INTANGIBLE ASSETS AND CAPITAL STRUCTURE

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INTANGIBLE ASSETS AND CAPITAL STRUCTURE

Abstract

With intangible assets representing a substantial proportion of corporate assets, it is important to understand to what extent intangible assets support debt. Intangible assets' high valuation risk and potentially poor collateralizability can discourage debt financing, but some intangible assets are identifiable and separately valuable, may be collateralizable, and may therefore support debt like tangible assets do. The empirical capital structure research has struggled to quantify the effects of intangible assets on leverage because most intangible assets are not observable. We take advantage of a recent accounting rule change that has made it possible to observe market-based valuations of many intangible assets and find a strong positive relation between intangible assets and financial leverage. The strength of this relation depends on the type of firm. Intangible assets primarily affect leverage in firms with limited tangible assets. On a per dollar basis across all firms, intangible assets support roughly three quarters as much debt financing as tangible assets do.

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"The big difference between the new economy and the old is the changed nature of investment. In the past, businesses primarily invested in the tangible means of production, things like buildings and machines. The value of a company was at least somewhat related to the value of its physical capital; to grow bigger, a business had to build new factories roughly in proportion to the increase in its sales. But now businesses increasingly invest in intangibles. And once you've designed a chip, or written the code for a new operating system, no further investment is needed to ship the product to yet another customer." (Paul Krugman, *New York Times*, 22 October 2000)

"Brands are the most valuable assets many companies possess. But no one agrees on how much they are worth or why." (*The Economist*, 30 August 2014)

I. Introduction

It has long been recognized that intangible assets can be critically important to firm value and potentially affect firms' financial policies. However, heretofore it has been difficult to assess their importance since their values are largely unobservable. For example, firms' R&D expenditures are expensed and usually do not find their way onto the firms' balance sheets. In this study, we focus on the relation between intangible assets and financial leverage. Our main goal is to document to what extent intangible assets support debt. Are intangible assets, due to characteristics such as high valuation risk and poor collateralizability, unable to support debt? Or do intangible assets support debt like tangible assets do? We answer these questions with a novel dataset that for the first time offers comprehensive accounts of the values of firms' intangible assets.

The capital structure research has struggled to empirically quantify the effects of intangible assets on leverage. The problem lies in accounting rules that distinguish between two types of intangible assets: those that are acquired externally, through transactions such as mergers and acquisitions, and those that are self-created internally. The self-created intangible assets, essentially all intangible assets that the firm did not acquire externally, are not reflected in financial statements, due to the conservatism tradition in accounting and the difficulty, cost, and effort

associated with valuing intangible assets.[1] Instead, the costs associated with creating these intangible assets are generally expensed. As the quote from The Economist (2014a) above implies, the self-created intangible assets frequently include items of substantial value, such as brand names, trademarks, patents, developed technology, in-process research and development, and customer relationships. The Economist (2014b) reports that "[i]n 2005 Procter & Gamble, a consumer-goods company, paid $57 billion for the Gillette razor company. The brand alone, P&G reckoned, was worth $24 billion." Other examples include Apple's operating systems iOS and macOS, Microsoft's Windows and Office software, Coca-Cola's Coke brand name, and American Express' list of customers' identities, spending patterns, and creditworthiness. For these intangible assets, researchers usually cannot even observe book values, not to mention market or fair values. The only exception are sporadic estimates like the ones The Economist (2014a, 2014b) refers to.

Our study circumvents this data problem by taking advantage of a recent accounting rule change that allows us to observe fair values of self-created intangible assets for a subset of firms. For mergers and acquisitions since 2001, acquirers must allocate the purchase prices they pay for targets to the tangible and identifiable intangible assets they acquire, and the remainder to goodwill.[2] Acquirers must report these allocations that provide us with fair market value estimates of the targets' tangible and identifiable intangible assets, including those intangible assets that are self-created by the targets. We take these estimates of targets' tangible and intangible assets and relate them to the targets' pre-acquisition financial leverage.[3]

[1] According to the Wall Street Journal (2016), "the FASB [Financial Accounting Standards Board] hasn't been able to find a solution in which benefits of reporting intangibles outweigh the costs."
[2] For ease of exposition, we refer to "identifiable intangible assets" simply as "intangible assets" when the meaning is clear in the context.
[3] Harford, Klasa, and Walcott (2009) also examine financial leverage in a mergers and acquisitions setting.

Note that our measures of tangible and intangible assets differ primarily along two dimensions from the prior capital structure research, where tangibility is commonly defined as property, plant, and equipment divided by total assets. We use fair market value estimates instead of book values, and we separate intangible assets into identifiable intangible assets and goodwill. Prior studies usually find a positive relation between tangibility and leverage, implying a negative relation between intangible assets (scaled by total assets) and leverage if everything that is not property, plant, or equipment is considered an intangible asset. Because we independently observe tangible assets and identifiable intangible assets, there is no such mechanical relation in our paper. Goodwill, i.e., all unidentifiable intangible assets, is the third component of firm value in our study that adds a degree of freedom so that the coefficients on tangible assets and identifiable intangible assets are not forced to have opposite signs.

While it has been challenging to assess the relation between intangible assets and leverage, it is well known that firms with more tangible assets tend to have more debt. There are several possible explanations for this phenomenon. One reason is that many tangible assets constitute suitable collateral (Harris and Raviv 1991; Frank and Goyal 2008; Parsons and Titman 2009) because they can more easily be redeployed at relatively low transaction costs when the borrower defaults or becomes distressed. Tangible assets also tend to be less risky and easier to value than intangible assets. Therefore, borrowing costs should be relatively low when tangible assets support firms' debt, resulting in a positive relation between asset tangibility and financial leverage.[4]

As in the prior literature, firms with high levels of tangibility have on average high financial leverage in our sample. Our new and interesting finding is that firms' use of financial leverage is

[4] Campello and Giambona (2013) analyze the effects of different components of tangible assets on leverage. They show that it is not only the tangibility of assets that increases the use of leverage, but also the ease with which tangible assets can be sold.

also positively related to identifiable intangible assets and that this relation is both statistically significant and economically large. Moreover, there are differences based on asset tangibility. In firms with ample tangible assets, the tangible assets can support the desired debt and intangible assets do not affect leverage. In firms with limited tangible assets, however, intangible assets augment, and even substitute for, tangible assets in the role they play in determining leverage and supporting debt. Therefore, our findings are an extension of, not a replacement for, the established leverage-tangibility results.

Our most important contribution to the literature is that we can quantify the effect of intangible assets on debt levels. Quantifying this effect has been largely impossible in the existing research that primarily analyzes imprecise proxies for intangible assets, for example patents, instead of the actual intangible assets. We show that the quantitative impact of intangible assets is substantial as the coefficient estimates of intangible assets are similar to those of tangible assets in our leverage regressions. In dollar terms, one dollar of tangible assets supports $0.21 of debt while one dollar of intangible assets supports $0.16 of debt, on average.

The results suggest that identifiable intangible assets can support debt well because they function similarly to collateralizable tangible assets. While they may be more difficult to use as collateral than many tangible assets, the fact that they are identifiable and separately valuable implies that they should have substantial value in the hands of a different owner. This preservation of the value of identifiable intangible assets when transferred to a new owner is in stark contrast to the likely substantial value destruction in transfers of unidentifiable intangible assets, e.g., goodwill.

Our insights are vital because intangible assets play an increasingly important role in today's knowledge-based economy. Nakamura (2001, 2003) estimates that a third of the value of

U.S. corporate assets are intangible assets. Furthermore, the annual investment rate in intangible assets in the U.S. is $1 trillion as of 2001, practically equal to that in tangible assets according to Nakamura's analysis. In 2014, the investment rate in intangible assets represented 14% of private sector gross domestic product compared to 10% in tangible assets according to the Wall Street Journal (2016).

Further corroborating our main result, we find that the relative prevalence of tangible and intangible assets is associated with the firms' types of debt. Firms with relatively few tangible assets are likely riskier borrowers. Correspondingly, these firms tend to have debt with features that better protect the lenders from risk, such as relatively shorter maturities, more term loans, more bank debt, more convertible debt, less unsecured debt, and less fixed-rate debt.[6]

Overall, our results show that identifiable intangible assets behave largely like tangible assets in their effects on capital structure. Therefore, the focus of the existing empirical capital structure literature on tangibility, necessitated by data availability, can lead to misspecified, incomplete, and potentially misleading estimations. As a case in point, one result in Rauh and Sufi (2010) is that tangibility does not help explain the fraction of bank debt in total book capital. This finding is not surprising because, as we show, bank debt is particularly prevalent in firms where intangible assets constitute relatively high proportions of firm value, and the usual measures of tangibility do not reflect differing amounts of intangible assets.

Our focus, the relation between intangible assets and leverage, has long been recognized theoretically,[7] but has been difficult to examine empirically. Titman and Wessels (1988) use the ratio of intangibles to total assets as a proxy for the collateralizability of a firm's assets and find a negative relation between this ratio and leverage. However, likely because they are not reported in

[6] Denis and Mihov (2003) show that the borrower's credit quality affects the type of debt.
[7] For example, see Shleifer and Vishny (1992) and Morellec (2001).

financial statements, their measure of intangibles does not include self-created intangible assets that arose, for example, out of the firm's own R&D or brand management efforts, but does include goodwill which is difficult to interpret. Mann (2015) uses patents as a proxy for intangible assets and finds that court decisions that enhance creditor rights in default increase the role of patents as collateral and allow patenting companies to raise more debt. Patents may be a decent proxy for intangible assets, but our intangible asset measure is much more inclusive and provides a more direct reflection of the market value of a firm's intangible assets. It is also the only measure that allows us to quantify the relation between the market value of intangible assets and debt. Peters and Taylor (2016) account for intangible assets in examining the relation between investment and Tobin's q. They estimate intangible assets from past research and development spending and selling, general, and administrative expenses. While their estimates can be calculated for most Compustat firms, they are a more indirect measure of intangible assets. For example, their measures do not differ whether the past expenses had successful outcomes, i.e., resulted in valuable assets, or not. Furthermore, they cannot distinguish between identifiable and unidentifiable intangible assets, a distinction that seems to be critical for the collateralizability of the intangible assets.

II. Purchase price allocation and Statement of Financial Accounting Standards 141

Prior studies do not use intangible assets as determinants of leverage because the values of firms' self-created intangible assets are largely unobservable. We get around this data limitation with a unique dataset that takes advantage of a recent accounting rule change that requires an acquiring firm to provide more detailed fair (market) value estimates of the target firm's identifiable intangible assets. Starting in July 2001, Statement of Financial Accounting Standards (SFAS) 141 requires that an acquiring firm allocates the purchase price paid for a target to

identifiable assets, both tangible and intangible, based on estimated fair market values at the time of the acquisition, before allocating the remaining purchase price to goodwill.[8] These estimates of the market values of the tangible and intangible assets are reported in the acquirers' 10-Ks or 10-Qs where we, with the generous help of Houlihan Lokey, obtain them.[9] In effect, SFAS 141 provides the fair market values of target firms' identifiable intangible assets that are based on arm's length transactions. Prior to SFAS 141, acquirers allocated most of the intangible portion of the purchase price to acquisition goodwill without providing detailed valuations of identifiable intangible assets.[10] For example, Henning, Lewis, and Shaw (2000) report that, on average, 57% of the purchase price is allocated to acquisition goodwill prior to SFAS 141 while it is only 38% in our post SFAS 141 data. Like other recent papers, our study validates the usefulness of the SFAS 141-based purchase price allocation data.[11]

[8] Financial Accounting Standards Board (FASB) standards are now incorporated into FASB's Accounting Standards Codification (ASC), and SFAS 141 can be found under FASB ASC 805: Business Combinations. However, to be consistent with prior literature, we will refer to SFAS 141 instead of ASC 805. FASB revised SFAS 141 in 2007 and it is now called SFAS 141R. Paragraph 14 of SFAS 141R states that "The acquirer's application of the recognition principle and conditions may result in recognizing some assets and liabilities that the acquiree [target] had not previously recognized as assets and liabilities in its financial statements. For example, the acquirer recognizes the acquired identifiable intangible assets, such as a brand name, a patent, or a customer relationship, that the acquiree [target] did not recognize as assets in its financial statements because it developed them internally and charged the related costs to expense."

[9] Houlihan Lokey is a global investment banking firm founded in 1972. The firm operates through three main service lines: corporate finance (comprising mergers and acquisitions, capital markets, and second advisory), financial restructuring, and financial advisory services. For 2012, Houlihan Lokey ranked No. 1 in announced U.S. M&A deal volume for deals under $3 billion.

[10] Prior to SFAS 141, the accounting for mergers and acquisitions followed Accounting Principles Board (APB) Opinion 16, Business Combinations. Two methods of accounting, "purchase" and "pooling of interests," were allowed under APB 16. The "pooling" method combined assets and liabilities at book value. No fair values needed to be determined and no goodwill was created. The "purchase" method valued assets and liabilities at fair value and recognized intangible assets, including goodwill. In addition to eliminating the "pooling" method, SFAS 141 clarifies how intangibles should be valued in allocating the purchase price and requires reporting details on each major intangible asset class.

[11] For example, Kimbrough (2007) offers evidence that the value of intangible assets reported in the purchase price allocation provides valuable information to equity investors. Shalev, Zhang, and Zhang (2013) document that CEOs whose compensation packages rely on earnings-based bonuses are more likely to overallocate the purchase price to goodwill because it helps boosting future reported earnings thanks to the removal of mandatory amortization of goodwill under SFAS 141.

We also examine the effects on leverage of components of intangible assets. Under SFAS 141, acquirers allocate the purchase price to two main categories, tangible and intangible assets. The intangible assets category is further divided into five categories of identifiable intangible assets and one category of unidentifiable intangible assets, i.e., acquisition goodwill. Among the identifiable intangible asset categories, two are technology-related. They are developed technology, including patents, and in-process research and development. Another two are marketing-related. They are trademarks and trade names, including domain names, and customer-related assets, including backlog, customer contracts, and customer relationships. The fifth category covers all other identifiable intangible assets.

III. Hypotheses

We develop our hypotheses in the context of the following leverage regression model:

$$Lev_i = \alpha + \beta Tan_i + \omega Int_i + \gamma Con_i + \varepsilon_i \quad (1)$$

where *Lev* is the long-term debt divided by total assets, *Tan* stands for the ratio of tangible assets to total assets, *Int* stands for the fair market value of intangible assets reported in the purchase price allocation data of the acquiring firms' 10-Ks or 10-Qs, normalized by the purchase price, *Con* is a vector of control variables, and *i* denotes a firm.

Since the fair market value of identifiable intangible assets is available only at the time when the target is acquired, the purchase price allocation data limits us to a cross-sectional analysis. Due to our relatively short sample period, we include year indicators only in some regressions as robustness tests. Similarly, with our limited sample size, we add industry indicators only as robustness checks.

We measure *Tan* in two alternative ways, either with the tangible assets from the hand-collected purchase price allocation data (i.e., fair value estimates) normalized by the purchase price or with

the ratio of property, plant, and equipment (i.e., historical costs) to total assets from Compustat. We omit goodwill from the regressions because *Tan* plus *Int* plus goodwill divided by the purchase price add up to one, i.e., we can only have two of the three variables in a regression at the same time.

It is implausible that intangible assets have a negative effect on leverage because any valuable asset should contribute at least somewhat to a firm's debt capacity.[12] Still, this positive effect can be small or even insignificant, i.e., ω can be relatively small and may be even indistinguishable from zero. There are at least three reasons why intangible assets can be unrelated to leverage. First, collateralizing intangible assets is challenging. Intangible assets tend to be more difficult to identify, separate, utilize, and value. Furthermore, repossessing intangibles in case of default or bankruptcy is difficult, and agency problems can prevent the efficient use of intangible assets in production processes by anyone other than the owners of the intangible assets (Rampini and Viswanathan 2013). Second, and partially related to the first point, intangible assets traditionally have been regarded as more risky than tangible assets. Financing risky assets with equity should be more appropriate than financing them with debt in most cases. Third, intangible assets can be unimportant because most firms have enough tangible assets to support their desired leverage.

It is also possible that intangible assets provide important, substantial backing for leverage, in particular in light of intangible assets comprising increasing proportions of many firms' values as Paul Krugman's quote at the beginning of the paper implies. Loumioti (2012) reports that some intangible assets can constitute collateral. Some lenders accept liquid and redeployable intangible

[12] Empirically, it is possible to observe a negative relation between intangible assets and leverage if intangible assets proxy for other firm characteristics that are associated with low leverage, and we do not adequately control for such characteristics.

assets as collateral because they have found innovative ways of leveraging, financing, and valuing intangible assets. Ellis and Jarboe (2010) provide examples of such intangible asset-backed loans. Moreover, if the recent breed of intangible assets is less risky than traditional intangible assets, risk considerations may not prevent financing intangible assets with debt. Supporting this view, Larkin (2013) argues that positive consumer attitude towards a brand, an intangible asset, reduces the overall firm riskiness. She finds that firms use the higher stability provided by better brand perception to increase leverage and lower cash holdings. Finally, if the effect of intangible assets on leverage depends on the level of tangible assets that are present, we should find that intangible assets matter more when there are fewer tangible assets. Therefore, many intangible assets can support debt, i.e., ω can be significantly positive and relatively large.

We have several mechanisms in mind when we claim that, in particular collateralizable, assets support debt. Collateral should reduce borrowing costs (see Figure 1), and lower borrowing costs should lead to more debt financing. Collateralized debt is less information-sensitive than regular debt and, in the spirit of Myers and Majluf (1984), reduces the effects of asymmetric information. It can also prevent asset substitution that would otherwise lead to higher borrowing costs. For example, the more value that lenders can recover in case of the borrower's bankruptcy, the less likely is the borrower to substitute low-risk with high-risk projects which in turn allows the lenders to charge lower interest rates. Appendix A provides a simple numerical example. Other explanations can be based on moral hazard based on the *inalienability of human capital* as in Hart and Moore (1994) or private benefits as in Holmstrom and Tirole (1997).

IV. Data

The sample comprises 514 non-financial U.S. public firms that became targets of completed acquisitions by U.S. public acquirers between 2002 and 2014. Houlihan Lokey provides

us the original dataset of 6,133 acquisitions with purchase price allocation (PPA) information that is hand-collected from 10-Ks and 10-Qs. We match the 6,133 targets with Compustat using target company names. This matching reduces the sample to 1,216 targets. Limited data availability in Compustat and the exclusion of subsidiary and foreign targets further reduce the sample size to 671 firms.[13] After excluding financial firms, our final sample consists of 514 firms.

The unique feature of our dataset is that it provides fair value estimates of tangible and intangible assets based on arms' length transactions between targets and acquirers. With these exceptional data, we examine the relation between a target's tangible and intangible assets at the time of the acquisition and the target's leverage at the last fiscal year-end before the acquisition.

The dataset has three drawbacks. First, it is limited to target firms that are successfully acquired by other firms. Firms that become targets and are eventually acquired may have unique unobservable characteristics that drive intangibles to be positively correlated with leverage. Controlling for such biases and the endogeneity of becoming a target is difficult because we lack appropriate instruments. Yet, other evidence makes it unlikely that our findings only apply to the firms in our distinct sample. For example, our sample firms are similar along many dimensions to the Compustat universe of firms. Second, our sample only gives us a snapshot of the fair market values of targets' assets at the time of their acquisitions. Therefore, our analyses are limited to being strictly cross-sectional. Third, we have to assume that there are no systematic changes in the values of these assets in the year immediately prior to the acquisitions. While asset values generally change over the year before an acquisition, and such value changes can even be the reasons for

[13] We exclude from our sample 50 observations where the total purchase price allocation is less than half of the target's book or market value of assets at the time of the last fiscal year-end of the target because a negative 50% offer premium suggests a severely distressed target. For such targets, our assumption of no substantial change in the target's business situation between the prior fiscal year-end and the acquisition date is almost certainly violated. Furthermore, the negative 50% threshold can capture subsidiary or similar deals that we potentially failed to remove from the sample. Our results are qualitatively similar if we include these 50 observations.

some acquisitions, if the changes are not systematic, they should primarily add noise to our estimations. Ultimately, there are currently no other good alternatives to our sample for accurately measuring the fair value of firms' self-created intangible assets.[14]

Figure 2 shows the composition of purchase price allocations. It is a modified copy from the Houlihan and Lokey 2011 Purchase Price Allocation Study. Appendix B shows how the disclosure formats of the purchase price allocations in their 10-K filings to the Securities and Exchange Commission differ between two firms in our final sample. These variations in the reporting formats make collecting the purchase price allocation data nontrivial. The first example in Appendix B is the case of Zhone Technologies acquiring Sorrento Networks in July 2004. The total purchase price of $98 million is allocated to net tangible assets of $23.4 million, amortizable intangible assets of $14.8 million (consisting of $9.2 million of core technology and $5.6 million of customer relationships), in-process research and development (R&D) of $2.4 million, and acquisition goodwill of $57.2 million. The second example in Appendix B is K2 Inc. acquiring Brass Eagle, Inc. in December 2003. The purchase price of $81.7 million is allocated to $16.4 million of net tangible assets and $65.3 million of intangible assets. The intangible assets consist of $27 million of identifiable intangible assets ($1.9 million of patents, $0.2 million of order backlog, $0.3 million of trademarks, and $24.6 million of trade names and trademarks with indefinite lives not subject to amortization), and $38.4 million of acquisition goodwill.

We first compare our sample to the Compustat universe. The first column of Table 1 shows the variable means of these 96,477 firm-year observations of non-financial Compustat firms during our sample period. The remaining columns present the descriptive statistics for our 514 sample

[14] A possible estimate would be the difference between the market value of the firm and the book value of assets. Yet, it is unclear whether such an estimate measures the value of intangible assets, the difference between the market and book values of tangible assets, or the firm's future growth potential. Furthermore, this variable is mechanically tied to market leverage and therefore not useful in examining market leverage.

firms. Appendix C defines all variables. Unless otherwise noted, all variables are measured at the last fiscal year-end before the acquisition announcement. We winsorize all variables, except for *Marginal tax rate*, at 1% and 99% to reduce the impact of extreme observations.

Compared to the Compustat universe, the firms in our sample tend to be smaller, are more likely in technology industries, have fewer tangible assets, have higher cash liquidity, and experience lower cash flow volatilities. Overall, these characteristics are consistent with younger firms that tend to be typical acquisition targets. Beyond that, they do not appear to be substantially different from all other Compustat firms. In terms of leverage, both book and market leverage are insignificantly different between our sample firms and the Compustat universe. While both book and market leverage seem to decline over the four quarters prior to the last fiscal year-end before the acquisition announcement, the decline is not straight-line and of a small magnitude.

Table 2 shows the purchase price allocation data. Panel A presents the purchase price allocation in dollar amounts and Panel B in percentages of the total purchase price. All purchase price allocation data are hand-collected from acquirers' 10-Ks or 10-Qs. *Purchase price* (abbreviated *PP*) is the sum of *Tangible assets*, *Intangible assets*, and *Goodwill* from the PPA dataset. The main variable of interest in our subsequent analysis is *Intangible assets/ PP* while we control for *Tangible assets/ PP*. On average, 37% the purchase price is allocated to tangible assets, 25% to identifiable intangible assets, and the remaining 38% to acquisition goodwill. The 25% allocated to identifiable intangible assets consist of 11% technology-related, 11% marketing-related, and 3% other intangible assets.

In an untabulated correlation analysis, we find that the correlations among the historical cost-based Compustat variables *PPE/ assets*, *R&D/ sales*, and *Advertising/ sales* of the target firms and the fair value-based purchase price allocation variables *Tangible assets/ PP* and *Intangible*

assets/ PP have the expected signs. For instance, *PPE/ assets* is positively related to *Tangible assets/ PP*, negatively related to *Intangible assets/ PP*, and positively related to leverage. Both *R&D/ sales* and *Advertising/ sales* are positively correlated with *Intangible assets/ PP*. These positive correlations are not surprising because firms that spend substantially on R&D or advertising activities are likely creating technology-related or marketing-related intangible assets. *R&D/ sales* is negatively related to leverage supporting that research-oriented firms tend to have lower leverage. In contrast, *Advertising/ sales* is not significantly related to leverage. We further discuss and examine these associations in the multivariate analysis.

Panel A of Table 3 describes the distribution of our PPA sample and the Compustat universe across the 12 Fama-French industries[15]. We find higher proportions of acquisitions in certain industries, consistent with acquisitions occurring in industry waves (e.g., Mitchell and Mulherin 1996; Maksimovic and Phillips 2001; Rhodes-Kropf, Robinson, and Viswanathan 2005; Harford 2005; Ahern and Harford 2014). The industry variation of the purchase price allocation components and the proportions of firms with high tangible asset intensities in Panel B of Table 3 are largely as expected. For example, the top four industries with the highest intangible assets are healthcare, consumer non-durables, telecommunications, and business equipment. Healthcare has the highest percentage of technology-related intangible assets followed by the business equipment industry. Consumer non-durables has the highest percentage of marketing-related intangible assets.[16] Not surprisingly, utilities have the highest tangible asset intensity.

[15] Results are insensitive to different methods of industry classification, such as 2-digit Standard Industrial Classification (SIC) codes or the Fama-French 48-industry classification.

[16] Because most sample firms in the telecommunication industry are small and engaged in broadcasting and integrated telecommunication services, their intangible assets tend to be marketing-related rather than technology-related. Customer-related intangible assets are the main component of marketing-related intangibles.

V. Multivariate analysis of the relation between intangible assets and leverage

We design our multivariate tests to examine the extent to which intangible assets affect capital structure in addition to the variables already established in the literature, in particular tangible assets.

A. Analysis of aggregate intangible assets

Because our dependent variable is truncated at zero with 21% of firms in our sample having no leverage, Tobit estimations would be appropriate.[17] Since the Tobit results are similar to those from using ordinary least squares (OLS) with and without deleting the observations with zero leverage, and for easy in interpreting the results, we present the OLS estimations (without deleting the observations with zero leverage) in the paper. We assess statistical significance with heteroskedasticity-robust standard errors clustered by industry using the Fama-French 12-industry classification.[18] *Book leverage* is the dependent variable in Panel A of Table 4 while it is *Market leverage* in Panel B.

We control for the usual determinants of leverage that have been used in the literature.[19] *Log Market capitalization* and *Log Sales* control for size as larger firms tend to have more leverage. Since fast growing firms may have less debt, *Market-to-book* controls, among other, for growth opportunities. Profitability (*Operating profitability*) can have positive and negative effects on leverage. More cash on hand (*Cash liquidity*) should be associated with less leverage. The tax benefits of debt are higher with a higher *Marginal tax rate* and riskier cash flows (*Cash flow*

[17] Similarly, Strebulaev and Yang (2013) report that 22% of their sample firms have leverage ratios below 5%.
[18] Our results are robust to clustering by industry using the Fama-French 48-industry classification, 2-digit SIC codes, or 4-digit SIC codes. Results are also robust to double clustering by both year and industry.
[19] We base our variable selection on Barclay and Smith (1995), Rajan and Zingales (1995), Graham (2000), Baker and Wurgler (2002), Frank and Goyal (2003), Korajczyk and Levy (2003), Hovakimiam, Hovakimian, and Tehranian (2004), Faulkender and Petersen (2006), Flannery and Rangan (2006), Lemmon, Roberts and Zender. (2008), and Campello and Giambona (2013).

volatility) should discourage borrowing. To assess whether the fair value-based purchase price allocation data provide any additional information that is not captured by the historical cost-based Compustat variables *PPE/ assets, R&D/ sales*, and *Advertising/ sales*, we run our models with and without these variables.

The coefficients of the traditional determinants of leverage have, in general, the expected signs, and there are no surprises in the coefficients of the control variables. *PPE/ assets* and *R&D/ sales* are always significantly positive while *Advertising/ sales* has, with one exception, positive, yet insignificant coefficients. *Log Sales* is, with two exceptions, significantly positive and *Cash liquidity* is significantly negative in all estimations.

More importantly, the association between *Intangible assets/ PP* and leverage is positive and significant in all but one of the model specifications in Table 4, regardless of whether book or market leverage is the dependent variable or whether we control for fair value-based or historical cost-based estimates of tangible assets. The point estimates for *Intangible assets/ PP* are smaller than those for the two tangible asset measures when *Market leverage* is the dependent variable, but they are larger than those for *Tangible assets/ PP* when *Book leverage* is the dependent variable. For example, in model 4 with *Book leverage* as the dependent variable, the coefficient of *Intangible assets/ PP* is 0.224 while that of *Tangible assets/ PP* is 0.155. In model 4 with *Market leverage* as the dependent variable, the coefficients are 0.099 and 0.132, respectively. The coefficients of *PPE/ assets* are not directly comparable to those of *Intangible assets/ PP* and *Tangible assets/ PP* because *PPE/ assets* has a different denominator. Additionally, *PPE* is a book value from Compustat while *Tangible assets*, *Intangible assets*, and *PP* are fair (market) values from the PPA dataset. Overall, Table 4 shows that intangible assets are an important determinant of capital structure, apparently just as important as tangible assets. Although intangibles are

generally not even reported in financial statements, they seem to support debt in similar ways as tangible assets do.

The results in Table 4 are quite similar whether we include year and industry indicators or not. The sample covers 13 years and 12 industries. With 475 usable observations in most regressions, we must be cautious whether there is enough remaining variation in the sample when using year and industry indicators. We note that the indicators seem reduce our coefficient estimates meaningfully. Because of this concern, and the otherwise similar results with and without year and industry indicators, we omit these indicators in the remaining analyses where we frequently use subsamples that would exacerbate the problem of too many indicator variables.

Since tangible assets, identifiable intangible assets, and goodwill as fractions of the purchase price add up to one, we can only examine two of these three items at the same time. We choose to focus our tests on tangible assets and identifiable intangible assets because our hypotheses are for these two variables. In untabulated tests, we repeat our main analyses with goodwill as the main explanatory variable. Its coefficients are generally negative and significant, as expected in light of the coefficients on tangible and identifiable intangible assets being significantly positive. The negative correlation between goodwill (as a fraction of the purchase price) and leverage does not necessarily mean that goodwill by itself reduces leverage. Rather, this result can obtain because a large fraction of goodwill implies a low fraction of the sum of tangible assets and identifiable intangible assets. Our results show that tangible and identifiable intangible assets support debt, so the absence of tangible and identifiable intangible assets should have the opposite effect.

Firms that become targets and are eventually acquired may have unique unobservable characteristics that make their intangible assets particularly suitable to support debt. We would

like to address this potential sample selection bias with an appropriate econometric method. Yet, for identification purposes, we would need variables that predict which firms become targets and end up in our sample, but that are unrelated to the leverage of target firms prior to being acquired. We conjecture that acquirers seek targets for growth and profitability while large target size should be an impediment to becoming a target. So, we could use *Assets*, *Profit margin,* and *Sales growth* as instruments. However, these three variables almost certainly affect leverage and therefore are not appropriate instruments. Unfortunately, we have not found appropriate instruments and suppose that finding them is likely impossible in our case. Still, we use our inappropriate instruments in untabulated Heckman analyses and our main results remain unchanged. We acknowledge that the lack of endogeneity and selection controls limits any claims of causation. Yet, we contend that even just the descriptive nature of our analyses provides important new insights.

B. Analysis of intangible assets components

We also separately examine the effects on leverage of the three components of identifiable intangible assets: technology-related [*TRI*], marketing-related [*MRI*], and other intangible assets [*OI*]. In Table 5, we replicate Table 4 after decomposing identifiable intangible assets into these three components, measured as percentages of the purchase price. The dependent variable is *Book leverage* in models 1 to 3 and *Market leverage* in models 4 to 6.

Technology-related intangible assets have a positive and significant effect on leverage in all models, as do the intangible assets that are lumped together in the "other" category.[20] Marketing-related intangible assets have positive point estimates throughout, but are significant

[20] Some examples of intangible assets reported as "other" are unproved oil and gas properties, mineral rights, coal supply agreements, non-compete agreements, and leasehold interests.

only in one out of the six estimations. Overall, Table 5 suggests that technology-related and other intangible assets are the main drivers for the significantly positive relation between intangible assets and leverage.

C. Role of industry

Specific components that matter when they should matter would be further evidence that the leverage results are indeed related to the intangible assets. Intangible assets that are most relevant for a specific industry should have larger effects on leverage in that industry. We test this conjecture by examining whether technology-related intangible assets matter more for firms in technology industries than for firms in other industries. Accordingly, we expect technology firms to have higher *Intangible assets/ PP*, in particular *TRI/ PP*. In contrast, we expect firms in non-technology industries to have larger *MRI/ PP* compared to firms in technology industries. The univariate analyses in Panel A of Table 6 confirm our expectations. Given that technology firms have higher *Intangible assets/ PP*, we expect a stronger positive relation between intangible assets and leverage in technology firms. Furthermore, *TRI/ PP* should be the primary driver of this positive relation.

Panel B of Table 6 provides evidence that being a technology firm affects the relation between intangible assets leverage. In general, firms in technology industries have lower leverage than firms in non-technology industries as indicated by the negative, yet mostly insignificant coefficient of *Technology industry*. Models 2 and 4 show that the positive relation between *Intangible assets/ PP* and both book and market leverage is similar in technology firms compared to non-technology firms because the coefficients on the interaction variable *Intangible assets/ PP * Technology industry* are insignificant.

Models 3 and 5 demonstrate the importance of technology-related intangible assets for technology firms. They only support debt for technology firms. In contrast, for firms in non-technology industries the relation between leverage and *TRI/ PP* is negative. *MRI/ PP* is insignificantly positive for non-technology firms and significantly negative for technology firms. The coefficient of *Other/ PP* is significantly positive for all firms and insignificantly higher for technology firms in both the book and the market leverage estimations. Overall, our results indicate that the relation between leverage and intangible assets depends on industry and the nature of the intangible assets.

D. Role of tangible asset intensity

Intangible assets should matter less for firms that have high tangible asset intensities, i.e., firms where tangible assets comprise large portions of the firms' values. Most of these firms should have sufficient tangible assets to support all the debt they desire, making it unnecessary for intangible assets to back debt. We test this conjecture by running our regressions separately for firms with high and low tangible asset intensities.

Table 7 presents analyses of subsamples of firms with high or low tangible asset intensities. We classify the tangible asset intensity as high if the tangible assets are in the top tercile of the ratio of tangible assets to total purchase price (the other two components of the purchase price allocation are identifiable intangible assets and acquisition goodwill), and as low otherwise.[21] The resulting threshold for high asset tangibility is 0.45, i.e., tangible assets comprising 45% or more

[21] Since we use the fair value-based *Tangible assets/ PP* to split the sample, we include historical cost-based *PPE/ assets* as the tangibility measure in the subsample estimations. Note that *PPE* should be a subset of *Tangible assets*. Results are similar if we include *Tangible assets/ PP*.

of the total purchase price.[22] The dependent variable is *Book leverage* in models 1 and 2 and *Market leverage* in models 3 and 4. We use the same controls as in Table 4.

We find that intangible assets have significantly positive associations with leverage in the low tangible asset intensity subsample while the coefficients are insignificant in the high tangible asset intensity subsample. Untabulated results indicate that *TRI/ PP* and *OI/ PP* primarily drive the results, but that *MRI/ PP* also has a significant relation with *Book leverage* when the tangible asset intensity is low.[23] Overall, the results in Table 7 demonstrate that intangible assets support debt in particular for firms with low tangible asset intensities. Firms with high tangible asset intensities seem to have sufficient tangible assets to support debt to make intangible assets unimportant in their leverage decisions.

E. Quantifying debt supported by tangible and intangible assets

Next, we quantify the debt supported by tangible and intangible assets. Table 8 reports the relation between intangible assets and leverage that is estimated with OLS, Tobit, and median regressions. The dependent variable is *Long-term debt* and our explanatory variables of interest are *Tangible assets* and *Intangible assets*. Note that all variables are in dollars, i.e., they are not scaled. Data used in Panel A are not winsorized while data in Panel B are winsorized at the 5% and 95% levels because of the large skewness of variables in dollars. We do not include additional independent variables because, due to the measurement in dollars instead of ratios, many are highly correlated with our two included variables.

Model 1 in Panel A shows that a one dollar increase in intangible assets increases leverage by $0.16 while a one dollar increase in tangible assets increases leverage by $0.21. The magnitudes

[22] Results are robust to using a threshold of 0.5.
[23] The results in all models are robust to including R&D/sales and Advertising/sales as additional control variables.

are similar in the Tobit regression of model 2 but the estimate for *Intangible assets* is meaningfully smaller, yet still significant, in the median regression of model 3. In Panel B with the winsorizing, the point estimates on both *Tangible assets* and *Intangible assets* are generally lower than those in Panel A, except the point estimate of *Intangible assets* in the median regression approximately doubles. The significance levels are similar between Panels A and B. Overall, Table 8 shows that both tangible and intangible assets support debt. On average, on a per dollar basis, intangible assets support about three quarters as much debt as tangible assets.

F. Additional robustness tests

In Table 9, we split our sample approximately in half by announcement year. For both book and market leverage, the coefficients on *Intangible assets/ PP* are larger and substantially more significant in the latter part of the sample period from 2008 to 2014 than in the earlier part from 2002 to 2007. There are no systematic changes in the coefficients of *Tangible assets/ PP* between the two time periods. A possible explanation for these findings is that as intangible assets continue to become more important, their effects on capital structure become more pronounced. Furthermore, it is comforting that we get generally consistent results after splitting the sample in half.

G. Type of debt and debt maturity supported by intangible assets

Table 10 shows univariate analyses of various debt types (Panel A) and debt maturities (Panel B) after splitting the sample into low and high tangible asset intensity firms. We collect the various debt types from Capital IQ. In Panel A, firms with lower asset tangibility have relatively more term loans, bank debt, and convertible debt while they have relatively less unsecured and fixed-rate debt. These types of debt are well-suited for riskier and less transparent borrowers. Lack of collateralizable assets leaves unsecured debt as the only debt choice while uncertainty about the

value of a firm's intangible assets favors convertible debt. With convertible debt, lenders benefit if the borrower's intangible assets turn out to be particularly valuable. This participation on the upside can compensate the lenders for the potential losses if the borrower's intangible assets turn out to be less valuable than expected. Short-term and bank debt usually allows the lender to scrutinize the borrower more frequently and more in-depth, and to more timely adjust lending terms.

In Panel B, we assess whether the tangible asset intensity is related to debt maturities. The measures for debt maturity are (i) the ratio of debt in current liabilities (DLC in Compustat) to total long-term debt (DLC/ DLTT), (ii) the ratio of long-term debt due in next year (DD1) to total long-term debt, (iii) the ratio of long-term debt due in the next three years (DD1+DD2+DD3) to total long-term debt, and (iv) the ratio of long-term debt due in the next five years (DD1+DD2+DD3+DD4+DD5) to total long-term debt. Firms with lower asset tangibility are more likely to have shorter-term debt, i.e., debt maturing within the next five years. Shorter-term debt is well-suited for riskier and less transparent borrowers. Again, it appears that intangible assets tend to support different types of debt than tangible assets. In sum, firms and their lenders seem to rationally choose debt types that are best aligned with the tangible or intangible nature of the firms' assets.

VI. Conclusion

We show empirically that intangible assets have a robust positive relation with leverage even though these intangible assets are generally not reported in firms' financial statements and regulatory filings, with the exception of our subsample of firms that were subsequently acquired. On average, one dollar of intangible assets supports approximately three quarters as much debt as one dollar of tangible assets. Intangible assets have the strongest effect on leverage in technology

firms and in firms with low tangible asset intensities. Consistent with the nature of intangible assets, the level of asset tangibility affects the debt type and its maturity. Our paper's main innovation is that it circumvents the near impossibility (for outsiders) of estimating the market value of a firm's intangible assets by using a novel dataset that became available after a recent accounting rule change. While the dataset can only provide market value-based estimates of intangible assets for a small subset of firms, it is the first such dataset that allows a direct empirical examination of the relation between intangible assets and financial leverage. With the novel data, our study is the first that can quantify the relation of intangible assets and debt financing. Our results are important for the empirical research on the capital structure because they are likely applicable to many, if not most, firms and they confirm that intangible assets are one of the primary determinants of capital structure.

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Appendix A: Asset substitution example

Suppose all agents are risk-neutral and the risk-free interest rate equals 0%. All payoffs are common knowledge and low and high states of the world are equally likely.

Without any collateral, a project has the following payoffs:

	Low	High	Expected
(R)isky	0	180	90
(S)afe	50	150	100

Clearly, project R has a higher net present value (NPV). Yet, depending on the amount of debt, managers will not always pick the higher NPV project. The reason is that switching to the riskier, lower NPV project can lead to higher expected payoffs for shareholders. Of course, lenders will anticipate such project switching and charge interest rates accordingly.

How much debt can the firm have and still choose project S? The condition is:

$180 - D \leq 150 - D + 50 - D$

$\Leftrightarrow D \leq 20$, where D is the face value of the debt.

With debt smaller or equal to 20, the firm picks the safe project, never defaults, and consequently the interest rate is 0%.

What happens if the face value of the debt is 50? Now,

$180 - 50 \leq 150 - 50$

$\Leftrightarrow 130 \leq 100$, which is never true.

With debt of 50, the firm always chooses the risky project. Because the firm defaults half the time and has zero to repay, it can only borrow 25 for a promised repayment (face value) of 50. Therefore, the interest rate is $50/25 - 1 = 100\%$

We model collateral by increasing the minimum payoff in the low state and reducing the payoffs in the high state by the same amount of 30. An example for such collateral would be if the firm could acquire the know-how for a project either by buying patents (that can be easily sold in default and therefore can serve as collateral) or by investing in research and development (which might fail or be incomplete and therefore of little value in default). The payoffs with collateral are as follows:

	Low	High	Expected
(R)isky	30	150	90
(S)afe	80	120	100

Note that the expected payoffs remain the same. Now, how much debt can the firm have and still choose project S? The condition is:

$150 - D \leq 120 - D + 80 - D$

$\Leftrightarrow D \leq 50$, where D is the face value of the debt.

With debt smaller or equal to 50, the firm picks the safe project, never defaults, and consequently the interest rate is 0%.

What happens if the face value of the debt is 50? Now,

$150 - 50 \leq 200 - 100$

$\Leftrightarrow 100 \leq 100$, which is always true.

With debt of 50, the firm always chooses the risky project (technically it is indifferent between both projects, but we assume that in a tie, the firm chooses the overall more valuable project). Again, the interest rate is zero.

When we compare the projects without and with collateral, we see that with collateral the firm can borrow more at lower interest rates. Therefore, collateralizable assets should lead to lower interest rates and therefore larger amounts of debt.

Appendix B

Appendix B.1

Acquirer: Zhone Technologies Inc. Target: Sorrento Networks Corporation
Form 10-K for the year ending December 31, 2004
http://www.sec.gov/Archives/edgar/data/1101680/000119312505052811/d10k.htm

Purchased Technology

The Company recorded purchased technology related to acquisitions of $9.2 million, and $2.2 million during the years ended December 31, 2004, and 2003, respectively. To determine the values of purchased technology, the expected future cash flows of the existing developed technologies were discounted taking into account the characteristics and applications of the product, the size of existing markets, growth rates of existing and future markets, as well as an evaluation of past and anticipated product lifecycles.

(a) Sorrento Networks Corporation

In July 2004, the Company completed the acquisition of Sorrento Networks Corporation in exchange for total consideration of $98.0 million, consisting of common stock valued at $57.7 million, options and warrants to purchase common stock valued at $12.3 million, assumed liabilities of $27.0 million, and acquisition costs of $1.0 million. The Company acquired Sorrento to obtain its line of optical transport products and enhance its competitive position with cable operators. One of the Company's directors is a partner of a venture capital firm which is a significant stockholder of Zhone, and which also held warrants to purchase Sorrento common stock that were assumed by Zhone.

The purchase consideration was allocated to the fair values of the assets acquired as follows: **net tangible assets—$23.4 million, amortizable intangible assets—$14.8 million, purchased in-process research and development—$2.4 million, goodwill—$57.2 million** and deferred compensation—$0.2 million. The amount allocated to purchased in-process research and development was charged to expense during the third quarter of 2004, because technological feasibility had not been established and no future alternative uses for the technology existed. The estimated fair value of the purchased in-process research and development was determined using a discounted cash flow model, based on a discount rate which took into consideration the stage of completion and risks associated with developing the technology. Of the amount allocated to amortizable intangible assets, **$9.2 million was allocated to core technology**, which is being amortized over an estimated useful life of five years. The remaining **$5.6 million was allocated to customer relationships**, which is being amortized over an estimated useful life of four years.

Appendix B.2

Acquirer: K2 Inc. Target: Brass Eagle, Inc.
Form 10-K for the year ending December 31, 2003
http://www.sec.gov/Archives/edgar/data/6720/000119312504040670/d10k.htm

2003 Acquisitions

On December 16, 2003, K2 completed the acquisition of Brass Eagle, Inc. ("Brass Eagle") in a stock-for-stock exchange offer/merger transaction. Brass Eagle is a worldwide leader in the design, manufacture, marketing, and distribution of paintball products, including paintball markers, paintballs, and accessories.

On December 8, 2003, K2 completed the acquisition of Brass Eagle, Inc. ("Brass Eagle"), a designer, manufacturer and marketer of paintball products, including paintball markers, paintballs, and accessories in a stock-for-stock exchange offer/merger transaction. Under the terms of the merger, each outstanding share of Brass Eagle common stock was converted into 0.6036 shares of K2 common stock. Based on the number of common shares outstanding of Brass Eagle, approximately 4.5 million shares of K2's common stock were issued to the Brass Eagle shareholders, and the aggregate purchase price of the transaction was valued at approximately $78.4 million (excluding merger costs of approximately $3.4 million). The results of the operations of Brass Eagle have been included in the consolidated financial statements of K2 beginning with the date of the merger

The Brass Eagle transaction was accounted for under the purchase method of accounting; and, accordingly, the purchased assets and liabilities assumed were recorded at their estimated fair values at the date of the merger. The following table summarizes the total purchase price, estimated fair values of the assets acquired and liabilities assumed, and the resulting net intangible assets acquired at the date of the acquisition:

	In thousands	
Total purchase price, including estimated merger expenses and value of K2 stock options issued in exchange for Brass Eagle stock options outstanding (a)		$ **81,778** .
Total current assets	$ 51,027 .	
Property, plant and equipment	9,916 .	
Deferred taxes and other assets	11,485 .	
Net tangible assets acquired (b)	72,428 ..	
Total liabilities assumed (c)	56,016 .	
Net assets acquired (b) – (c) = (d)		**16,412** .
Net intangible assets acquired (a) – (d)		$ **65,366** .

Based on a valuation completed by K2 during 2003, **net intangible assets acquired** were allocated to **patents of $1.9 million** with an average life of 9 years; **order backlog of $0.2 million** with an average life of less than one year; **product trademarks of $0.3 million** with an average life of 5 years; **tradenames/trademarks with indefinite lives not subject to amortization of $24.6 million**; and **goodwill not subject to amortization of $38.4 million**.

Appendix C: Variable definitions

Variable	Description
Advertising	Advertising expenditure. Source: Compustat
Advertising/ sales	*Advertising*/ *Sales*, three-year average. Source: Compustat
Assets	Book value of total assets. Source: Compustat
Book leverage	*Long-term debt*/ *Assets*. Source: Compustat
Cash	Cash and cash-equivalents. Source: Compustat
Cash flow volatility	Standard deviation of *Operating profitability*, measured over three years prior to acquisition announcement. Source: Compustat
Cash liquidity	*Cash*/ *Assets*. Source: Compustat
Debt in current liabilities/ total long-term debt	Debt in current liabilities (DLC in Compustat)/ total long-term debt (DLTT). Source: Compustat
Goodwill	Goodwill. Source: PPA dataset based on 10-K or 10-Q of acquirer
Intangible assets	Intangible assets. Source: PPA dataset based on 10-K or 10-Q of acquirer
Intangible assets/ PP	*Intangible assets*/ *Purchase price*
Long-term debt	Book value of long-term debt. Source: Compustat
Long-term debt due in next year/ total long-term debt	Long-term debt due in the next year (DD1 in Compustat)/ total long-term debt (DLTT). Source: Compustat
Long-term debt due in next 3 years/ total long-term debt	Long-term debt due in the next three years (DD1+DD2+DD3 in Compustat) / total long-term debt (DLTT). Source: Compustat
Long-term debt due in next 5 years/ total long-term debt	Long-term debt due in the next five years (DD1+DD2+DD3+DD4+DD5 in Compustat) / total long-term debt (DLTT). Source: Compustat
Marginal tax rate	Based on Graham's (2000) marginal tax rate
Market capitalization	*Assets* – book value of common equity + market value of common equity, measured at end of last quarter before the acquisition announcement
Market leverage	*Long-term debt*/ *Market capitalization*. Source: Compustat
Marketing-related	Marketing-related intangible assets, i.e., trademarks and trade names, including domain names, and customer-related assets, including backlog, customer contracts, and customer relationships. Source: PPA dataset based on 10-K or 10-Q of acquirer
Market-to-book	Market value of common equity/ book value of common equity. Source: Compustat
MRI/ PP	*Marketing-related*/ *Purchase price*
Non-technology industry	1 – *Technology industry*
OI/ PP	*Other*/ *Purchase price*
Operating profitability	Earnings-before-interest-taxes-and-depreciation/ *Assets*. Source: Compustat
Other	Non-marketing-related and non-technology-related intangible assets. Source: PPA dataset based on 10-K or 10-Q of acquirer

PPE	Net property, plant and equipment. Source: Compustat
PPE/ assets	*PPE*/ *Assets*
Profit margin	Net income/ *Sales*. Source: Compustat
Purchase price, abbreviated PP	*Tangible assets* + *Intangible assets* + *Goodwill*. Source: PPA dataset based on 10-K or 10-Q of acquirer
R&D	Research and development expenditures. Source: Compustat
R&D/ sales	*R&D*/ *Sales*, three-year average. Source: Compustat
Sales	Net annual sales. Source: Compustat
Sales growth	Ln(*Sales*/ lagged *Sales*)
Tangible assets	Tangible assets. Source: PPA dataset based on 10-K or 10-Q of acquirer
Tangible assets/ PP	*Tangible assets*/ *Purchase price*
Technology industry	Binary variable = 1 if firm's 2-digit SIC code is 12 (medical equipment), 13 (pharmaceutical products), 21 (machinery), 22 (electrical equipment), 26 (defense), 35 (computers), 36 (electronic equipment), or 37 (measuring and laboratory equipment)
Technology-related	Technology-related intangible assets, i.e., developed technology, including patents, and in-process research and development. Source: PPA dataset based on 10-K or 10-Q of acquirer
TRI/ PP	*Technology-related*/ *Purchase price*

Table 1: Descriptive statistics

This table reports descriptive statistics for our sample of 514 non-financial U.S. public firms that were acquired by U.S. public acquirers between 2002 and 2014 and compares them to the Compustat universe of 96,477 non-financial firm-year observations over the same time period. Appendix B defines all variables. All variables, except for *Marginal tax rate*, are winsorized at the 1st and 99th percentile. ***, **, and * denote significance at the 1%, 5% and 10% levels for the differences in means between our sample and the Compustat universe.

	Compustat		Our sample				
	mean	median	mean	sd	p25	p50	p75
Assets (billion $)	3.199	0.182	1.431 ***	4.663	0.078	0.247	0.891
Assets with MktCap. (billion $)	4.738	0.286	2.361 ***	7.321	0.115	0.465	1.671
Market capitalization (billion $)	2.565	0.164	1.467 ***	4.836	0.069	0.302	0.957
Long-term debt (billion $)	0.736	0.006	0.381 ***	1.264	0.000	0.004	0.180
Book leverage	0.198	0.100	0.174	0.345	0.000	0.046	0.259
Book leverage lag 1	0.196	0.100	0.170 **	0.223	0.000	0.076	0.279
Book leverage lag 2	0.194	0.100	0.172 **	0.230	0.000	0.060	0.281
Book leverage lag 3	0.195	0.100	0.186	0.248	0.000	0.081	0.301
Book leverage lag 4	0.194	0.100	0.195	0.255	0.000	0.109	0.313
Market leverage	0.100	0.042	0.109	0.152	0.000	0.028	0.179
Market leverage lag 1	0.100	0.042	0.110	0.150	0.000	0.036	0.185
Market leverage lag 2	0.101	0.042	0.108	0.149	0.000	0.025	0.178
Market leverage lag 3	0.101	0.042	0.115 *	0.154	0.000	0.030	0.195
Market leverage lag 4	0.104	0.042	0.121 **	0.159	0.000	0.047	0.195
Market-to-book	2.473	1.712	2.699 *	2.721	1.217	2.100	3.403
Sales (billion $)	2.110	0.151	1.221 ***	4.310	0.053	0.197	0.715
Operating profitability	-0.166	0.089	-0.076 **	4.052	-0.018	0.091	0.181
Cash liquidity	0.215	0.107	0.286 ***	0.254	0.055	0.207	0.492
Cash (billion $)	0.238	0.243	0.189 ***	0.151	0.020	0.210	0.346
Marginal tax rate	0.308	0.038	0.092 ***	0.211	0.020	0.046	0.098
Cash flow volatility	0.308	0.178	0.092 ***	0.211	0.020	0.046	0.098
PPE/ assets	0.269	0.028	0.198 ***	0.215	0.053	0.107	0.269
PPE (billion $)	0.970	0.000	0.443 ***	1.627	0.005	0.025	0.169
R&D/ sales	0.351	0.001	0.413	1.289	0.000	0.075	0.225
R&D (billion $)	0.026	0.000	0.029	0.074	0.000	0.006	0.026
Advertising/ sales	0.012	0.000	0.012	0.028	0.000	0.000	0.012
Advertising (billion $)	0.012	0.000	0.012	0.050	0.000	0.000	0.002
Technology industry	0.292	0.000	0.381 ***	0.486	0.000	0.000	1.000
Profit margin	-0.354	0.016	-0.345	1.385	-0.174	0.011	0.068
Sales growth	0.100	0.074	0.079	0.302	-0.052	0.070	0.195
Observations	96,477			514			

Table 2: Purchase price allocation details

This table reports descriptive statistics of the purchase price allocation data, Panel A in billions of dollars and Panel B as percentages of *Purchase price*. Appendix B defines all variables.

Panel A: In billions of dollars

	mean	sd	p25	p50	p75	p90
Purchase price allocation	2.863	6.972	0.186	0.687	2.325	6.372
Tangible assets	1.205	3.927	0.050	0.175	0.691	2.389
Intangible assets	0.721	1.811	0.027	0.117	0.515	1.628
Technology-related	0.139	0.343	0.000	0.008	0.074	0.422
Marketing-related	0.267	0.634	0.004	0.034	0.197	0.777
Other	0.139	0.774	0.000	0.000	0.011	0.110
Goodwill	0.937	2.071	0.050	0.227	0.872	2.139

Panel B: As percentages of *Purchase price*

	mean	sd	p25	p50	p75	p90
Tangible assets/ PP	36.48	23.22	18.65	32.13	50.09	70.75
Intangible asset/ PP	25.97	17.86	12.75	23.77	34.94	48.49
TRI/ PP	10.94	17.00	0.00	3.61	14.77	31.21
MRI/ PP	11.61	11.54	2.63	8.69	17.64	27.93
OI/ PP	3.39	9.39	0.00	0.00	1.43	11.25
Goodwill/ PP	37.55	19.90	21.80	37.55	51.98	63.98

Table 3: Sample distribution by industry

Panel A shows the distribution of our sample firms across the 12 Fama-French industries and compares it to the Compustat universe. Panel B shows the distribution of the purchase price allocation components and the proportion of firms with high tangible asset intensity, i.e., tangible assets are in the top tercile of the ratio of tangible assets to total purchase price, across the 12 Fama-French industries. Appendix B defines all variables.

Panel A: Distribution of firms across industries

	All		Non-PPA sample		PPA sample	
	N	%	N	%	N	%
Total	96,477	100	95,963	100	514	100
Consumer non-durables	5,368	5.6	4,547	4.7	21	4.1
Consumer durables	2,648	2.7	2,266	2.4	10	2.0
Manufacturing	10,098	10.5	8,611	9.0	38	7.4
Energy	5,107	5.3	4,445	4.6	17	3.3
Chemicals and allied products	2,730	2.8	2,373	2.5	12	2.3
Business equipment	22,337	23.2	18,859	19.7	200	38.9
Telecommunications	4,615	4.8	3,930	4.1	24	4.7
Utilities	4,263	4.4	3,663	3.8	7	1.4
Shops	9,759	10.1	8,215	8.6	42	8.2
Healthcare	12,691	13.2	11,026	11.5	80	15.6
Other (non-financial)	16,861	17.5	14,426	15.0	63	12.3

Panel B: Purchase price allocation components by industry

Percentage of Purchase price	Tangible assets	Intangible assets	Goodwill	Tech-nology-related	Market-ing-related	Other	Proportion of firms with high tangible asset intensity
All industries	36.7	25.9	37.5	11.0	11.5	3.4	0.12
Consumer non-durables	33.0	35.6	31.4	0.1	29.9	5.6	0.00
Consumer durables	44.2	21.2	34.6	8.2	11.9	1.1	0.30
Manufacturing	48.8	17.6	33.6	2.9	13.1	1.6	0.22
Energy	66.4	14.7	18.9	0.3	4.5	9.9	0.40
Chemicals and allied products	53.0	19.2	27.8	4.7	11.0	3.5	0.25
Business equipment	31.2	25.3	43.5	12.1	10.8	2.4	0.06
Telecommunications	40.7	26.7	32.6	0.0	13.5	13.2	0.13
Utilities	75.7	4.7	19.7	0.0	4.6	0.0	0.75
Shops	41.5	20.2	38.3	1.6	15.7	2.7	0.23
Healthcare	23.2	42.3	34.5	33.9	5.4	2.9	0.04
Other	43.5	19.6	36.9	3.1	13.2	3.2	0.20

Table 4: Leverage regressions

This table shows OLS regressions. The dependent variable is *Book leverage* in Panel A and *Market leverage* in Panel B. Appendix B defines all variables. *p*-values are in parentheses. All regressions have intercepts and use Eicker-Huber-White-Sandwich heteroskedasticity-robust standard errors clustered by industry. ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Panel A: Book leverage

Dependent variable	Book leverage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Purchase price allocation:								
Tangible assets/ PP			0.150***	0.155***		0.156***	0.107***	0.112***
			(0.000)	(0.000)		(0.000)	(0.002)	(0.002)
Intangible assets/ PP			0.201***	0.224***	0.216***	0.226***	0.132***	0.143**
			(0.001)	(0.000)	(0.002)	(0.001)	(0.006)	(0.011)
PPE/ assets					0.323***			
					(0.000)			
Control variables								
R&D/ sales		0.018***	0.016***			0.016**	0.010***	0.011*
		(0.000)	(0.000)			(0.020)	(0.008)	(0.058)
Advertising/ sales		0.037	0.093			0.063	0.045	0.012
		(0.839)	(0.588)			(0.702)	(0.813)	(0.951)
Log Market capitalization	0.001	-0.001	0.006	0.008	-0.008	0.005	0.000	-0.002
	(0.945)	(0.953)	(0.332)	(0.165)	(0.154)	(0.534)	(0.982)	(0.860)
Market-to-book	0.005	0.005	0.003	0.002	0.001	0.003	0.002	0.003
	(0.172)	(0.138)	(0.534)	(0.631)	(0.701)	(0.408)	(0.530)	(0.457)
Log Sales	0.030	0.032	0.025***	0.023**	0.035***	0.029***	0.030***	0.032***
	(0.117)	(0.105)	(0.004)	(0.014)	(0.000)	(0.000)	(0.006)	(0.000)
Operating profitability	-0.018**	-0.007	0.005	-0.001	-0.002	0.004	0.003	0.002
	(0.015)	(0.306)	(0.178)	(0.457)	(0.237)	(0.280)	(0.412)	(0.500)
Cash liquidity	-0.287***	-0.297***	-0.317***	-0.307***	-0.169**	-0.319***	-0.255***	-0.263***
	(0.007)	(0.005)	(0.000)	(0.000)	(0.012)	(0.000)	(0.005)	(0.005)
Marginal tax rate	-0.127	-0.121	-0.108	-0.109	-0.093	-0.128	-0.077	-0.090
	(0.265)	(0.293)	(0.305)	(0.299)	(0.341)	(0.218)	(0.361)	(0.281)
Cash flow volatility	-0.111	-0.152	-0.075	-0.032	-0.041	-0.093	-0.070	-0.082
	(0.190)	(0.214)	(0.571)	(0.764)	(0.673)	(0.398)	(0.565)	(0.443)
Year indicators	No	No	No	No	No	Yes	No	Yes
Industry indicators	No	No	No	No	No	No	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.185	0.190	0.210	0.207	0.263	0.211	0.253	0.248
Observations	475	475	475	476	476	475	475	475

Panel B: Market leverage

Dependent variable	Market leverage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Purchase price allocation:								
Tangible assets/ PP			0.127***	0.132***		0.131***	0.098***	0.103***
			(0.000)	(0.000)		(0.000)	(0.005)	(0.005)
Intangible assets/ PP			0.078***	0.099***	0.078**	0.090**	0.039**	0.039
			(0.009)	(0.002)	(0.036)	(0.021)	(0.036)	(0.180)
PPE/ assets					0.221***			
					(0.000)			
Control variables								
R&D/ sales		0.014***	0.014***			0.014**	0.010***	0.010**
		(0.000)	(0.000)			(0.011)	(0.000)	(0.025)
Advertising/ sales		-0.034	0.044			0.028	0.044	0.022
		(0.709)	(0.703)			(0.811)	(0.730)	(0.871)
Log Market capitalization	-0.020	-0.022	-0.013	-0.011	-0.023***	-0.013	-0.019	-0.019
	(0.135)	(0.114)	(0.175)	(0.220)	(0.006)	(0.188)	(0.140)	(0.142)
Market-to-book	0.000	0.001	-0.001	-0.001	-0.002	0.000	-0.001	-0.001
	(0.939)	(0.821)	(0.827)	(0.698)	(0.476)	(0.991)	(0.782)	(0.841)
Log Sales	0.041**	0.043**	0.033***	0.031***	0.041***	0.033***	0.039***	0.038***
	(0.013)	(0.010)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Operating profitability	-0.016***	-0.008	0.001	-0.004***	-0.005***	0.001	0.000	-0.001
	(0.008)	(0.168)	(0.571)	(0.000)	(0.000)	(0.719)	(0.862)	(0.781)
Cash liquidity	-0.165**	-0.171**	-0.191***	-0.183***	-0.085**	-0.198***	-0.157***	-0.168***
	(0.023)	(0.015)	(0.000)	(0.000)	(0.037)	(0.000)	(0.009)	(0.005)
Marginal tax rate	-0.045	-0.041	-0.049	-0.050	-0.036	-0.055	-0.020	-0.023
	(0.552)	(0.591)	(0.455)	(0.447)	(0.529)	(0.373)	(0.704)	(0.644)
Cash flow volatility	-0.089**	-0.117	-0.066	-0.030	-0.039	-0.076	-0.067	-0.072
	(0.049)	(0.109)	(0.386)	(0.608)	(0.458)	(0.233)	(0.324)	(0.220)
Year indicators	No	No	No	No	No	Yes	No	Yes
Industry indicators	No	No	No	No	No	No	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.244	0.253	0.281	0.273	0.321	0.281	0.321	0.317
Observations	475	475	475	476	476	475	475	475

Table 5: Purchase price allocation components

This table reports OLS estimations. The dependent variable is *Book Leverage* in columns 1 to 3 and *Market leverage* in columns 4 to 6. Appendix B defines all variables. *p*-values, based on Eicker-Huber-White-Sandwich heteroskedasticity-robust standard errors clustered by industry, are in parentheses ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Dependent variable	Book leverage			Market leverage		
	(1)	(2)	(3)	(4)	(5)	(6)
Purchase price allocation						
Tangible assets/ PP	0.146***	0.149***		0.119***	0.122***	
	(0.001)	(0.000)		(0.000)	(0.000)	
TRI/ PP	0.168***	0.205***	0.208***	0.051**	0.085***	0.075**
	(0.010)	(0.002)	(0.007)	(0.038)	(0.001)	(0.045)
MRI/ PP	0.179	0.182	0.221*	0.031	0.033	0.036
	(0.122)	(0.120)	(0.065)	(0.352)	(0.348)	(0.317)
OI/ PP	0.306**	0.319**	0.227*	0.205***	0.214***	0.142*
	(0.014)	(0.015)	(0.084)	(0.008)	(0.010)	(0.097)
PPE/ assets			0.323***			0.211***
			(0.001)			(0.001)
Control variables						
R&D/ sales	0.016***			0.015***		
	(0.001)			(0.000)		
Advertising/ sales	0.052			0.005		
	(0.739)			(0.965)		
Log Market capitalization	0.006	0.007	-0.007	-0.014	-0.013	-0.024***
	(0.567)	(0.482)	(0.307)	(0.180)	(0.221)	(0.007)
Market-to-book	0.003	0.002	0.001	-0.001	-0.001	-0.002
	(0.523)	(0.637)	(0.711)	(0.837)	(0.708)	(0.497)
Log Sales	0.025**	0.023*	0.035***	0.034***	0.032***	0.042***
	(0.033)	(0.058)	(0.000)	(0.001)	(0.003)	(0.000)
Operating profitability	0.005	-0.002	-0.002	0.001	-0.005***	-0.005***
	(0.174)	(0.379)	(0.273)	(0.626)	(0.000)	(0.000)
Cash liquidity	-0.310***	-0.303***	-0.167***	-0.184***	-0.179***	-0.089**
	(0.000)	(0.000)	(0.006)	0.000	0.000	(0.025)
Marginal tax rate	-0.110	-0.108	-0.094	-0.049	-0.047	-0.034
	(0.330)	(0.337)	(0.364)	(0.471)	(0.483)	(0.558)
Cash flow volatility	-0.070	-0.031	-0.040	-0.063	-0.030	-0.040
	(0.594)	(0.781)	(0.696)	(0.386)	(0.599)	(0.448)
Intercept	-0.006	-0.008	-0.036	0.008	0.005	-0.001
	(0.918)	(0.881)	(0.489)	(0.835)	(0.887)	(0.985)
Adjusted R^2	0.23	0.22	0.28	0.31	0.29	0.34
Observations	475	476	476	475	476	476

Table 6: Effect of technology industry

Panel A reports the distribution of the purchase price allocation components after splitting the sample into technology and non-technology industry firms. The last row indicates the significance of the differences between technology and non-technology industry firms. Panel B shows OLS estimations. The dependent variable is *Book Leverage* in columns 1 to 3 and *Market leverage* in columns 4 and 5. All estimations contain the same control variables as in Table 4. *p*-values, based on Eicker-Huber-White-Sandwich heteroskedasticity-robust standard errors clustered by industry, are in parentheses. Appendix B defines all variables. ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Panel A: Purchase price allocation components by technology industry classification

	Tangible assets/ PP	Intangible assets/ PP	Goodwill/ PP	TRI/ PP	MRI/ PP	OI/ PP
Technology industry [N=196]	30.9	32.2	36.9	22.0	8.1	2.0
Non-technology industry [N=316]	40.2	22.0	37.8	4.1	13.6	4.3
Significance of difference	***	***		***	***	***

Panel B: OLS models with *Technology industry* interactions

Dependent variable	Book leverage			Market leverage	
Model	(1)	(2)	(3)	(4)	(5)
Tangible assets/ PP		0.114**	0.083*	0.127***	0.099**
		(0.043)	(0.100)	(0.002)	(0.021)
Tangible assets/ PP * Technology industry		0.018	0.049	-0.060	-0.035
		(0.848)	(0.596)	(0.431)	(0.627)
Intangible assets/ PP		0.159*		0.082*	
		(0.056)		(0.078)	
Intangible assets/ PP * Technology industry		0.081		-0.008	
		(0.429)		(0.905)	
TRI/ PP			-0.284*		-0.161*
			(0.085)		(0.055)
TRI/ PP* Technology industry			0.505**		0.225**
			(0.013)		(0.022)
MRI/ PP			0.207		0.045
			(0.215)		(0.647)
MRI/ PP * Technology industry			-0.353**		-0.167**
			(0.019)		(0.031)
OI/ PP			0.250**		0.214***
			(0.015)		(0.010)
OI/PP * Technology industry			0.337		0.079
			(0.118)		(0.500)
Technology industry	-0.047*	-0.079	-0.075	-0.010	-0.019
	(0.088)	(0.144)	(0.125)	(0.807)	(0.627)
R&D/ sales	0.019***	0.014***	0.014***	0.013***	0.013***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Intercept	0.114	0.041	0.087	0.014	0.047
	(0.103)	(0.586)	(0.276)	(0.734)	(0.342)
Other firm characteristics as in Table 4	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.20	0.21	0.23	0.27	0.29
Observations	475	475	475	476	475

Table 7: Leverage regressions by tangible asset intensity

This table shows OLS estimations separately for firms with low and high tangible asset intensities. We classify tangible asset intensity as high if the tangible assets comprise at least 45% of the total purchase price. The dependent variable is *Book leverage* in columns 1 and 2 and *Market leverage* in columns 3 and 4. Appendix B defines all variables. *p*-values, based on Eicker-Huber-White-Sandwich heteroskedasticity-robust standard errors clustered by industry, are in parentheses. ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Tangible assets/ PP	Bottom 2 terciles	Top tercile	Bottom 2 terciles	Top tercile
Tangible asset intensity	low	high	low	high
Dependent variable	Book leverage		Market leverage	
	(1)	(2)	(3)	(4)
Purchase price allocation				
PPE/ assets	0.309*	0.299***	0.144*	0.209***
	(0.053)	(0.002)	(0.089)	(0.003)
Intangible assets/ PP	0.236***	0.193	0.120***	0.085
	(0.008)	(0.162)	(0.008)	(0.289)
Control variables				
R&D/ sales	0.005**	0.075***	0.005***	0.065***
	(0.046)	(0.001)	(0.008)	(0.001)
Advertising/ sales	0.092	0.096	0.043	0.019
	(0.628)	(0.791)	(0.641)	(0.947)
Log Market capitalization	-0.003	-0.004	-0.022***	-0.014
	(0.840)	(0.844)	(0.008)	(0.422)
Market-to-book	0.000	0.012	-0.001	-0.001
	(0.993)	(0.499)	(0.540)	(0.947)
Log Sales	0.028*	0.038*	0.037***	0.041**
	(0.080)	(0.073)	(0.001)	(0.025)
Operating profitability	0.001	-0.001	-0.002**	-0.004
	(0.747)	(0.952)	(0.037)	(0.821)
Cash liquidity	-0.234**	-0.165*	-0.130**	-0.123
	(0.039)	(0.057)	(0.029)	(0.110)
Marginal tax rate	-0.109	-0.113	-0.053	-0.049
	(0.349)	(0.426)	(0.422)	(0.718)
Cash flow volatility	-0.072	-0.190	-0.068	-0.165
	(0.487)	(0.483)	(0.194)	(0.458)
Intercept	-0.014	-0.066	0.011	-0.024
	(0.839)	(0.476)	(0.779)	(0.764)
Adjusted R^2	0.226	0.309	0.289	0.285
Observations	330	145	330	145

Table 8: Quantifying debt supported by tangible and intangible assets

This table reports OLS, Tobit, and Median regression models. The dependent variable is *Long-term debt*. The only independent variables are *Tangible asset* and *Intangible assets*. We do not include additional explanatory variables because of the substantial correlations of the variables measured in dollar amounts. Appendix B defines all variables. *p*-values are in parentheses. The regressions have intercepts and use different methods to estimate the significance of the standard errors, robust for OLS and Tobit and simple standard errors for Median. ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Panel A: Unwinsorized

Dependent variable	Long-term debt		
	(1)	(2)	(3)
Estimation method	OLS	Tobit	Median
Tangible assets	0.212***	0.222***	0.285***
	(0.005)	(0.000)	(0.000)
Intangible assets	0.161*	0.183**	0.023**
	(0.056)	(0.025)	(0.031)
Intercept	6.842	-270.335**	-13.999
	(0.887)	(0.012)	(0.481)
Adjusted R^2 or Pseudo R^2	0.659	0.065	0.336
Observations	508	508	508

Panel B: Winsorized at 5% and 95%

Dependent variable	Long-term debt		
	(1)	(2)	(3)
Estimation method	OLS	Tobit	Median
Tangible assets	0.124***	0.131***	0.176***
	(0.001)	(0.000)	(0.000)
Intangible assets	0.104*	0.118**	0.057***
	(0.052)	(0.024)	(0.000)
Intercept	90.720	-99.108	-6.622
	(0.109)	(0.256)	(0.702)
Adjusted R^2 or Pseudo R^2	0.575	0.053	0.336
Observations	508	508	508

Table 9: Leverage regressions split by time

This table reports OLS regressions after splitting the sample approximately in half. The dependent variable is *Book Leverage* in columns 1 and 2 and *Market leverage* in columns 3 and 4. Appendix B defines all variables. *p*-values, based on Eicker-Huber-White-Sandwich heteroskedasticity-robust standard errors clustered by industry, are in parentheses ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Dependent variable	Book leverage		Market leverage	
Time period	2002 to 2007	2008 to 2014	2002 to 2007	2008 to 2014
	(1)	(2)	(3)	(4)
Purchase price allocation:				
Tangible assets/ PP	0.130**	0.224**	0.136***	0.124**
	(0.011)	(0.016)	(0.007)	(0.021)
Intangible assets/ PP	0.156*	0.382***	0.051	0.156***
	(0.052)	(0.000)	(0.210)	(0.002)
Control variables				
R&D/ sales	-0.006	0.019*	0.005	0.015*
	(0.524)	(0.069)	(0.325)	(0.067)
Advertising/ sales	0.332	-0.001	0.243	-0.036
	(0.360)	(0.998)	(0.296)	(0.827)
Log Market capitalization	0.009	0.003	-0.008	-0.022
	(0.174)	(0.906)	(0.330)	(0.399)
Market-to-book	0.003	0.004	-0.001	0.001
	(0.253)	(0.751)	(0.616)	(0.931)
Log Sales	0.019***	0.037	0.024***	0.048**
	(0.000)	(0.159)	(0.003)	(0.025)
Operating profitability	-0.015	0.007	-0.007	0.002
	(0.106)	(0.198)	(0.105)	(0.686)
Cash liquidity	-0.370***	-0.267***	-0.226***	-0.150**
	(0.000)	(0.007)	(0.000)	(0.036)
Marginal tax rate	-0.252**	0.039	-0.133*	0.048
	(0.029)	(0.739)	(0.081)	(0.580)
Cash flow volatility	-0.139	-0.112	-0.095*	-0.102
	(0.186)	(0.624)	(0.083)	(0.542)
Intercept	0.090**	-0.198**	0.056**	-0.087
	(0.011)	(0.031)	(0.046)	(0.208)
Adjusted R^2	0.210	0.223	0.282	0.281
Observations	259	216	259	216

Table 10: Univariate analysis on debt type and maturity by tangible asset intensity

This table shows univariate analyses of various debt types (Panel A) and debt maturities (Panel B) after splitting the sample based on tangible asset intensities. We classify tangible asset intensity as high if it is in the top tercile of *Tangible assets/ PP*. The debt types are from Capital IQ. Appendix B defines all other variables. ***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

Panel A: Debt types

Tangible assets/ PP	All	Bottom 2 terciles	Top tercile	Difference	
Tangible asset intensity		low	high	low-high	
Type of debt as % of total debt					
Long-term debt (including capital leases)	74.3	72.2	78.9	-6.7	**
Total secured debt	54.7	56.3	51.1	5.1	
Total unsecured debt	47.5	45.2	52.7	-7.5	**
Total term loans	25.8	28.8	19.1	9.8	***
Fixed-rate debt	45.1	41.5	53.0	-11.5	***
Variable-rate debt	35.3	35.9	33.8	2.1	
Total bank debt	41.5	43.9	36.0	7.9	**
Total commercial paper	0.5	0.3	1.0	-0.7	*
Total convertible debt	15.4	17.4	11.0	6.4	**
Total revolving debt	19.5	19.3	19.9	-0.6	
Observations	453	313	140		

Panel B: Debt maturity

Tangible assets/ PP	All	Bottom 2 terciles	Top tercile	Difference	
Tangible asset intensity		low	high	low-high	
Debt in current liabilities/ total long-term debt	37.2	40.4	30.6	9.7	**
Long-term debt due in next year/ total long-term debt	25.0	28.2	18.7	9.5	***
Long-term debt due in next 3 years/ total long-term debt	46.5	49.7	39.9	9.7	**
Long-term debt due in next 5 years/ total long-term debt	63.2	65.6	58.1	7.5	**
Observations	453	313	140		

Figure 1: Cost of debt with and without collateral

This figure shows the cost of debt with and without collateral.

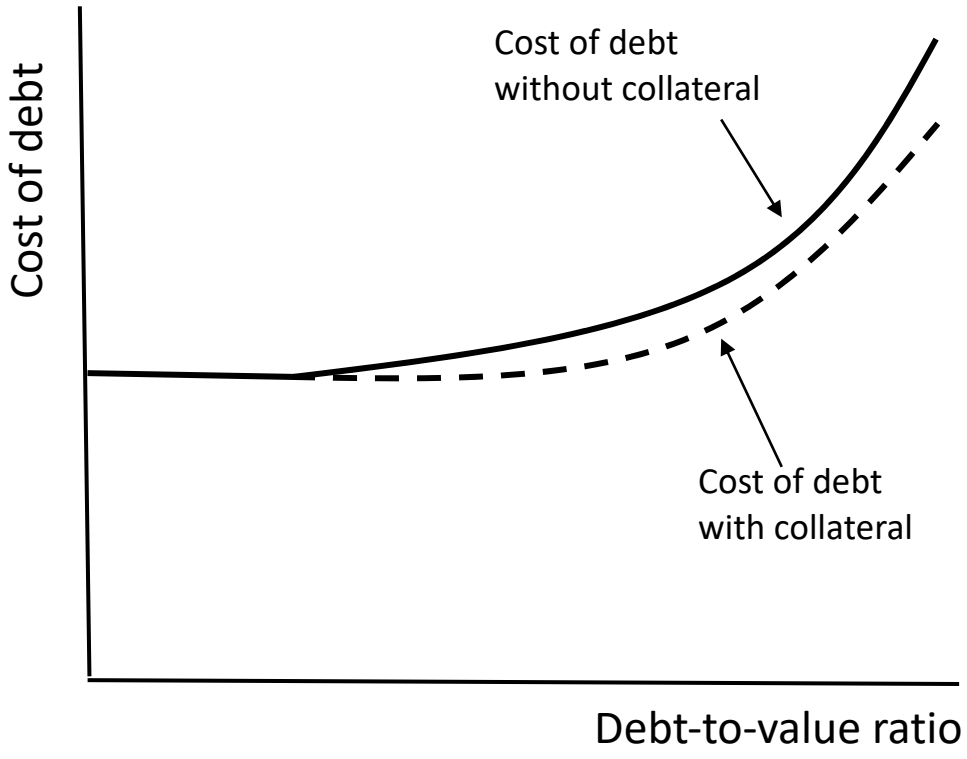

Figure 2: Purchase price allocation

This figure shows the composition of the purchase price. It is modified from a figure in the Houlihan and Lokey 2011 Purchase Price Allocation Study.