employees through wage cuts and pension reversions, and Auerbach and Reishus (1988) and Hayn (1989) for transfers from the government through the tax system.

⁷ See Shleifer and Vishny (2003) and Rhodes-Kropf, Robinson, and Viswanathan (2005).

⁸ Three exceptions are Mantecon (2008), Almeida, Campello, and Hackbarth (2011), and Liao (2012). Mantecon uses a sample of private targets acquired shortly after filing for an IPO and examines the role of uncertainty, which limits access to external financing, in explaining the wealth effects to the acquirers. Almeida, Campello, and Hackbarth make similar arguments to ours applied to acquisitions of firms in financial difficulties, and Liao focuses on the financing role of acquisitions of partial stakes in firms.

efficiency is potentially substantial.⁹ The empirical literature has paid much attention to comparing the values of diversified and single-segment firms, as well as the nature of cross-subsidization inside diversified firms. However, this literature has been criticized because divisions do not combine randomly into firms, and the empirical results could potentially be a consequence of nonrandom selection rather than of internal capital markets.¹⁰ Our results, while also coming from nonrandom combinations of companies, are potentially cleaner than those in the internal capital markets literature since we can observe firms' financial management policies both as separate entities and as part of new parents.

In a sense, the results in this paper are the mirror image of several papers that consider investment policies before and after divisions are spun off or divested from larger firms (see Gertner, Powers, and Scharfstein (2002), Dittmar and Shivdasani (2003), and Ahn and Denis (2004)). Similar to these papers, we find increasing investment, even though these papers study separations of firms while we evaluate combinations of different firms. Most likely, the principle that organizations tend to evolve toward efficiency holds here, and the inefficiencies from internal capital markets dominate in the samples of those papers, while the efficiencies due to being a subsidiary of a larger firm are most important in the sample of acquisitions considered here.

The remainder of the paper proceeds as follows. Section I describes the construction of our sample, presents statistics on this sample, and discusses conceptual and practical issues involved in measuring financial constraints. Section II presents tests of how cash levels, cash and investment sensitivities with cash flow, and investment levels change when a firm is acquired. Section III examines the extent to which financial constraints are reduced in different kinds of acquisitions. Section IV analyzes possible explanations for the decline in targets' financial constraints following acquisitions. Section V presents robustness checks that address alternative interpretations of our results. Section VI concludes.

I. Measuring Financial Constraints in Acquired Firms

A. Data Availability

To evaluate the way in which financial constraints are affected by acquisitions, it is important to have access to a sample of acquisitions for which one can measure both the existence of constraints prior to a potential acquisition and how these constraints change following the acquisition. A number

⁹ But not necessarily. Scharfstein and Stein (2000) present a model in which combining firms can create inefficient rent-seeking, and Ozbas and Scharfstein (2010) provide empirical support for this argument.

¹⁰ See Berger and Ofek (1995) and Lang and Stulz (1994) for evidence on valuation differences, Shin and Stulz (1998) for evidence on cross-subsidization between divisions, and Campa and Kedia (2002) and Chevalier (2004) for the case that these results could be a consequence of selection rather than internal capital markets.

of approaches have been proposed to evaluate the magnitude of financial constraints, most of which depend on access to financial data on the firm. Measuring the *change* in this magnitude requires financial data for target firms both before and after the acquisition. Constructing a sample of acquisitions containing such data is not straightforward for a number of reasons.

Before being acquired, targets are either independent firms or subsidiaries of other companies. If the target is free standing and also publicly traded, disclosure requirements in all countries ensure that financial data on the firm are publicly available. However, the vast majority of targets are private and/or subsidiaries of other corporations (see Ellis et al. (2012), Erel, Liao, and Weisbach (2012) and Netter, Stegemoller, and Wintoki (2011)). Given that it is impossible to obtain financial data for privately held firms or subsidiaries of public firms in the United States, estimating the extent to which acquisitions mitigate financial constraints would be difficult using U.S. data.¹¹

Gathering financial data on the targets subsequent to the acquisition is even more problematic. In the United States, acquirers often integrate targets with their existing assets. Indeed, if operational synergies are the driving force behind the acquisition, then it is plausible that optimal use of these synergies will lead to integration of the two firms' assets. Even if the assets are not integrated operationally, in the United States their financial data are sometimes consolidated with those of the rest of the acquiring firm. If financial statements are consolidated at the parent firm level, it is impossible to identify financial data from only the former target's assets, since such data will be combined with the financial data from the new parent's other assets.

B. European Financial Data

In contrast to the United States, most European countries require firms to report financial data publicly on an *unconsolidated* basis, even if they are privately held.¹² Thus, for most targets, it is possible to acquire financial data prior to the acquisition, even if the firm is a subsidiary of another firm prior to being acquired. These data are accessible through the Amadeus database. Using this database, we construct a sample of acquisitions of European firms where target firms are operated as subsidiaries of their new parents following the acquisitions.¹³

¹¹ There are recently available databases assembled through accounting firms on privately held U.S. firms such as Sagemworks. However, in these databases, firms are generally anonymous, which would preclude matching targets to acquirers. See Asker, Farre-Mensa, and Ljungqvist (2011) and Farre-Mensa (2011) for more information on these data and examples of their use.

¹² There are some exceptions such as Switzerland, where not all private firms (except for banks and insurance companies) are required to file. Also, filing requirements are not uniform across countries. For example, in the United Kingdom, firms are not required to report sales data. Furthermore, in some countries, subsidiaries in the smallest size category are not obligated to report their financials so we drop all subsidiaries in this size category from our sample.

¹³ European firms can be targets of non-European acquirers. In such an acquisition, we generally cannot track the acquirer's financials postacquisition but can usually track the target's. Consequently, we include all the acquisitions of European targets, but for some analysis where the

A potential concern is whether we can correctly track the target firm's assets after the firm is acquired. One possibility is that the parent combines some of its other assets with those of the target firm and keeps them together organizationally in a subsidiary that appears to consist of only the target firm's assets. Therefore, we include in our sample only targets whose number of employees or size as measured by total assets (if data on number of employees are missing) does not change more than 100%.¹⁴

C. Sample Construction

We start with a sample of European acquisitions taken from the Zephyr database. We rely on Zephyr rather than the more commonly used SDC, because both Zephyr and Amadeus are provided by a common data vendor, Bureau Van Dycik, and therefore share firm identifiers. Because of the common firm identification, it is possible to match acquisitions from Zephyr to financial data from Amadeus more accurately than if one were to match SDC to Amadeus. In addition, Zephyr's coverage of private-firm acquisitions is better than SDC's.

Amadeus is structured so that each firm has a maximum of 10 observations, generally occurring between 2000 and 2009 in our sample.¹⁵ To allow an acquisition to have financial information for at least one year before and after the deal, we restrict the sample to those acquisitions occurring between 2001 and 2008, leaving one to eight years before and after an acquisition. We also require target firms to be from countries with at least 10 acquisition targets in this time period, eliminating 74 deals with targets from Cyprus, Iceland, Luxembourg, Macedonia, Lithuania, Malta, Moldova, Serbia, and Slovenia. We exclude deals in which the target is a financial firm, as well as restructurings, privatizations, LBOs, and exits from private equity deals. We also drop firms with less than 10 employees, with asset size less than \$1 million, and without data on fixed assets for at least one year before and after the acquisition. We end up with a sample consisting of 5,187 deals with acquirers from 64 countries from all over the world and targets from 25 European countries.

D. Sample Characteristics

Amadeus provides a variety of financial data on our sample firms. However, it does not contain data on capital expenditures, which is important for

acquirer's financial information is needed, we restrict our sample to acquisitions with European firms as both acquirers and targets.

¹⁴ This change is measured by comparing the average of the first two years available prior to the acquisition to the average of the first two years available following it. We find qualitatively similar results when we only use firms whose number of employees or size changes by less than 10%. We present these results in the Internet Appendix, available in the online version of the article on the *Journal of Finance* website.

¹⁵ When we accessed the data set utilized in this paper, the last year fully covered was 2009. Firms that were alive in 2009 have data starting in 2000. However, for the firms that disappear from the sample before 2009, Amadeus keeps the data of its last 10 years as well. For example, a firm that disappeared from the sample in 2006 potentially has data available back to 1997.

Table I
Statistics on the Acquisition Sample over Time

This table displays statistics on European targets from 2001 to 2008. The sample includes acquisitions of European targets, reported by the Zephyr database, with at least one year of financial data available (in Amadeus) before and after the acquisition. Financial firms, firms with less than 10 employees, and firms with total assets less than 1 million USD are excluded. The table presents the characteristics of acquisitions tabulated by deal completion year. The total assets of target firms are the averages of the last two years before the merger. Statistics in the last four columns are as of the last fiscal year-end before the deal is completed. Variable definitions are provided in the Appendix.

Deal Completion Year	No. of Deals	Target's Total Assets before the Acquisition (USD Million)		Domestic Deals (%)	Independent Targets (%)	Private Targets (%)	Public Acquirer (%)
		Mean	Median				
2001	228	76.850	7.233	62.95	72.81	95.18	46.05
2002	393	125.500	7.665	59.07	69.72	96.69	44.27
2003	429	57.448	7.528	61.20	62.47	97.20	29.37
2004	603	78.870	7.952	62.35	69.98	97.18	38.47
2005	768	94.849	8.628	63.53	67.97	97.40	36.72
2006	999	49.298	7.210	60.20	68.77	97.70	35.34
2007	1,270	38.377	7.270	65.51	77.48	97.72	34.96
2008	497	83.230	7.453	67.58	78.47	97.59	31.59
Total	5,187	67.716	7.578	63.05	71.58	97.36	36.11

understanding financial constraints. We therefore follow Becker and Sivadasan (2010) and Chung (2011) and estimate capital expenditures as the change in fixed assets plus depreciation, all of which are normalized by total assets. To reduce the effect of outliers in our data set, we trim accounting variables other than leverage at the top and bottom 1% of the distribution.¹⁶ Leverage (normalized by assets) is trimmed between zero and one.

Table I presents statistics on the acquisition sample. Most deals are small, with a median target asset size of roughly \$7.6 million. However, the size distribution is skewed, with a mean asset size of about \$67.7 million, more than eight times the median. Almost two-thirds (63.1%) of the deals are domestic and almost three-fourths (71.6%) have independent targets (not subsidiaries of another firm). The vast majority (97.4%) of the acquisitions involve private targets and 36.1% of the deals are by publicly traded acquirers. The number of deals increases over time until 2007, and then declines with the financial crisis in 2008. The average deal size is larger in the earlier years of the sample, with a mean of \$125.5 million in 2002 compared to \$38.3 million in 2007. Combined with the lower number of deals in the early part of the sample, this pattern suggests that the sampling process becomes less restrictive over time, so that more (smaller) deals are included.

¹⁶ The results are similar if we winsorize rather than trim all accounting variables.

This table highlights that the target firms in our sample are quite small, and are likely to be firms for which an acquisition is a relatively attractive source of relieving financial constraints. As a comparison, between 2001 to 2008, the SDC database contained 1,872 European IPOs. The mean (\$358 million) and median (\$20 million) value of assets of these IPOs were more than twice our sample mean and median. The small size of our firms relative to those that go public suggests that the vast majority of our sample could not have gone public, and were also likely to be too small to access the public debt markets.

The Internet Appendix contains the distribution of the countries of the target firms in the sample. Almost 30% of the deals (1,527) involve U.K. targets. France has the second largest number of targets, with 748, and eight countries have between 200 and 350 targets. The United Kingdom also has targets of the largest average size, with a mean asset value of \$114.2 million. However, there are also a lot of very small U.K. targets as illustrated by the median asset size of U.K. targets being only \$6.8 million.

Table II presents summary statistics for the accounting variables of the targets and acquirers in our sample, each computed as the average of the two years prior to the acquisition.¹⁷ To calculate these statistics, we use data from unconsolidated statements for the targets and from consolidated statements for the acquirers. Not surprisingly, targets are substantially smaller than acquirers, with a mean (median) target asset size of \$67.7 million (\$7.6 million), compared to a mean (median) acquirer asset size of \$2,438.8 million (\$172.9 million). Targets also hold more cash as a fraction of their assets, with a mean of 12.2%, compared to the mean of 9.8% for the acquirers. Targets have a lower investment-to-asset ratio (mean of 6.4%) than acquirers (mean of 12%).

For target firms, cash holdings decline following the acquisitions, as both the mean and the median cash holdings are higher in the two years before the acquisition compared with the holdings after the acquisition. In addition, the median gross investment-to-asset ratio declines after the acquisition. However, it is difficult to draw inferences from this table. Secular trends as well as the changing composition of firms in the sample are likely to mask the incremental effect the acquisition has on these variables. To evaluate the effect of acquisitions on firms' financial policies, it is important to hold firm composition constant over time and to control for other factors statistically.

E. Measuring Financial Constraints

Financial constraints occur when financial frictions cause firms to deviate from their first-best investments. When firms are constrained, the availability and pricing of financing in addition to a potential investment's value will determine the projects a firm chooses to undertake.¹⁸

¹⁷ Since some acquirers are not from Europe and hence not contained in the Amadeus data set, and some others do not report consolidated statements, the number of acquirers for which we have accounting data is substantially smaller than the corresponding number of targets.

¹⁸ Tirole (2006) provides a number of models in which constraints occur because of contracting difficulties, moral hazard, or asymmetric information reasons.

Table II
Summary Statistics on the Financial Variables of the Targets and Acquirers

This table presents summary statistics for the accounting variables of the targets as averages of the first two available years before and after the acquisition. All firm-level data are from Amadeus. Statistics are based on unconsolidated financial statements for the targets and consolidated financial statements for the acquirers. Variable definitions are provided in the Appendix. *Total Assets* are in USD million. We assess the differences in means using the mean difference test and medians using the Wilcoxon-Mann-Whitney test. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Target				Acquirer			
	Before		After		Before		After	
	Obs.	Mean	SD	Median	Obs.	Mean	SD	Median
Total Assets	5,187	67.716	622.835	7.578	5,187	88.993	945.946	9.717***
Number of Employees	4,121	282.901	1,741.023	76.500	4,363	256.792	1,919.958	69.000***
Cash/Total Assets	5,002	0.122	0.145	0.064	4,936	0.103***	0.127	0.054***
Gross Investment/Total Assets	4,148	0.064	0.107	0.034	4,484	0.062	0.118	0.027***
Cash Flows/Total Assets	4,305	0.077	0.139	0.082	4,413	0.068**	0.151	0.073***
ROA	4,126	0.110	0.154	0.109	4,270	0.093***	0.168	0.094***
Sales Growth	2,464	0.133	0.344	0.068	2,663	0.131	0.433	0.058***
Leverage	4,541	0.577	0.229	0.594	4,341	0.552***	0.241	0.564***
Acquirer								
	Obs.	Mean	SD	Median	Obs.	Mean	SD	Median
Total Assets	1,429	2,438.834	11,215.136	172.891	1,504	3,394.176*	14,144.267	281.863***
Number of Employees	1,318	7,837.190	23,942.573	885.000	1,404	9,114.769	29,737.385	1,057.250***
Cash/Total Assets	1,406	0.098	0.100	0.063	1,492	0.077***	0.077	0.050***
Gross Investment/Total Assets	1,144	0.120	0.146	0.081	1,029	0.099**	0.152	0.059***
Cash Flows/Total Assets	1,262	0.079	0.072	0.078	1,344	0.067***	0.071	0.069***
ROA	1,352	0.096	0.075	0.089	1,423	0.083***	0.071	0.078***
Sales Growth	807	0.201	0.425	0.108	725	0.133**	0.387	0.080***
Leverage	1,385	0.492	0.180	0.494	1,475	0.523***	0.178	0.528***

Discussion of financial constraints goes back at least to Keynes (1936), who argues that, because of financial market frictions, firms hold cash as a precaution against potential future financial constraints. Firms' optimal cash holdings will be determined by equating the incremental holding cost of cash with the expected benefit in terms of improved investment coming from avoiding potential financing constraints. Consequently, firms' cash holdings should be positively related to the degree to which firms expect to face financial constraints in the future. A large empirical literature beginning with Opler et al. (1999) confirms that, consistent with Keynes's prediction, cash holdings are largely explained by a firm's ability to access capital markets.

A particularly controversial measure of financial constraints was introduced by Fazzari, Hubbard, and Petersen (1988), and involves estimating the sensitivity of a firm's investment to its cash flow. The idea is that, with frictionless capital markets, investments should be a function of the value of the firm's investment opportunities and independent of the firm's financial position. However, if there are financial constraints, then a firm will choose among projects. The firm is able to undertake more projects when financing is more available, in particular, when there is an increase in the firm's cash flows. Empirically, Fazzari, Hubbard, and Petersen (1988) and many others document a robust relation between a firm's cash flows and its investments. These authors interpret their findings as consistent with financing constraints being an important factor in determining corporate investments.¹⁹

An alternative approach to measuring financing constraints suggested by Almeida, Campello, and Weisbach (2004) involves estimating a firm's propensity to save cash from incremental cash flows. In the Almeida, Campello, and Weisbach model, unconstrained firms invest at the first-best level, so incremental cash flows do not have any real effects on the firm's investments. However, a firm facing financial constraints will choose to allocate additional cash flows to increase its investments both today and in the future, so cash holdings to finance future incremental investment should increase with the firm's cash flows. Consequently, the fraction of cash retained by a firm from incremental cash flows reflects management's view as to whether the firm is likely to face financial constraints in the future. While the cash flow sensitivity of investment measures the effect of constraints on *today's* investment, the cash flow sensitivity of cash reflects management's assessment of *future* constraints. Almeida, Campello, and Weisbach find empirical evidence suggesting that the cash flow

¹⁹ Fazzari, Hubbard, and Petersen (1988) have spawned a huge literature, both debating their methodological approach and using the investment cash flow relation to test for financial constraints in particular settings (see, e.g., Hoshi, Kashyap, and Scharfstein (1991) and Becker and Sivadasan (2010)). Important critiques of the investment/cash flow method are Kaplan and Zingales (1997), Erickson and Whited (2000), Gomes (2001), Altı (2003), and Moyen (2004). In contrast, Rauh (2006) and Almeida and Campello (2007) argue that, even in a setting where the measurement issues that these papers focus on are not relevant, cash flows nonetheless affect investment, so investment-cash flow sensitivities can be good measures of financial constraints despite these papers' critiques.

sensitivity of cash is strongly related to other measures of financial constraints in a sample of large publicly traded U.S. firms.²⁰

Several papers estimate loadings of financial variables on other measures of constraints to easily construct indices of constraints that can be used more broadly. In particular, Lamont, Polk, and Saa-Requejo (2001) estimate the factors that predict the firms that Kaplan and Zingales (1997) classify as constrained, leading to the “KZ index.” Whited and Wu (2006) use an Euler equation approach from a structural model of investment to create the “WW index.” Both indices are estimated using data on publicly traded U.S. firms from Compustat.

However, even for publicly traded U.S. firms, Hadlock and Pierce (2010) find that both the KZ and the WW indices are dominated by a simple index of firm age and size. Therefore, according to the Hadlock-Pierce index, all target firms would by definition become less constrained after being acquired. We later explore the effect of size on the significance of our results through subsample analysis based on targets’ size. Other measures of constraints that have been discussed in the literature, such as the existence of a bond rating and membership in a Keiretsu (Hoshi, Kashyap, and Scharfstein (1991)), are obviously not relevant for small private European companies. Unfortunately, Amadeus does not contain data on dividends, so we cannot use a measure of constraints based on dividend payouts.

Consequently, given that firms in our sample are substantially smaller than Compustat firms and are mostly privately held, we do not use measures of financial constraints that can be calculated for relatively larger and/or public firms only. The measures we use, namely, the level of cash (normalized by a firm’s assets), the sensitivity of investment to cash flow, and the sensitivity of cash to cash flow, are each motivated by theory that is equally valid in all countries and for both public and private firms. Our goal is not to take a stand on which measure of financial constraints is the most accurate. Rather, our hope is that, by using three different measures, we can estimate whether acquisitions appear to reduce financial constraints in target firms, as well as the extent to which the effect is robust across alternative measures.

II. Estimates of Acquisitions’ Impact on Targets’ Financial Constraints

A. The Cash Holdings of Target Firms

We estimate multivariate models predicting aspects of firms’ financial policies that are likely to be associated with financial constraints. We evaluate whether these policies change when the firm is acquired, controlling for other potentially relevant factors. The first such policy we consider is the level of

²⁰ Other authors have also used the cash flow sensitivity of cash and found that it is related to other measures of financial constraints. See, for example, Sufi (2009), Hadlock and Pierce (2010), Farre-Mensa (2011), and Ostergaard, Sasson, and Sorensen (2011). However, this approach is also not without its critics; see Riddick and Whited (2009).

cash holdings. If the precautionary demand for holding cash decreases when financial constraints are eased by an acquisition, then we should observe that, holding other factors constant, firms' cash holdings decline after they are acquired. To test this hypothesis, we estimate equations predicting the quantity of cash, normalized by the firm's total assets.

In particular, we estimate the following specification:

$$\text{Cash/Assets} = a + b \text{ AFTER} + c \text{ Controls} + e, \quad (1)$$

where *AFTER* is a binary variable that takes a value of one after the acquisition. In all equations, we exclude the firm-year observations in the deal completion year. We include fixed effects for the target firm to control for time-invariant firm characteristics omitted in regressions. All specifications also include year dummies to control for changing macroeconomic conditions. In addition, we add three target country-level variables, namely, total private credit to GDP (gross domestic product), stock market capitalization to GDP, and nominal GDP growth in local currencies, to control for variation in external financing availability. Finally, we also include firm-level controls that vary across specifications. We estimate this equation on the entire panel of firm-years for which we have data both before and after the acquisition.

We present estimates of this equation in the first four columns of Table III. In column (1), we include only total assets and total assets squared as firm-level variables, since some firm-level variables are missing for some countries because of differences in reporting requirements. In column (2), we add the firm's cash flow to total assets as a control, dropping Dutch firms from the analysis since firms from the Netherlands do not have cash flow data in Amadeus.²¹ Column (3) includes ROA but not cash flow since these variables are highly correlated, which, because of data availability, allows us to include Dutch but not Russian firms. In column (4), we add the number of employees, leverage, and sales growth, which potentially could be related to the firm's growth opportunities. In this final specification, the number of firms declines substantially because data on some items are missing for firms from Denmark, Ireland, the Netherlands, Russia, and the United Kingdom. In all estimations, standard errors are corrected for clustering of observations at the firm level.

The estimates in the cash equations in the first panel of Table III are consistent with the view that target firms reduce their cash holdings after being acquired. The coefficient on the dummy variable indicating that a firm-year is after the acquisition is between -0.0135 and -0.0173 , implying a drop of between 1.35% and 1.73% in the cash-to-asset ratio following the acquisitions. In all specifications, this decline is statistically significantly different from zero. Cash-to-asset has a mean of 12.2% and a median of 6.4% before the acquisition. Relative to the sample mean, the regression coefficients imply that, following

²¹ Depreciation, which is one of the components of cash flow, is missing for all Russian firms in Amadeus. We replaced these missing values with zeros and therefore used nonmissing profit/loss values for Russian firms as their cash flows. For robustness, we reestimate our equations eliminating Russian target firms from the sample and get almost identical results.

Table III
The Effect of Acquisitions on Cash Holdings of Target and Acquirer Firms

This table presents estimates of equations predicting cash holdings normalized by total assets, for target firms in columns (1) through (4) and acquirer firms in columns (5) through (8). *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. The estimates are based on unconsolidated data for the targets and consolidated data for the acquirers. Definitions and sources of the other variables are provided in the Appendix. Firm and year fixed effects are included in all equations. Standard errors are corrected for clustering of observations at the target-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Target				Panel B: Acquirer			
AFTER	-0.0173*** (0.003)	-0.0139*** (0.003)	-0.0135*** (0.003)	-0.0145*** (0.005)	-0.0164*** (0.004)	-0.0136*** (0.004)	-0.0140*** (0.004)	-0.0077 (0.006)
Ln(Total Assets)	0.0304 (0.022)	0.0160 (0.023)	0.0151 (0.027)	0.0514 (0.039)	-0.0155 (0.023)	-0.0270 (0.025)	-0.0318 (0.024)	0.0495 (0.044)
Ln(Total Assets) ²	-0.0012* (0.001)	-0.0008 (0.001)	-0.0008 (0.001)	-0.0016 (0.001)	-0.0000 (0.001)	0.0002 (0.001)	0.0004 (0.001)	-0.0012 (0.001)
Cash Flow/Total Assets		0.0931*** (0.008)		0.0637*** (0.015)		0.0924*** (0.026)		0.1120*** (0.040)
ROA			0.0945*** (0.008)				0.0490* (0.030)	
Ln(Number of Employees)				-0.0140*** (0.005)				-0.0113 (0.008)
Sales Growth				-0.0004 (0.003)				-0.0078 (0.006)
Leverage				-0.0892*** (0.011)				-0.1050*** (0.032)
Private Credit/GDP	-0.0239*** (0.008)	-0.0183*** (0.009)	-0.0162* (0.009)	-0.0202* (0.012)	-0.0284** (0.011)	-0.0284** (0.013)	-0.0271** (0.012)	-0.0358* (0.019)

(Continued)

Table III—Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Target				Panel B: Acquirer			
Market Cap/GDP	0.0007 (0.005)	0.0015 (0.005)	-0.0040 (0.006)	-0.0039 (0.009)	0.0161** (0.008)	0.0163* (0.009)	0.0148* (0.008)	0.0159 (0.017)
GDP Growth	-0.0028 (0.015)	-0.0042 (0.015)	0.0317 (0.041)	0.1171 (0.071)	-0.0393 (0.075)	-0.0886 (0.064)	-0.0739 (0.060)	-0.1978 (0.174)
Constant	-0.0600 (0.178)	0.0411 (0.189)	0.0616 (0.221)	-0.1830 (0.329)	0.4757** (0.225)	0.5435** (0.242)	0.5876** (0.240)	-0.2503 (0.454)
Observations	34,378	29,018	27,793	11,941	9,662	8,252	8,895	3,128
R ²	0.607	0.628	0.623	0.672	0.648	0.660	0.664	0.740

an acquisition, there is about an 11% drop in cash holdings by target firms. These multivariate results confirm the pattern suggested by the univariate comparisons in Table II, that is, that cash holdings decline after a target is purchased.

One explanation for the drop in cash holdings in target firms after being acquired is that financial constraints are relieved in the target firms following the acquisition. However, an alternative explanation for this finding is that companies centralize their treasury functions, so that they effectively hold the target firm's cash in the new parent firm. To evaluate this possibility, we reestimate the equations from panel A of Table III using the acquirer's cash holdings as a dependent variable, and report them in panel B of Table III. We calculate these acquirer holdings using the 1,215 acquirers for which we have consolidated financial data, so that they reflect the cash in the entire acquiring firm.²² Inconsistent with the view that cash is moved from the target to the new parent following the acquisition, we find that cash holdings at the acquiring firm decline after the acquisition.

The reduction in the acquirer's cash could occur because, by adding the target firm's assets to the assets of the acquirer, the acquirer has a lower precautionary demand for holding cash. In other words, in some states of the world, the acquirer will be able to rely on the cash flows generated by the former target's assets. Alternatively, it is possible that the acquirer's cash could decline because some of it is used to pay for the acquisition rather than because of a change in financial policy.

To evaluate this alternative explanation, we calculate an "adjusted" measure of cash, which equals the reported cash for the acquiring firm plus the price that the acquirer paid for the target firm, for the subsample of acquisitions whose deal value is available in Zephyr. We then reestimate the equations in panel B of Table III, adjusting acquirer unconsolidated cash holdings for the acquisition itself by "adding back" the cash paid for the target firm. This approach overstates the effect of acquisitions on the acquirer's cash, since not all deals are paid for entirely by cash. Nonetheless, the estimates, presented in the Internet Appendix, indicate that the decline in the acquirer's cash is of a similar magnitude to that documented in panel B of Table III. The decline in the acquirer's cash following the acquisition does not appear to be driven by the amount paid for the acquisition itself. Instead, the decline likely occurs because the target's assets help insure the acquirer against bad states of the world. The fact that cash goes down in both targets and acquirers suggests that the decline in the quantity of cash kept by the target is not merely a transfer to the new parent.

²² In a previous draft, we presented estimates of these equations using unconsolidated financial data on acquirers, so that they reflect only the parent's financials. The results were similar to those reported here.

B. The Cash Flow Sensitivity of Cash

Almeida, Campello, and Weisbach (2004) suggest that one could measure financial constraints through the way firms save cash from incremental cash flow. In the Almeida, Campello, and Weisbach model, constrained firms save a positive fraction of incremental cash flows as cash to finance future investments; however, there is no reason for unconstrained firms to adjust their savings behavior, since their investments are already at the first-best levels. Almeida, Campello, and Weisbach (2004), as well as a number of other papers, document that estimates of the sensitivity of cash holdings to incremental cash flows are highly correlated with other measures of financial constraints. Therefore, the *change* in the cash flow sensitivity of cash around the time of the acquisition should reflect changes in financial constraints occurring at that time.

To estimate the change in the cash flow sensitivity of cash at the time of the acquisition, we use a specification similar to the equations presented in Table III, with two changes. First, the dependent variable is the change in cash holdings over total assets. Second, in addition to cash flow divided by assets, we include this variable interacted with a dummy indicating whether the firm-year is after the acquisition. In this specification, the coefficient on cash flow divided by assets represents the cash flow sensitivity of assets before the acquisition, and the sum of this coefficient and the coefficient on cash flow interacted with the "AFTER" dummy variable represents the sensitivity after the acquisition.

We present estimates of this equation in columns (1) and (2) of Table IV. To evaluate whether the target firms were constrained before being acquired, we focus on the coefficients on cash flow. These coefficients are all positive and statistically significantly different from zero. In column (1), where we include country-level controls, firm-level size controls, as well as firm and year fixed effects, the coefficient on the uninteracted cash flow term (representing the preacquisition sensitivities) is 0.074. This coefficient equals 0.104 when we include other controls but lose firms from Denmark, Ireland, the Netherlands, Russia, and United Kingdom from the sample in column (2). As a rough comparison, Almeida, Campello, and Weisbach (2004) estimate similar equations on a sample of large publicly traded U.S. firms, and find statistically significant coefficients of 0.05 or 0.06 for their constrained subsamples and estimates close to zero for the unconstrained subsamples. Even though the studies use vastly different samples, our estimates for the preacquisition target firms are remarkably close to those for constrained firms reported by Almeida, Campello, and Weisbach. The fact that the coefficients are close between the two papers suggests that the tests are picking up a common phenomenon, likely the existence of financial constraints.

The coefficients on *AFTER* interacted with cash flow are negative, indicating that the cash flow sensitivity of cash declines following the acquisition. The magnitudes of the coefficients on this interaction term are -0.059 and -0.093 , almost the opposite of the coefficients indicating the cash flow sensitivity

Table IV
The Effect of Acquisitions on the Cash–Cash Flow and Investment–Cash Flow Sensitivities of Target Firms

This table presents estimates of equations in which the dependent variables are changes in the ratio of cash holdings to total assets in columns (1) through (2), and gross investment normalized by total assets in column (3) and (4). *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. We also include its interaction with cash flows to examine changes in the sensitivities subsequent to the acquisitions. Definitions and sources of the other variables are provided in the Appendix. Target-firm and year fixed effects are included in all regressions. Standard errors are corrected for clustering of observations at the target-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable	$\Delta(\text{Cash/Total Assets})$	Gross Investment/Total Assets		
<i>AFTER</i>	-0.0138*** (0.003)	-0.0104** (0.004)	0.0218*** (0.004)	0.0247*** (0.006)
Cash Flow/Total Assets	0.0741*** (0.013)	0.1036*** (0.025)	0.0818*** (0.016)	0.0713** (0.028)
<i>AFTER</i> × Cash Flow	-0.0590*** (0.017)	-0.0929*** (0.029)	-0.0436** (0.018)	-0.0563* (0.033)
Ln(Total Assets)	-0.0277 (0.019)	-0.0251 (0.031)	0.0134 (0.037)	-0.0058 (0.057)
Ln(Total Assets) ²	0.0010* (0.001)	0.0009 (0.001)	0.0007 (0.001)	0.0019 (0.002)
Ln(Number of Employees)		-0.0020 (0.004)		-0.0196*** (0.007)
Sales Growth		-0.0030 (0.004)		0.0310*** (0.005)
Leverage		-0.0098 (0.009)		0.0224* (0.013)
Private Credit/GDP	-0.0036 (0.007)	0.0025 (0.008)	-0.0163 (0.010)	-0.0222 (0.015)
Market Cap/GDP	-0.0048 (0.006)	-0.0107 (0.009)	-0.0117 (0.008)	-0.0064 (0.012)
GDP Growth	-0.0192 (0.021)	0.0421 (0.063)	0.1330*** (0.042)	0.1183 (0.138)
Constant	0.2055 (0.161)	0.1906 (0.269)	-0.2733 (0.302)	-0.2925 (0.466)
Observations	23,668	11,632	25,591	12,138
<i>R</i> ²	0.159	0.195	0.320	0.368

before the acquisition. The sum of the coefficients on cash flow and on cash flow interacted with *AFTER* measures the existence of constraints following the acquisition. In these equations, these sums are very close to, and not statistically different from, zero. These results on the cash flow sensitivity of cash suggest that target firms appear to be financially constrained prior to being acquired but essentially unconstrained after being acquired.²³

²³ The estimates are similar if we exclude firm fixed effects or include industry and/or country fixed effects.

C. The Cash Flow Sensitivity of Investment

Starting with Fazzari, Hubbard, and Petersen (1988), a large literature estimates the sensitivity of investment to cash flow, and uses this estimated sensitivity as a measure of financial constraints. The idea is that, if a firm is unconstrained, then a firm should undertake all value-increasing investments regardless of the firm's financial condition. However, if the firm faces constraints, then the projects it will undertake will be rationed, and an increase in cash flow will allow it to undertake more projects. Therefore, we should observe a relation between a firm's investment and its cash flow if the firm is financially constrained.

To estimate the cash flow sensitivity of investment, we use the same specification as for the cash flow sensitivity of cash with investment, normalized by assets, as the dependent variable. We report estimates of this equation in columns (3) and (4) of Table IV. In each specification, the coefficient on cash flow is positive and statistically significant, suggesting that, before the acquisition, the targets were indeed financially constrained. However, the coefficients on cash flow interacted with the after-acquisition dummy are negative and statistically significantly different from zero, which implies that the cash flow sensitivity of investment is lower following the acquisition.²⁴

The usual interpretation of this result, following Fazzari, Hubbard, and Petersen (1988), is that financial constraints are eased at the time of the acquisition. This interpretation is subject to the standard critique of the investment/cash flow literature, namely, that cash flow is likely to be correlated with investment opportunities. Such a correlation would imply that the positive sensitivity of investment to cash flow reflects investment opportunities rather than financial constraints.²⁵ Nonetheless, given that the results are in line with those for cash levels and cash/cash flow sensitivities, we view them as additional evidence consistent with the view that acquisitions relax financing constraints.

D. The Quantity of the Target Firm's Investments

Financial constraints effectively lead firms to apply a higher cost of capital than they would in frictionless markets. Therefore, if acquisitions ease financial constraints, being acquired will lead target firms to evaluate investment opportunities using a lower cost of capital, and consequently undertake more of them. This logic that acquirers can more easily finance investments for the target than the target could independently, which is formalized in models such

²⁴ Most estimates of investment–cash flow sensitivity control for lagged values of the investment, since investment tends to be autocorrelated. We do not include lagged investment because of the way we measure investment as the change in fixed assets plus depreciation. Therefore, including lagged investment into the equation would lead measurement error in lagged investment to be mechanically related to current investment.

²⁵ This idea was originally suggested by Poterba (1988) in his published discussion of Fazzari, Hubbard, and Petersen, and was developed further by Erickson and Whited (2000) and Alti (2003).

Table V
The Effect of Acquisitions on Investments of Target Firms

This table presents estimates of equations in which the dependent variables are gross investment normalized by total assets. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. Definitions and sources of the other variables are provided in the Appendix. Target-firm and year fixed effects are included in all regressions. Standard errors are corrected for clustering of observations at the target-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	(1)	(2)	(3)	(4)
	Gross Investment/Total Assets			
AFTER	0.0161*** (0.004)	0.0184*** (0.004)	0.0156*** (0.004)	0.0201*** (0.005)
Ln(Total Assets)	0.0187 (0.036)	0.0087 (0.037)	0.0006 (0.040)	-0.0140 (0.056)
Ln(Total Assets) ²	0.0006 (0.001)	0.0009 (0.001)	0.0012 (0.001)	0.0021 (0.002)
Cash Flow/Total Assets		0.0587*** (0.011)		0.0411** (0.019)
ROA			0.0218** (0.010)	
Ln(Number of Employees)				-0.0203*** (0.007)
Sales Growth				0.0308*** (0.005)
Leverage				0.0232* (0.012)
Private Credit/GDP	-0.0159 (0.010)	-0.0166 (0.010)	-0.0144 (0.010)	-0.0214 (0.015)
Market Cap/GDP	-0.0092 (0.007)	-0.0108 (0.008)	-0.0032 (0.008)	-0.0057 (0.012)
GDP Growth	0.1222*** (0.042)	0.1299*** (0.042)	0.2229*** (0.072)	0.1141 (0.139)
Constant	-0.3169 (0.292)	-0.2272 (0.302)	-0.2712 (0.327)	-0.2155 (0.463)
Observations	27,322	25,591	24,434	12,138
<i>R</i> ²	0.315	0.319	0.330	0.367

as in Almeida, Campello, and Weisbach (2004), is often used by managers to justify acquisitions.

In Table V, we report estimates of equations predicting investment (normalized by assets) using specifications similar to those presented for cash in panel A of Table III. In each specification, the coefficient on the variable indicating if a firm-year is after the acquisition is positive, and is statistically significantly different from zero. In addition, the magnitude of the coefficient is economically large. The coefficients are between 0.0156 and 0.0201, implying that investment increases by 1.5% to 2% of assets following the acquisition. Since the mean investment-to-asset ratio is 6.4% and the median is 3.4%

during the year before the acquisition, these estimates suggest that the acquisition increases the mean firm's investment by 23% to 31% and the median firm's by 44% to 59%.

The increase in the target's investment following the acquisition is consistent with lower financial constraints leading to a lower cost of capital being applied to investment projects. However, it is also consistent with operational synergies improving investment opportunities. It is likely that both effects combine to explain the observed increase in investment following acquisitions.

If the increase in investment reflects reductions in constraints, as well as synergies, then the combined value of the acquirer and target should increase. The vast majority of our targets are private, so it is impossible to measure value changes for these firms. However, 36% of the acquirers are publicly traded, so we can measure the acquirer's stock price reaction to these acquisitions. For this subsample of deals with public acquirers the average abnormal stock price reaction is 1.5% for 3 days and 2.3% for 21 days around the merger announcement date, both of which are statistically significantly different from zero at the 1% level. This finding is consistent with the notion that value is created in these deals. It is also consistent with the view that acquirers can make acquisitions at a discount because of the private targets' illiquidity or uncertainty about their valuation. (See Koeplin, Sarin, and Shapiro (2000) or Ellis et al. (2012) for more discussion of acquisitions of private companies.)

III. Within-Sample Comparisons

The estimates presented thus far suggest that acquisitions are associated with declines in cash holdings, the sensitivity of cash holdings to cash flow, and the sensitivity of investment to cash flow, as well as an increase in the quantity of investment for the acquired firms in our sample. These findings suggest that the acquisitions in our sample led to a reduction in financial constraints in the target firms. If an increase in the availability and a reduction in the cost of finance were indeed the reason for these results, we would expect that they would be strongest for acquisitions for which the reduction in financial constraints is likely to be highest. We evaluate this prediction in this section.

A. Independent Firms versus Subsidiaries of Other Firms

An important distinction concerns whether, prior to the acquisition, the target firms are independent firms (71.6% of the sample) or subsidiaries of other firms (28.4%). If being acquired and becoming part of a larger organization helps to relieve financial constraints, then going from being independent to becoming a subsidiary should relieve such constraints more than if a firm changes from being a subsidiary of one firm to a subsidiary of another.

To evaluate this hypothesis, we separately reestimate the specifications from Tables III–V for the subsample of deals in which the target is an independent firm and the subsample in which it is a subsidiary. In panel A of Table VI, we report one equation for the level of cash holdings, the cash flow sensitivity of

Table VI
Subsamples of Target Firms

This table presents estimates of equations from Tables III–V for subsamples based on target-firm characteristics. Panel A examines subsamples of independent targets and targets as subsidiaries of other firms. Panel B divides the sample of acquisitions into terciles based on the size of the target firm (calculated as the average assets for the last available two years). The dependent variables are cash holdings normalized by total assets in columns (1) and (5), changes in cash holdings in columns (2) and (6), and gross investment normalized by total assets in columns (3), (4), (7), and (8). The regression specifications follow column (2) in Table III, columns (1) and (3) in Table IV, and column (2) in Table V. The coefficients on the size variables and two country-level variables are not reported to save space. *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. We also include the interaction of *AFTER* with cash flows to examine the changes in the sensitivities following the acquisitions. Definitions and sources of the other variables are provided in the Appendix. Target-firm and year fixed effects are included in all regressions. Standard errors are corrected for clustering of observations at the target-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	Panel A: Independent vs. Subsidiary							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Independent				Subsidiary			
	Cash/Asset	Δ(Cash/Asset)	Inv/Asset	Inv/Asset	Cash/Asset	Δ(Cash/Asset)	Inv/Asset	Inv/Asset
AFTER	-0.0183*** (0.004)	-0.0135*** (0.004)	0.0215*** (0.005)	0.0170*** (0.004)	-0.0030 (0.006)	-0.0129** (0.005)	0.0227*** (0.007)	0.0212*** (0.007)
Cash Flow/Total Assets	0.0995*** (0.010)	0.0903*** (0.018)	0.0899*** (0.019)	0.0609*** (0.013)	0.0761*** (0.013)	0.0417** (0.016)	0.0609** (0.029)	0.0488** (0.021)
AFTER × Cash Flow		-0.0822*** (0.021)	-0.0520** (0.022)			-0.0092 (0.028)	-0.0251 (0.034)	
Constant	-0.0587 (0.208)	0.2649 (0.198)	-0.0361 (0.383)	0.0244 (0.382)	0.1505 (0.413)	-0.1216 (0.308)	-1.3396*** (0.500)	-1.3195*** (0.500)
Observations	20,569	16,777	18,129	18,129	8,449	6,891	7,462	7,462
R ²	0.634	0.167	0.331	0.330	0.608	0.143	0.299	0.299

(Continued)

Table VI—Continued

		Panel B: Target Size							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Small (Bottom 1/3)				Large (Top 1/3)			
Dependent Variable		Cash/Asset	Δ (Cash/Asset)	Inv/Asset	Inv/Asset	Cash/Asset	Δ (Cash/Asset)	Inv/Asset	Inv/Asset
AFTER		-0.0242*** (0.007)	-0.0207*** (0.007)	0.0274*** (0.008)	0.0204*** (0.007)	-0.0032 (0.005)	-0.0080** (0.004)	0.0151** (0.007)	0.0145** (0.006)
Cash Flow/Total Assets		0.1199*** (0.015)	0.1177*** (0.028)	0.0905*** (0.027)	0.0462** (0.019)	0.0555*** (0.012)	0.0245 (0.016)	0.0816*** (0.031)	0.0767*** (0.022)
AFTER \times Cash Flow			-0.0729** (0.032)	-0.0777** (0.031)			-0.0340 (0.025)	-0.0098 (0.034)	
Constant		-0.5883 (1.077)	0.7212 (0.960)	-2.1973** (1.076)	-2.0904** (1.065)	0.5494** (0.276)	-0.0537 (0.230)	0.1910 (0.580)	0.1915 (0.581)
Observations		8,059	6,422	7,156	7,156	10,813	8,921	9,450	9,450
R ²		0.628	0.208	0.341	0.340	0.591	0.118	0.301	0.301

cash, the cash flow sensitivity of investment, and the quantity of investments. The specifications follow column (2) in Table III, columns (1) and (3) in Table IV, and column (2) in Table V, not reporting the coefficients on the size variables and two country-level controls to save space.

The results indicate that, for independent targets, there is a statistically significant 1.8% decline in the quantity of cash, an 8.2% decline in the cash flow sensitivity of cash, and a 5.2% decline in the cash flow sensitivity of investment following the acquisition. However, the corresponding estimated changes are not statistically significant for targets that are subsidiaries. We can reject the cross-equation restriction that the declines are equal for acquisitions of independent firms and subsidiaries in cash holdings and cash flow sensitivity of cash, but not in the cash flow sensitivity of investment. These estimates suggest that the declines in the measures of constraints are largest in acquisitions of independent firms, consistent with the view that they reflect reductions in financing constraints, not some other factor.²⁶

The one variable for which the effect of an acquisition is similar regardless of the target firm's status is the quantity of investments. The estimates in Table VI indicate that the quantity of investments increases by about the same amount for both types of targets (1.7% for independent targets, 2.1% for subsidiary targets). These positive effects likely occur because the increase in investments following an acquisition contains some operational synergies that are present, regardless of whether the target was independent or a subsidiary prior to being acquired. In general, it is difficult to ascribe the cause of investment increases to a particular reason, and it is likely that the investment increases we observe for all types of targets could come from multiple sources.

B. Target Firm Size

Hadlock and Pierce (2010) present evidence suggesting that, to a first approximation, a firm's size is a reasonable proxy for the likelihood it faces financial constraints. Assuming that small firms are more likely to be constrained in our sample as well, we expect to observe more reductions in constraints for smaller targets. To test this hypothesis, we reestimate our main equations from earlier tables on subsamples based on the size of the target, as measured by the average total assets in U.S. dollars over the two years immediately prior to the acquisition.

In panel B of Table VI, we divide the sample acquisitions into terciles based on the size of the target firm and reestimate our equations for the bottom and top terciles. We report one equation for cash holdings, the cash flow sensitivity of cash, the cash flow sensitivity of investment, and the quantity of investment using the same specifications as in panel A. The results suggest that the reduction in cash holdings is statistically significant only for the subsample of the

²⁶ One puzzling finding in Table VI is that the sensitivities of cash and investment to cash flow indicate that the subsidiary targets are constrained prior to being acquired, and that these constraints are not reduced by the acquisition.

smaller targets, with an estimated reduction in cash-to-asset ratio of 0.242%. In addition, the cash flow sensitivities of both investment and cash are larger in magnitude and statistically significantly different from zero for the smaller target subsample but not the larger target one. We test the cross-equation restriction that the declines in cash levels and both sensitivities are larger for the smaller targets. The results indicate that the declines in cash holdings are significantly larger for the smallest tercile than for the largest one. However, the tests reject the hypotheses that the declines in sensitivities are statistically significantly different between these subsamples. Finally, the investment-to-asset ratio increases significantly both for the smaller and the larger targets following the acquisitions, suggesting that acquisitions of both sets of targets are associated with synergies.

These results emphasize that the reduction in financial constraints is more likely to be mitigated for smaller targets when they are acquired. The smallest tercile of our sample, for which the reduction in constraints is most prevalent, has a median asset value of only \$2.6 million. Reductions in financial constraints upon acquisition appear to occur mostly in very small private targets rather than in the more commonly studied larger public targets.

IV. Acquirer Constraints and Cross-Subsidization

We have documented that financial constraints in target firms, measured using these firms' own financial management policies, appear to decline after they are acquired. Financial constraints could decline for two reasons. First, being part of a larger organization could improve the ability of target firms to raise capital, either because it lowers the underlying friction causing the constraints or because the acquirers' other assets combined with those of the targets lower the risk to a potential lender. Second, there could be transfers within combined firms that effectively lower the constraints faced by target firms after the acquisition. In this section, we study this second explanation.

If there are transfers, there are two possibilities. First, postacquisition firms could be unconstrained, meaning that, because of the existence of internal capital markets, they can invest at the first-best level. Second, the postacquisition firms could be constrained and there could be transfers of funds across units that are value increasing (or possibly decreasing) as characterized in Stein (1997) (or Scharfstein and Stein (2000)).

If the postacquisition firms are unconstrained, then the postacquisition sensitivities of investment and cash to cash flow should be zero. If they are constrained, then for the acquired division (and other divisions as well) the sensitivities should be positive but lower than the preacquisition sensitivities. To see why, think about the Stein (1997) equilibrium, which illustrates how incremental cash flows could be allocated in a constrained firm. In this equilibrium, each division invests from its cash flow plus or minus transfers from or to the parent. If there is an incremental shock to a division's cash flow, then the division keeps that amount, minus whatever fraction goes to the headquarters and the other divisions. To assess whether the logic of the Stein (1997) model

provides an explanation for the reduction in constraints we observe in our target firms, we test two of the model's implications: first, whether the combined firm is in fact constrained, and second, whether there are transfers across units within the firm.

A. Measuring Acquiring Firm Constraints

To measure the extent to which acquirers face financial constraints, we estimate cash-cash flow and investment-cash flow sensitivities for the acquirers in our sample, both before and after the acquisition. We estimate these equations using a subsample of 1,647 deals by 1,241 acquirers for which consolidated financial data are available, covering all subsidiaries including the target firm following the acquisition.²⁷ Results in this section should be interpreted with the caveat that about 70% of the acquisitions in our main sample are not included in these tests due to the limited data availability for the acquirers. We report estimates of the cash-cash flow and investment-cash flow sensitivities for these acquirers in Table VII.

The coefficients for the cash-cash flow and investment-cash flow sensitivities in Table VII are all positive, which suggests that the acquirers are financially constrained prior to the acquisitions. However, when we control for the number of employees, sales growth, and leverage in columns (2) and (4), the coefficients become statistically insignificantly different from zero. After acquisitions, the estimates in column (1) indicate that there is a decline in the cash-cash flow sensitivity by about half, which is difficult to interpret because neither the decline nor the postacquisition sensitivity ($0.0864 - 0.0482 = 0.0382$) is significantly different from zero. The investment-cash flow sensitivity increases by a small amount following acquisitions (column (3)) but this increase is not statistically significant. The postacquisition sensitivity of investment to cash flow is positive and statistically significant in the specification presented in column (3). However, neither sensitivity is statistically significantly different from zero when we control for the number of employees, sales growth, and leverage in columns (2) and (4). Overall, these results provide fairly weak evidence suggesting that acquirers are constrained before acquisitions, and it is difficult to draw inferences about whether acquirers are constrained following them.

B. Postacquisition Cross-Subsidization

To test the hypothesis that transfers across subsidiaries of the new parent are the source of the reduction in financial constraints, we estimate equations similar to those reported in Shin and Stulz (1998). The idea is that, if there is cross-subsidization, the cash flows of one part of the firm are, to some extent, transferred to fund investments in other parts of the firm. Empirically, this argument suggests that cash flows in the rest of the combined firm should

²⁷ The results are similar if we use unconsolidated financial data on acquirers that do not reflect the target firm's financials postacquisition.

Table VII
The Effect of Acquisitions on the Cash-Cash Flow and Investment-Cash Flow Sensitivities of Acquirer Firms

This table presents estimates of panel equations in which the dependent variables are changes in the ratio of the acquirer's cash holdings to total assets in columns (1) and (2) and the acquirer's gross investment normalized by total assets in columns (3) and (4). *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. Definitions and sources of the other variables are provided in the Appendix. Acquirer-firm and year fixed effects are included in all regressions. Standard errors are corrected for clustering of observations at the acquirer-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	(1) $\Delta(\text{Cash/Total Assets})$	(2)	(3) Gross Investment/Total Assets	(4)
AFTER	0.0041 (0.006)	0.0013 (0.007)	-0.0287** (0.013)	-0.0339** (0.016)
Cash Flow/Total Assets	0.0864** (0.035)	0.0845 (0.056)	0.1232* (0.065)	0.0734 (0.102)
AFTER \times Cash Flow	-0.0482 (0.046)	-0.0676 (0.056)	0.0252 (0.087)	0.0312 (0.111)
Ln(Total Assets)	0.0194 (0.024)	0.0224 (0.031)	0.0096 (0.087)	0.1550* (0.094)
Ln(Total Assets) ²	-0.0006 (0.001)	-0.0005 (0.001)	0.0019 (0.002)	-0.0007 (0.003)
Ln(Number of Employees)		-0.0088* (0.005)		-0.0449** (0.017)
Sales Growth		-0.0094 (0.007)		0.1098*** (0.023)
Leverage		0.0033 (0.022)		0.0545 (0.058)
Private Credit/GDP	-0.0040 (0.012)	-0.0109 (0.015)	0.0052 (0.029)	0.0231 (0.034)
Market Cap/GDP	-0.0159 (0.012)	0.0000 (0.012)	-0.0293 (0.024)	-0.0521 (0.032)
GDP Growth	-0.1140 (0.096)	0.0801 (0.185)	0.2900 (0.245)	0.4159 (0.505)
Constant	-0.1619 (0.245)	-0.1746 (0.337)	-0.5516 (0.848)	-2.4146*** (0.874)
Observations	5,531	3,113	5,610	3,110
R^2	0.177	0.194	0.352	0.385

affect investment and changes in cash ratios in the former target. We test this idea focusing on the sensitivity to the cash flows from the target firm as well as the cash flows from the acquiring firm's assets other than those coming from the target firm (calculated by subtracting the target's cash flows from the acquiring firm's postacquisition consolidated cash flows).

Table VIII contains estimates of this equation. The estimates indicate that the sensitivities of the target's cash holdings and investment to the acquirer's cash flows (excluding the target's cash flows postacquisition) are not economically or statistically significantly different from zero. These results are

Table VIII
Cross-Subsidization between Target and Acquirer Firms Subsequent to the Acquisition

This table presents estimates of equations in which the dependent variables are changes in the ratio of the target firm's cash holdings to total assets in columns (1) and (2) and changes in the target firm's gross investment normalized by total assets in columns (3) and (4). *AFTER* is a dummy variable that equals one (zero) for the years after (before) an acquisition. *Target Cash Flow* is the cash flow of the target firm. *Acquirer Cash Flow* is the consolidated cash flow of the acquiring firm for preacquisition firm-years, and the cash flow coming from the target firm is subtracted for postacquisition firm-years. Definitions and sources of the other variables are provided in the Appendix. Target-firm and year fixed effects are included in all regressions. Standard errors are corrected for clustering of observations at the acquirer-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	(1)	(2)	(3)	(4)
	Target $\Delta(\text{Cash}/\text{Total Assets})$		Target Gross Investment/Total Assets	
AFTER	-0.0178*** (0.007)	-0.0230** (0.009)	0.0203** (0.008)	0.0195 (0.013)
Target Cash Flow	0.0814*** (0.026)	0.0873** (0.041)	0.1063*** (0.037)	0.0758 (0.056)
AFTER \times Target Cash Flow	-0.0329 (0.034)	-0.0533 (0.048)	-0.0890** (0.041)	-0.1200** (0.061)
Acquirer Cash Flow	0.0026* (0.001)	-0.0398 (0.048)	0.0015 (0.002)	-0.0409 (0.067)
AFTER \times Acquirer Cash Flow	0.0304 (0.020)	0.0270 (0.052)	-0.0124 (0.027)	0.0075 (0.077)
Ln(Total Assets)	-0.0103 (0.049)	-0.0730 (0.063)	0.1367* (0.078)	0.0744 (0.086)
Ln(Total Assets) ²	0.0004 (0.001)	0.0020 (0.002)	-0.0028 (0.002)	-0.0003 (0.003)
Ln(Number of Employees)		0.0072 (0.009)		-0.0197 (0.012)
Sales Growth		0.0089 (0.009)		0.0279*** (0.010)
Leverage		-0.0164 (0.020)		0.0408 (0.028)
Private Credit/GDP	-0.0208 (0.015)	-0.0182 (0.017)	-0.0038 (0.022)	-0.0125 (0.026)
Market Cap/GDP	-0.0197 (0.014)	-0.0274 (0.018)	0.0015 (0.015)	-0.0092 (0.021)
GDP Growth	0.0034 (0.098)	-0.0094 (0.127)	0.2669* (0.147)	0.2845* (0.165)
Constant	0.1229 (0.416)	0.7035 (0.548)	-1.4575** (0.639)	-1.0381 (0.715)
Observations	5,599	3,055	6,028	3,171
R ²	0.203	0.243	0.396	0.424

not consistent with the notion of cross-subsidization from acquiring to target firms.

The results in Table VIII calculate the acquirer's nontarget cash flows as those from the acquirer's consolidated financial statements minus the target's cash flows, which are taken from the unconsolidated financial statements. However, if there is cross-subsidization, subsidiary characteristics such as size and sales growth can affect the magnitude of transfers of cash flows from other subsidiaries to the target firm subsequent to the acquisitions. To examine this idea, we use historical updates (from old DVDs) of the Amadeus data to identify other subsidiaries of the acquiring firms within two years following the acquisitions. We are able to gather data on such subsidiaries and their cash flows before and after the acquisitions for a subsample of 1,369 of targets.

In the Internet Appendix, we provide estimates of the sensitivity of the target firm's cash or investment to its own cash flows as well as to the asset-weighted or sales-growth-weighted cash flows of the other subsidiaries of the acquiring firm. These estimates confirm the results from Table VIII, and suggest that other subsidiaries' cash flows do not affect cash or investment behavior in the target firms. Consequently, cross-subsidization does not appear to be the explanation for the changes in cash and investment policies we observe in target firms subsequent to their being acquired.

Given the lack of evidence for cross-subsidization and the weak evidence that acquirers are financially constrained, the reduction in financial constraints in targets nonetheless likely comes from the target being part of a larger company. A constrained acquirer can still relieve constraints in a target firm, provided that the constraints are more "binding" in the target firm. A financial constraint occurs whenever limited access to capital causes a firm to invest at less than the efficient rate. So if two constrained firms combine, then before the acquisition each will have its own hurdle rate of return, which is higher than the appropriate rate given each firm's risk. If the acquirer's required rate of return is lower than the target's, then the target's required rate of return will be lowered by the acquisition and its constraints will be reduced.

C. Diversifying versus Related Acquisitions

The issues we consider are similar to those in the internal capital market literature. However, an important distinction is that our arguments conceivably apply to both diversifying and related acquisitions. In contrast, the internal capital markets literature focuses on whether diversification leads to efficient or inefficient cross-subsidization. Zephyr provides acquirer and target industry classification for 3,465 of the 5,187 deals in our sample. Of these 3,465 deals, 1,902 are in different industries and the remaining 1,563 are in related ones, using a common two-digit primary SIC code to define related industries.²⁸

²⁸ We rely on Zephyr rather than Amadeus for industry classifications because the classifications in Zephyr are done at the time of the acquisition while those in Amadeus are done at the time the data are downloaded.

While to some degree all of our deals are diversifying since they are kept in separate subsidiaries following the acquisition, presumably the ones in different industries diversify firms more.

The Internet Appendix presents estimates of our equations for diversifying and related mergers separately. In each subsample, following the acquisitions, there are declines in the level of cash, as well as the sensitivities of cash and investment to cash flow. All relevant coefficients are statistically significantly different from zero except those in the cash holdings equations for the diversifying subsample and investment-cash flow sensitivities for the same-industry subsample. For all three variables, we cannot reject the hypothesis that the coefficients are equal to one another across subsamples. It appears that the reduction in financial constraints occurs in both diversifying and same-industry mergers.²⁹

V. Potential Concerns

A. Cross-Country Differences

One possible concern with our analysis is that the main sample includes cross-border deals, but we cannot completely control for institutional differences in cross-border deals. For example, countries differ in their restrictions on firms' abilities to move cash from a local subsidiary to a foreign parent, as well as many aspects of their tax system. We do not have data on the exact treatment of subsidiaries' cash movements across countries. However, in panel A of Table IX, we reestimate the equations from Tables III–V for a subsample of cross-border deals, including the difference in corporate tax rates as a control, and find similar results to those reported above. One difference is that the coefficient measuring the change in investment in column (4) is still positive but no longer statistically significant. However, in the Internet Appendix we include other firm-level controls as in the specification in column (4) of Table V, and this coefficient is significant at the 5% level.

In addition, we reestimate these equations on the subsample including only domestic acquisitions since such deals are not subject to these international concerns. We report the estimates in panel B of Table IX. The estimated coefficients that reflect constraints are similar to those using the entire sample and are all statistically significantly different from zero at the 5% level or better. These results suggest that the findings above do not occur because of international factors affecting cross-border acquisitions.

B. Matched Sample of Firms That Were Not Acquired

While we document changes in the financial policies of target firms consistent with constraints being relieved, it is impossible to know definitively whether

²⁹ An important caveat is that we have information on only the main industry of the acquirer or the target. Therefore, we identify diversifying mergers with potential error since we do not know whether other subsidiaries within the acquirer are in the same industry as the target.

Table IX
Acquisitions and Financial Constraints: International Considerations

This table presents estimates of equations from Tables III-V, with the difference in corporate tax rates between target and acquiring countries as an additional control variable in panel A and using the sample of domestic targets only in panel B. The dependent variables are cash holdings normalized by total assets in columns (1) and (5), changes in cash holdings in columns (2) and (6), and gross investment normalized by total assets in columns (3), (4), (7), and (8). Definitions and sources of the variables are provided in the Appendix. Year fixed effects are included in panel A and target-firm and year fixed effects are included in panel B. Standard errors are corrected for clustering of observations at the target-firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	Panel A: Difference in Corporate Tax Rates			Panel B: Domestic Targets				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AFTER	-0.0189*** (0.004)	-0.0042** (0.002)	0.0061* (0.003)	0.0011 (0.003)	-0.0194*** (0.004)	-0.0174*** (0.004)	0.0262*** (0.005)	0.0212*** (0.005)
Cash Flow/Total Assets	0.1499*** (0.011)	0.0562*** (0.009)	0.1008*** (0.013)	0.0686*** (0.009)	0.0875*** (0.011)	0.0605*** (0.016)	0.0921*** (0.021)	0.0587*** (0.015)
AFTER x Cash Flow		-0.0415*** (0.013)	-0.0600*** (0.016)			-0.0520*** (0.022)	-0.0626*** (0.024)	
Ln(Total Assets)	-0.0977*** (0.013)	0.0043 (0.005)	0.0033 (0.012)	0.0012 (0.012)	-0.0026 (0.031)	-0.0572*** (0.023)	0.0671 (0.051)	0.0585 (0.051)
Ln(Total Assets) ²	0.0023*** (0.000)	-0.0001 (0.000)	0.0000 (0.000)	0.0001 (0.000)	-0.0003 (0.001)	0.0018*** (0.001)	-0.0007 (0.002)	-0.0005 (0.002)
Private Credit/GDP	-0.0113* (0.006)	0.0032 (0.003)	-0.0019 (0.005)	-0.0020 (0.005)	-0.0187 (0.012)	0.0075 (0.009)	-0.0261* (0.014)	-0.0264* (0.014)
Market Cap/GDP	0.0355*** (0.006)	-0.0037 (0.002)	-0.0020 (0.005)	-0.0017 (0.005)	0.0020 (0.007)	-0.0066 (0.007)	-0.0057 (0.010)	-0.0044 (0.010)
GDP Growth	0.0071 (0.079)	-0.1176*** (0.038)	0.1901*** (0.068)	0.1910*** (0.068)	-0.0131 (0.017)	-0.0416 (0.026)	0.1017* (0.055)	0.0985* (0.055)
Diff_Corptax	-0.1070*** (0.029)	-0.0075 (0.009)	0.0320 (0.020)	0.0317 (0.020)				
Constant	1.0299*** (0.115)	-0.0422 (0.041)	-0.0123 (0.101)	0.0098 (0.100)	0.2274 (0.250)	0.4656*** (0.199)	-0.8408*** (0.417)	-0.7604* (0.415)
Observations	22,450	18,317	19,968	19,968	17,831	14,525	15,776	15,776
R ²	0.085	0.007	0.016	0.015	0.630	0.159	0.320	0.319

these policies would have changed even if the target firms had not been acquired. We can observe, however, the policies of firms that were not acquired but are similar to the target firms. Presumably, any unobservable factors unrelated to the acquisition that could have affected financial policies in the target would have affected financial policies in these similar firms as well. Therefore, estimating whether the target firms' acquisitions coincided with changes in the financial policies of the matched firms provides a "placebo" test of whether other factors that we do not control for influence financial policies at the target firms.

To construct a sample of firms similar to the target firms, we match each target firm with the firm on Amadeus from the same country and two-digit industry code as the target firm with as close to a book value of assets as possible one year prior to the acquisition. We require that the matching firm has nonmissing financial data for at least one year before and one year after the merger. We drop the matched firms for which the difference in total assets between the target and matched firms is greater than 20% of the target firm's total assets. We are able to find matched firms meeting these criteria for 5,012 of the target firms in our sample.

For our placebo test, we estimate equations similar to those in Tables III–V on the sample of matched firms rather than target firms. We present these estimates in Table X. The results in this table are in sharp contrast to those for the target firms. The estimates in the first column do predict a decline in cash for the matching firms, but it is less than one-tenth of that for the target firms (0.11% compared to 1.4%) and is not statistically significantly different from zero. While there is a significant increase in investment for the target firms, there is a significant *decrease* in investment for the matched firms. The cash flow sensitivities of cash and investment are significantly positive for the matched firms prior to the "acquisition." However, neither sensitivity declines as significantly for the matched firms as for the target firms. Overall, the placebo tests imply that the matched firms do not experience any of the changes in financial policies indicative of a decline in financial constraints.

C. Managerial Risk Aversion

One possible explanation for our findings is that target managers could be replaced at the time of the acquisition by less risk-averse managers. Equivalently, if target managers are not replaced following the acquisition, they could behave in a less risk-averse manner because their ownership declines when their firms are acquired. We cannot evaluate this hypothesis directly, since we do not observe the identity of the managers of our firms. If acquisitions did lead to less risk-averse managers, the implications would be similar to acquisitions lowering financial constraints, since less risk-averse managers would likely apply lower discount rates to investment projects and act as if they were less financially constrained.

We can test this possibility indirectly, however, since changes in managers' risk aversion are likely to be a function of changes in the firm's ownership

Table X
Placebo Test: Matched Sample

This table presents estimates of our basic regressions in Tables III–V using the sample of industry-size-country matched firms. For each target firm, we find a matched firm on Amadeus from the same country and two-digit industry code that had the closest total assets at the year prior to the acquisition. We require that the matching firm has non-missing financial data for at least one year before and one year after the merger. We drop the matched firms for which the difference in total assets between the target and matched firms is above 20% of the target firm's total assets. The dependent variables are cash holdings normalized by total assets in column (1), changes in cash holdings in column (2), and gross investment normalized by total assets in columns (3) and (4). AFTER is a dummy variable that equals one (zero) for the years after (before) an acquisition of target firms to which the firm is matched. Definitions and sources of the variables are provided in the Appendix. Firm and year fixed effects are included. Standard errors are corrected for clustering of observations at the firm level and associated standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	(1)	(2)	(3)	(4)
Cash/Asset	$\Delta(\text{Cash}/\text{Asset})$	Inv/Asset	Inv/Asset	Inv/Asset
AFTER	−0.0011 (0.003)	0.0019 (0.004)	−0.0032 (0.004)	−0.0060* (0.003)
Cash Flow/Total Assets	0.1199*** (0.011)	0.1220*** (0.019)	0.0679*** (0.018)	0.0509*** (0.014)
AFTER × Cash Flow		−0.0347 (0.023)	−0.0344 (0.021)	
Ln(Total Assets)	0.0375 (0.024)	0.0178 (0.027)	0.0837** (0.035)	0.0809** (0.034)
Ln(Total Assets) ²	−0.0012* (0.001)	−0.0004 (0.001)	−0.0012 (0.001)	−0.0012 (0.001)
Private Credit/GDP	−0.0195** (0.009)	−0.0103 (0.007)	−0.0019 (0.009)	−0.0018 (0.009)
Market Cap/GDP	0.0037 (0.005)	0.0019 (0.006)	−0.0097 (0.007)	−0.0092 (0.007)
GDP Growth	0.0207 (0.017)	0.0316 (0.027)	0.1306*** (0.040)	0.1275*** (0.040)
Constant	−0.1769 (0.199)	−0.1827 (0.224)	−1.0053*** (0.287)	−0.9772*** (0.287)
Observations	26,202	18,439	23,149	23,149
R^2	0.717	0.154	0.358	0.358

distribution. Shareholders of the target are likely to be more risk averse, because of their lack of diversification, relative to the shareholders of the acquiring company. If so, and if the control change is associated with a reduction in risk aversion, the change in ownership could lead to the observed change in financial management policies that we document.

Using data on ownership, we employ the change in insider ownership of target firms as a proxy for the risk aversion of managers reflected in their lack of diversification. To do so, we create a variable designed to measure the “independence” of a firm, which takes a value of zero if a company has a shareholder with total (direct or indirect) ownership of over 50%, one if a company has no

shareholder with more than 50% but has one or more shareholders with an ownership percentage of above 25%, two if none of the shareholders have more than 25% of direct or total ownership, and three if a company is publicly traded and has a missing independence indicator as defined above. We calculate this variable for up to two years before and after the acquisition for our targets whenever the data are available.

Unfortunately, this variable is available for only a subset of our targets.³⁰ Nevertheless, we can identify targets for which we observe either no change in their independence level (1,066 targets) or a decrease in their independence level (111 targets). In the Internet Appendix, we present our main results for this subsample of 1,177 targets, for which there is likely *no* increase in risk aversion. Our results remain similar to those reported elsewhere in the paper despite the significant drop in the number of observations. In the Internet Appendix, we also present results for a larger subsample of targets, for which we exclude acquisitions of private targets by public acquirers. Again, the results remain similar to those reported elsewhere in the paper. These findings suggest that the paper's main findings do not reflect cases in which managerial risk aversion is likely to have decreased following the acquisitions; instead, they likely occur because of reductions in financial constraints in target firms.

D. Changes in Target Size

A potential issue is that, even if Amadeus calls a subsidiary of a new parent by the same name and gives it the same identifier as a preacquisition firm, the assets of the subsidiary could nonetheless be different. Such differences in assets could occur if the new parent reallocates assets, moving some of the target's assets to another part of the firm, adding some of the parent's other assets to the target, or even potentially both adding and subtracting assets from the target. While this issue could only explain the results if the errors were systematic and we know of no reason why they would be, it still would be comforting to know that the assets in the subsidiaries are basically the same as those in the original target firm.

In the Internet Appendix, we reestimate our equations eliminating observations where the number of employees changes by more than 10% in the two years following the acquisition. This criterion is much more strict than the one we use to construct the main sample, in which the number of employees could change by up to 100% with the firm remaining in the sample. Nonetheless, the results are similar to those reported in Tables III–V, except that the reduction in investment-cash flow sensitivity is not statistically significantly different from zero. These tests suggest that dramatic changes in the assets of target firms following the acquisition are not an important determinant of our results.

³⁰ The current version of the Amadeus data set includes only the latest available information on firms' ownership information. We used 2002, 2005, and 2008 versions of the database to acquire historical information on shareholders of a subsample of our targets.

E. Changes in the Book Value of Assets

Another potential concern is that there could be changes in the book value of the target firm's assets around the time of an acquisition, affecting the regressions reported above. Assets could change if the acquisitions involve stepping up the assets' basis, or if the acquisitions are associated with high growth, as suggested by the finding that acquisitions are followed by higher investment. Since we use the book value of assets to scale many of the variables throughout the analyses, we want to ensure that the findings we report are driven by the changes in cash holdings and investment and not by changes in the book value of assets.

To address this concern, we first reestimate our equations eliminating the year immediately following the acquisition from the estimation as well as the year of the acquisition (which is not included in any equation reported in the paper). Eliminating these observations ensures that any accounting (or other) changes occurring because of these changes are not the explanation for our results. We report estimates of the specifications used in Tables III–V in the Internet Appendix. The results are similar to those reported in Tables III–V.

Second, we reestimate the equations scaling *all* variables by assets in the year prior to the acquisition, rather than the contemporaneous value of assets. We report these equations in the Internet Appendix. Again, the results are similar to those reported in Tables III–V. The results in this analysis strongly suggest that the findings reported above are driven by changes in cash and investment as a function of financial constraints, and not by changes in the book value of assets used to normalize these variables.

F. Potential Selection Issues

One potential selection concern comes from the way in which Amadeus is constructed and our sampling process. Amadeus has a maximum of 10 years of data per firm, so for our sample, firms typically have data from 2000 to 2009.³¹ Our data construction process uses all available firm-years in our analysis. This process maximizes our sample size, but leads to an unbalanced structuring of the before- and after-acquisition observations. In particular, an acquisition later in the sample period will have a larger number of preacquisition observations while an acquisition earlier in the sample period will have a larger number of postacquisition observations.

While we do not know of any particular bias that this selection process will cause in our results, and we do include year-specific fixed effects that adjust for any macroeconomic shocks, we would like to ensure that this admittedly unusual data construction procedure is not somehow an important determinant of our results. Therefore, we reestimate the equations presented in

³¹ For firms that disappeared prior to 2009, Amadeus keeps earlier data. For example, if a firm disappeared from Amadeus in 2004, it could potentially have data starting in 1995. We generally follow the rule of "keep and use all data" but reestimate all equations using just post-2000 data with almost identical results to those reported in the paper.

Tables III–V using two alternative samples. First, we restrict the sample to firm-years no more than three years away from the acquisition. Second, we restrict the sample to firm-years no more than five years away from the acquisition. The estimates, reported in the Internet Appendix, are similar to those reported in Tables III–V. Therefore, the basic conclusion that financial constraints decline around the time of acquisitions does not appear to be driven by the sampling approach used in our main tables.

VI. Conclusion

Managers often justify acquisitions with the argument that they can add value to targets by enhancing the target's ability to invest efficiently. If being acquired leads to a reduction in financial constraints, then the target firm effectively faces a lower cost of capital, and is potentially able to undertake more valuable investments. However, examining this view empirically is difficult, since for most acquisitions one cannot observe data on target firms subsequent to being acquired. Because of disclosure requirements in European countries, we are able to construct a sample of European acquisitions containing financial data on target firms both before and after the acquisitions. We use this sample to test the hypothesis that target firms' financial constraints are lower subsequent to acquisitions.

Our approach is to evaluate whether the financial management decisions of target firms change when the firm is acquired in ways consistent with their becoming less financially constrained. Theory suggests that financial constraints should lead managers to increase cash holdings, to increase the cash flow sensitivity of cash as well as the cash flow sensitivity of investment, and to decrease investment. If constraints are eased when a firm is acquired, then these effects should be reversed. In our sample, we document that, subsequent to an acquisition, managers do in fact lower their cash holdings, lower the sensitivity of cash holdings to cash flow, lower the sensitivity of investment to cash flow, and increase the quantity of their investments. These results are consistent with the view that financial constraints are reduced for target firms when they are acquired.

We document that these effects are most important in deals for which one would expect financial constraints to be relatively important. In particular, the reduction in financial constraints appears to be more important for targets that were independent firms prior to the acquisition and for smaller targets. In addition, the reduction in financial constraints occurs in both diversifying and same-industry acquisitions. This cross-deal pattern of empirical results suggests that they reflect reductions in financial constraints rather than other factors.

It seems likely that financial synergies resulting from reductions in financial constraints could motivate some acquisitions, or even induce managers to take value-decreasing acquisitions. While a reduction in financial constraints could potentially be a factor leading to acquisitions, it is not likely to be the only factor. Substantial evidence indicates that operational synergies and wealth

transfers are also important determinants of acquisitions. From our results, it is impossible to quantify the relative importance of financing motivations compared to other factors. Doing so would greatly add to our understanding of why certain firms combine with others.

Initial submission: May 7, 2012; Final version received: December 17, 2013
 Editor: Campbell Harvey

Appendix

This table contains descriptions and sources of the variables used in our analyses. Country-level and firm-level variables are measured at the annual frequency. Deal-level items are measured as of the last fiscal year-end before the deal is completed.

Variable	Description
Panel A: Country-Level Variables	
Private Credit/GDP	Private credit by deposit money banks and other financial institutions to GDP. (Source: Beck and Demirgüç-Kunt (2009), updated as of April 2010. The raw data used in this paper are from IMF's International Financial Statistics)
Market Cap/GDP	Value of listed shares to GDP. (Source: Beck and Demirgüç-Kunt (2009), updated as of April 2010. The raw data used in this paper are from IMF's International Financial Statistics)
GDP Growth	Annual percentage nominal growth rate of GDP in local currencies (Source: World Bank)
Diff.Corptax	The difference in corporate income tax rates between the target's and the acquirer's countries. (Source: OECD)
Panel B: Deal-Level Variables (Source: Zephyr)	
Domestic (Cross-border) Deals	A deal is domestic (cross-border) if the target and acquiring firms are from the same nation (different nations).
Independent/Subsidiary Target	A given target firm is coded as independent if it is not a subsidiary of another firm.
Public/Private Target (Acquirer)	Target (acquirer) is a public firm if it is listed or delisted.
Financial Target	Target is a financial firm if its primary industry classification (NAICS) is 52 or 53 (or the first digit of the U.S. SIC code is 6 if the NAICS code is missing).
Same_Industry	Target is in the same industry as the acquiring firm if their first two digits of the primary U.S. SIC code are the same.

Panel C: Firm-Level Variables (Source: Amadeus)

Total Assets	Book value of assets = Fixed assets (FIAS) + Current assets (CUAS).
Ln(Total Assets)	Natural logarithm of total assets converted into U.S. dollars.
Number of Employees	The number of employees (EMPL).
Cash/Total Assets	Cash and cash equivalents (CASH)/Total assets.
Gross Investment/Total Assets	[Fixed assets – lagged fixed assets + Depreciation (DEPRE)]/Total assets.
Cash Flows/Total Assets	Cash flows (CF)/Total assets.
Δ (Cash/Total Assets)	Cash flows/Total assets – lagged (Cash flows/Total assets).
ROA	EBITDA(EBTA)/Total assets.
Sales Growth	(Sales (TURN) – Lagged Sales)/Lagged Sales.
Leverage	[Long-term debt (LTDB) + Current liabilities (CULI)]/Total assets.

REFERENCES

- Ahn, Seoungpil, and David Denis, 2004, Internal capital markets and investment policy: Evidence from corporate spinoffs, *Journal of Financial Economics* 71, 489–516.
- Almeida, Heitor, and Murillo Campello, 2007, Financial constraints, asset tangibility, and corporate investment, *Review of Financial Studies* 20, 1429–1460.
- Almeida, Heitor, Murillo Campello, and Dirk Hackbarth, 2011, Liquidity mergers, *Journal of Financial Economics* 102, 526–558.
- Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, 2004, The cash flow sensitivity of cash, *Journal of Finance* 59, 1777–1804.
- Alti, Aydogan, 2003, How sensitive is investment to cash flow when financing is frictionless? *Journal of Finance* 58, 707–722.
- Asker, John, Joan Farre-Mensa, and Alexander Ljungqvist, 2011, Comparing the investment behavior of public and private firms, Working paper, New York University.
- Auerbach, Alan, and David Reishus, 1988, The impact of taxation on mergers and acquisitions, in Alan J. Auerbach, ed.: *Mergers and Acquisitions* (University of Chicago Press, Chicago, IL).
- Beck, Thortsen, and Asli Demirgüç-Kunt, 2009, Financial institutions and markets across countries and over time: Data and analysis, World Bank Policy Research Working Paper No. 4943.
- Becker, Bo, and Jagadeesh Sivadasan, 2010, The effect of financial development on the investment cash flow relationship: Cross-country evidence from Europe, *B.E. Journal of Economic Analysis & Policy* 10, 1–49.
- Berger, Philip G., and Eli Ofek, 1995, Diversification's effect on firm value, *Journal of Financial Economics* 37, 39–65.
- Campa, Jose M., and Simi Kedia, 2002, Explaining the diversification discount, *Journal of Finance* 57, 1731–1762.
- Chevalier, Judith, 2004, What do we know about cross-subsidization? Evidence from merging firms, *Advances in Economic Analysis & Policy* 4, 1–29.
- Chung, Ji-Woong, 2011, Leveraged buyouts of private companies, Working paper, Chinese University of Hong Kong.
- Dittmar, Amy and Anil Shivdasani, 2003, Divestitures and divisional investment policy, *Journal of Finance* 43, 2711–2743.
- Ellis, Jesse, Sara Moeller, Frederik Schlingemann, and René M. Stulz, 2012, Globalization, country governance, and corporate investment decision: An analysis of cross-border acquisitions, Dice Working Paper 2012-3, Ohio State University.
- Erel, Isil, Rose C. Liao, and Michael S. Weisbach, 2012, Determinants of cross-border mergers and acquisitions, *Journal of Finance* 67, 1045–1082.
- Erickson, Timothy, and Toni M. Whited, 2000, Measurement error and the relation between investment and Q, *Journal of Political Economy* 108, 1027–1057.

- Farre-Mensa, Joan, 2011, Why are most firms privately held? Working paper, Harvard Business School.
- Fazzari, Steven M., R. Glenn Hubbard, and Bruce P. Petersen, 1988, Financing constraints and investment, *Brookings Papers on Economic Activity* 1, 141–195.
- Gertner, Robert, Eric Powers, and David Scharfstein, 2002, Learning about internal capital markets from corporate spinoffs, *Journal of Finance* 57, 2479–2506.
- Gomes, Joao, 2001, Financing investment, *American Economic Review* 95, 1263–1285.
- Hadlock, Charles, and Joshua Pierce, 2010, New evidence on financial constraints: Moving beyond the KZ index, *Review of Financial Studies* 23, 1909–1940.
- Hayn, Carla, 1989, Tax attributes as determinants of shareholder gains in mergers and acquisitions, *Journal of Financial Economics* 23, 121–153.
- Healy, Paul, Krishna Palepu, and Richard S. Ruback, 1992, Does corporate performance improve after mergers? *Journal of Financial Economics* 31, 135–175.
- Hoberg, Gerard, and Gordon Phillips, 2010, Product market synergies and competition in mergers and acquisitions: A text-based analysis, *Review of Financial Studies* 23, 3773–3811.
- Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1991, Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups, *Quarterly Journal of Economics* 106, 33–60.
- Jensen, Michael C., and Richard S. Ruback, 1983, The market for corporate control: The scientific evidence, *Journal of Financial Economics* 11, 5–50.
- Kaplan, Steven N., and Luigi Zingales, 1997, Do investment-cash flow sensitivities provide useful measures of financial constraints? *Quarterly Journal of Economics* 112, 159–216.
- Keynes, John M., 1936, *The General Theory of Employment, Interest, and Money* (McMillan, London).
- Koepflin, John, Atulya Sarin, and Alan C. Shapiro, 2000, The private company discount, *Journal of Applied Corporate Finance* 12, 94–101.
- Lamont, Owen, Christopher Polk, and Jesus Saa-Requejo, 2001, Financial constraints and stock returns, *Review of Financial Studies* 14, 529–554.
- Lang, Larry H.P., and René M. Stulz, 1994, Tobin's q, corporate diversification, and firm performance, *Journal of Political Economy* 102, 1248–1280.
- Liao, Rose C., 2012, What drives corporate block acquisitions: The case for financial constraints, Working paper, Rutgers University.
- Maksimovic, Vojislav, Gordon Phillips, and N.R. Prabhala, 2011, Post-merger restructuring and the boundaries of the firm, *Journal of Financial Economics* 102, 317–343.
- Mantecon, Thomas, 2008, An analysis of the implications of uncertainty and agency problems on the wealth effects of acquirers of private firms, *Journal of Banking and Finance* 32, 892–905.
- Moyen, Nathalie, 2004, Investment-cash flow sensitivities: Constrained versus unconstrained firms, *Journal of Finance* 59, 2061–2092.
- Netter, Jeffrey, Mike Stegemoller, and M. Babajide Wintoki, 2011, Implications of data screens on mergers and acquisitions: A large sample study of mergers and acquisitions from 1992–2009, *Review of Financial Studies* 24, 2316–2357.
- Opler, Tim, Lee Pinkowitz, René M. Stulz, and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of Financial Economics* 52, 3–46.
- Ostergaard, Charlotte, Amir Sasson, and Bent Sorensen, 2011, The marginal value of cash, cash flow sensitivities, and bank-finance shocks in nonlisted firms, Working paper, BI Norwegian Business School.
- Ozbas, Oguzhan, and David S. Scharfstein, 2010, Evidence on the dark side of internal capital markets, *Review of Financial Studies* 23, 581–599.
- Passov, Richard, 2003, How much cash does your company need? *Harvard Business Review*, 81, 119–128.
- Pontiff, Jeffrey, Andrei Shleifer, and Michael S. Weisbach, 1990, Reversions of excess pension assets after takeovers, *Rand Journal of Economics* 21, 600–613.
- Poterba, James M., 1988, Comment on “financing constraints and corporate investment,” *Brookings Papers on Economic Activity*, 200–206.

- Rauh, Joshua D., 2006, Investment and financing constraints: Evidence from the funding of corporate pension plans, *Journal of Finance* 61, 33–72.
- Rhodes-Kropf, Matthew, David T. Robinson, and S. Viswanathan, 2005, Valuation waves and merger activity: The empirical evidence, *Journal of Financial Economics* 77, 561–603.
- Riddick, Leigh A., and Toni M. Whited, 2009, The corporate propensity to save, *Journal of Finance* 64, 1729–1766.
- Scharfstein, David S., and Jeremy C. Stein, 2000, The dark side of internal capital markets: Segmental rent seeking and inefficient investments, *Journal of Finance* 55, 2537–2564.
- Shleifer, Andrei, and Robert W. Vishny, 2003, Stock market driven acquisitions, *Journal of Financial Economics* 70, 295–311.
- Schoar, Antoinette, 2002, Effects of corporate diversification on productivity, *Journal of Finance* 57, 2379–2403.
- Shin, Hyun-Han, and René M. Stulz, 1998, Are internal capital markets efficient? *Quarterly Journal of Economics* 113, 531–552.
- Shleifer, Andrei, and Lawrence Summers, 1988, Breach of trust in hostile takeovers, in Alan J. Auerbach, ed.: *Mergers and Acquisitions* (University of Chicago Press, Chicago, IL).
- Stein, Jeremy, 1997, Internal capital markets and the competition for corporate resources, *The Journal of Finance* 52, 111–133.
- Stein, Jeremy, 2003, Agency information and corporate investment, in George M. Constantinides, Milton Harris, and René M. Stulz, ed.: *Handbook of the Economics of Finance* (Elsevier/North-Holland, Amsterdam).
- Sufi, Amir, 2009, Bank lines of credit in corporate finance: An empirical analysis, *Review of Financial Studies* 22, 1057–1088.
- Tirole, Jean, 2006, *The Theory of Corporate Finance* (Princeton University Press, Princeton, NJ).
- Whited Toni, M., and Guojun Wu, 2006, Financial constraints risk, *Review of Financial Studies* 19, 531–559.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.