Financing Intangibles *

Bianca He

August 28, 2023

SUMMARY

This paper utilizes a large sample of detailed assets valuation data from M&A transactions to examine the impact of intangible assets on firms' capital structure decisions. Contrary to conventional wisdom, the findings reveal that intangibles do not result in lower debt usage compared to tangible assets; instead, intangible assets can support debt financing to a comparable extent, with a greater association with cash flow-based rather than asset-based debt. Furthermore, the research highlights the importance of considering heterogeneity among intangibles, presenting a theoretical framework for categorization. A model is developed to elucidate the mechanism underlying the finding that demand-shifter intangibles exhibit higher debt capacity than production intangibles.

*I thank Laura Born, Zhiyu Fu, Zhiguo He, Anil Kashyap, Maria Khrakovsky, Ralph Koijen, Yueran Ma, Mark Maffett, Raghu Rajan, Amir Sufi, Chad Syverson, Leifu Larry Zhang, Eric Zwick, Seminar Participants at CCSRG, Booth Finance Brownbag

1. Introduction

Intangible assets play a crucial role in the modern economy, constituting approximately 34% of assets for contemporary firms according to estimates by Corrado and Hulten (2010). Typically, these assets are associated with innovative properties, computerized information, and economic competencies (Corrado *et al.* (2005))[1]. Intangible assets are key indicators of business success, including growth (Chappell and Jaffe (2018)), productivity, profitability, and financial soundness (Eisfeldt *et al.* (2020)). Despite the importance of intangibles, how firms finance these assets is still less well understood.

I use precise measures of intangible assets and find intangibles support debt financing to a similar extent as tangible assets. Additionally, I differentiate between types of debt, specifically bank loans and bonds, and find that intangibles support bank loans and bond financing to the same extent as tangible assets. I then delve into the role of intangibles as collateral in borrowing and discover differences between tangibles and intangibles in the way that they are used as collateral. To explore heterogeneity within types of intangibles, and find the amount of debt financing differs along the dimension of the economic function of intangibles.

In this paper, I collect new data on firm-level precise estimation of intangible assets. The data comes from purchase price allocation in public company filings after a merger or acquisition (M&A). It discloses the market value of assets at the acquisition date in precise categories. The categories for intangible assets include goodwill, patents, trademarks, customer relationships, in-process R&D, technology, etc. I specifically exclude goodwill in my study and focus on the rest of the intangible assets, which are called "identifiable intangibles". The purpose of the categories is to accurately represent the value of the target company because customer relationships might have different implications in valuation compared to technology or brand value, and presenting the categories separately gives a clearer picture of the acquisition's impact. The data spans more than two decades, from 2001 to 2022,

[1] refer to Figure 1 for a word cloud representation of intangible assets

covers more than 5,100 target firms, and is associated with close to 3,200 public acquirers. The acquirer firm covers close to 10% of the Compustat firms in each of Fama-French 12 industries.

My main finding is a dollar of intangibles is associated with a 0.22-dollar increase in net debt issuance, while each dollar rise in tangible assets corresponds to a 0.34-dollar increase. This finding challenges the conventional wisdom that intangibles result in reduced debt usage compared to tangible assets. Contrary to expectations (Crouzet and Eberly (2019); Caggese and Pérez-Orive (2022); Li (2023)), greater intangible assets do not lead to more constrained borrowing for firms. Also, a dollar of intangibles is associated with a 0.22-dollar increase in new bank loans, while each dollar rise in tangible assets corresponds to a 0.35-dollar in new bank loans. A dollar of intangibles is associated with a 0.03-dollar increase in new bond debt, while each dollar rise in tangible assets corresponds to a 0.07-dollar in new bond debt. All these coefficients are statistically significant individually, but there is no significant difference between intangibles and tangibles.

I delve into the role of intangibles as collateral in borrowing. I categorize debt into cash flow-based and asset-based, following Lian and Ma (2021). The distinction lies in whether the debt has a direct positive dependence on specific asset value. Cash flow-based debt hinges on the operation's cash flow or going-concern, while asset-based debt relies on the valuation of a particular asset, akin to "fruit" and "land" borrowing concepts in Kiyotaki and Moore (1997). I find a dollar of intangibles is associated with a 0.23-dollar increase in cash flow-based debt, while each dollar rise in tangible assets corresponds to a 0.14-dollar in cash flow-based debt. For all these coefficients are statistically significant individually, but there is no significant difference between the coefficients. Conversely, a dollar of intangibles is associated with a 0.11-dollar increase in asset-based debt, while each dollar rise in tangible assets corresponds to a 0.32-dollar in asset-based debt. For this set of results, both the individual coefficients are statistically significant, and their difference is statistically significant.

For the empirical analysis, I implement a cross-sectional regression of M&A transactions and examine how acquiring firms' debt usage changes after target firms' intangible and tangible assets are acquired holding the pre-acquisition capital structure of the acquirer constant. This strategy addresses the issue of simultaneity inherent in directly regressing debt usage on intangibles. Another identification challenge arises from the possibility of other omitted variables, such as the internal funds firms have in accordance with the pecking order theory (Myers and Majluf (1984)). To mitigate this concern, several control variables are added, including cash on hand, cash from the target firm, rating-specific credit spread, Q factor, firm size, firm profitability, tangible assets of the firm, tangible assets from the acquisition, and operating earnings. Additionally, I use industry $\times$ year fixed-effects to account for unobserved heterogeneity across industries over time.

I unpack why and how firms can pledge intangibles by analyzing loan-level data for new loans in M&A. It becomes evident that intangibles are often paired with other assets, mainly tangible and current assets, as collateral but rarely used alone. On the other hand, tangible assets frequently serve as sole collateral. For loans involving tangible assets as collateral, 40% are backed solely by tangible assets, while this proportion is zero for intangibles. Among loans involving intangible assets as collateral, nearly 60% use the entire firm's assets as security. This indicates that these loans are essentially cash flow-based, where lenders target the going-concern value rather than valuing specific assets. In contrast, only 20% of loans with tangible asset collateral use the entire firm's assets as security. This finding suggests when pledging intangibles, the complementary between intangibles and others is high.

The amount of debt financing differs along the dimension of the economic function of intangibles. I distinguish between production-based intangibles, which directly enhance manufacturing more units of products, and demand-shifter intangibles, which primarily impact sales. This categorization is important for gaining deeper economic insights due to the diverse nature of intangible assets which are a hodgepodge of various types of assets, with important categories of intangibles including customer relationships, brands, trademarks,

business contracts, in-process R&D, patents, and technology. My findings indicate that demand-shifter intangibles are linked to higher levels of debt usage compared to production-based intangibles.

To elucidate this mechanism, I develop a theoretical model that suggests higher demand-shifter intangibles can partially offset negative market conditions and reduce the price impact of a large number of outputs Larkin (2013) finds firms with a strong brand perception perform better during recessions. I build on this finding and write a simple model to illustrate that firms with more demand-shifter intangibles have a higher optimal debt level. Interestingly, the difference in optimal debt levels between firms with high and low demand-shifter intangibles diminishes as economic downturns become less frequent.

This paper intersects with several strands of existing literature. To begin, this paper has important data contributions. Previous studies have grappled with the measurement complexities of intangible assets, employing a range of methods. Some measure intangibles at the firm level using a perpetual inventory method that discounts research and development (R&D) expenses and a ratio of selling, general, and administrative (SG&A) expenses (Crouzet and Eberly (2021); Eisfeldt *et al.* (2020), Belo *et al.* (2022); Eisfeldt and Papanikolaou (2013), Falato *et al.* (2020); Peters and Taylor (2017); Xiaolan (2014); Eisfeldt and Papanikolaou (2014)). Others focus on total intangible assets or use small samples consisting of public firms and public targets (Lim *et al.* (2020); Ewens *et al.* (2021)). In this study, I overcome these challenges by utilizing detailed asset valuation data from M&A transactions, specifically the purchase price allocation data. This data provides a comprehensive and precise measure of intangible assets in various categories, along with tangible assets and other financial accounting information As far as I am aware, this dataset constitutes one of the most extensive collections of purchase price allocation data, encompassing intricate intangible asset valuations.

Second, this research is related to empirical studies examining the use of intangibles as collateral and the broader landscape of financing intangibles (Loumioti (2012); Babus

et al. (2023); Ciaramella *et al.* (2022)). Mann (2018) examines patent intangibles and demonstrates how patents serve as collateral, enabling significant debt financing. Additionally, Lim *et al.* (2020) identifies a positive relation between identifiable intangible assets and leverage. My study builds upon this research and looks at the debt financing instruments, the type of intangibles, how firms pledge intangibles, and the mechanism.

Third, my study is motivated by the pivotal role of intangibles in reshaping a firm's borrowing constraints within macro-finance models (Falato *et al.* (2022); Giglio and Severo (2012); Döttling and Ratnovski (2023); Caggese and Pérez-Orive (2022); Howes *et al.* (2022); Li (2023)). Traditionally, the focus has been on intangible assets, with limited pledgeability leading to a reduction in firms' debt capacity. This outcome results in firms assuming less debt while holding increased cash reserves. These trends have important macro-finance implications and monetary policy implications in the corporate savings glut, weakening the credit channel of monetary policy transmission and financial stability such as the rise in cash holdings for US firms. Through detailed empirical analyses, I bridge model assumptions with real-world data: I show intangibles are not inherently associated with less debt capacity for firms in comparison to tangible assets. The finding suggests the need for revisiting existing assumptions to address essential questions in this domain.

2. Data and Empirical Approach

2.1 Data

Intangible Assets and Tangible Assets from SEC Filings A challenge for measuring intangible assets is limited data availability. Most intangible assets are not included in a company's assets on the balance sheet due to accounting regulations that prevent the inclusion of internally developed intangibles[2]. Additionally, secondary market transaction data are only available for certain categories of intangible assets, such as patents. As a result,

[2]There are some exceptions, such as software used internally or costs for developing websites, but these are only allowed under specific rules and circumstances (such as ASC 350-40 and ASC 350-50).

obtaining a comprehensive picture of a company's intangible assets for all types is difficult.

To overcome this problem, I turn to an alternative data source—the purchase price allocation during mergers and acquisitions. This process involves a careful assessment of a target company's assets to determine their market value, as part of the consolidation process for the acquiring company's balance sheet. Thus, this valuation provides the most comprehensive and precise measure of a firm's assets, including its intangible assets. Specialized accountants with expertise in mergers and acquisitions conduct these evaluations and also have access to the target company's operations and documentation. The results of these valuations are also subject to audit. Figure 2 and figure 3 shows two examples of the purchase price allocation.

I start with a list of mergers and acquisitions performed by non-financial US public companies, I focus on public companies due to difficulties in obtaining post-acquisition balance sheet and debt data for private firms. I gather data from public filings submitted to the SEC, including details such as acquirer firm CIK code, industry categorization of target and acquirer firms, purchase price allocations, and transaction specifics. While detailed information on intangible asset valuation is required by accounting standards, this information is often included in notes or in separate tables. I capture this information in textual form, and I employ natural language processing to extract the relevant data.I construct my own dataset of intangible assets to gain granular breakdown of the intangible assets in various categories.

I focus on transactions where the acquiring firm is a non-financial firm and where I have access to purchase price allocation data in text format. The focus on non-financial firms is because the assets (such as securities and loans) and liabilities (such as deposits) of financial institutions differ from other firms. My final dataset includes purchase price allocation data from 5,140 deals spanning more than two decades.

The accounting rules for intangibles follows the United States Generally Accepted Accounting Principles ASC 805, where identifiable intangibles such as customer relationships, brand,

patents, trademarks, technology, and various use rights are separately identified. Unidentifiable intangibles, also called goodwill, includes organizational capital, synergies, workforce in place, etc. Due to data limitations and the challenges of accurately separating organizational capital, the analysis focuses solely on identifiable intangibles, which can be measured more precisely and capture the richness associated with intangible assets. Detailed information on the categories of intangible assets can be found in Appendix D.5.

The purchase price allocation data has several advantages. First, the data on intangibles is comprehensive; it covers all the identifiable intangibles the firm owns. Secondly, the valuation process occurs around the acquisition time, reducing issues related to staled values. Thirdly, the reporting adheres to standardized accounting rules, enabling systematic collection and evaluation. Finally, the incentive for manipulating intangible asset values is relatively weak.

Characteristics of Debt: Capital IQ and DealScan I follow Lian and Ma (2021) in constructing the classification of asset-based debt and cash flow-based debt, see Appendix C. I use DealScan to see details on loan collateral.

The analysis incorporates annual balance sheet information from Compustat, granular M&A deal-level data, and debt-level data from Capital IQ and DealScan. While the baseline analysis is cross-sectional at the deal level, firms that acquire multiple targets within a year are collapsed into an acquirer firm-year panel. The debt-level data is aggregated into a firm-year panel by consolidating all outstanding credit facilities by type in a given year, following the approach by Lian and Ma (2021).

The merging of M&A deal-level information with Compustat is performed using transaction year and acquirer name through a string matching algorithm. Additionally, the merging of DealScan data with Compustat is conducted using Mike Roberts' linking table accessed through WRDS (Chava and Roberts (2008)). Although the linking table is only updated until 2018, I extend it using a similar string matching algorithm. The initial dataset consists of 4,038 M&A deals involving public firms as acquirers, with complete and observable

purchase price allocation. After matching with Compustat and Capital IQ, the final dataset includes approximately 3,400 firm and year combinations.

2.2 Empirical Approach

My baseline analysis lies in two steps. Firstly, I uncover the value of diverse forms of intangible capital the target firm possesses, using purchase price allocation data. This measurement approach is more accurate than deriving values from R&D and SG&A expenses listed in income statements, a practice commonly used in existing literature. Secondly, I monitor changes in the acquirers' capital structure pre and post-acquisition to understand the influence of intangible capital on changes in firms' capital structure.

In Figure 4, I illustrate the approach of the analysis with a graph. The top row displays the balance sheets of the acquirer and target before acquisition, with assets on the left, and liabilities and equity on the right for each individual entity. Conversely, the bottom row portrays the balance sheet of the consolidated business post-acquisition. Post-merger, the assets of the acquirer contain both the original assets and those acquired from the target. The liabilities include the pre-deal debt and the net debt procured or acquired during the acquisition process, while the equity consists of the pre-deal equity and net equity issued throughout the acquisition. Regarding the target's pre-deal debt, the acquirer has the option to settle it, assume and refinance the debt, or assume the debt without refinancing. The pre-deal equity is disbursed as the acquirer firm takes ownership. To facilitate the deal, the acquirer typically issues new debt or equity, with cash transactions occurring sporadically. It might appear that cash deals are frequent, however, these often involve the acquirer paying the target in cash while simultaneously raising debt. In such a scenario, despite the superficial appearance of a cash deal, a deeper analysis is required to trace the ultimate financing method as this determines capital structure changes. Cash deals without corresponding debt issuance result in no capital structure changes for the acquirer.

It is important to highlight that the ultimate financing decision rests with the acquirer,

and the amount of new debt or equity does not have to align directly with the purchased net asset. The acquirer retains the option to issue more debt or equity, thereby increasing cash in assets. While the deal-term between the acquirer and target is pertinent to the study, it is not central.

3. Regression Specifications

To understand the impact of intangibles on capital structure, I use the following regressions specifications

$$\frac{\Delta\text{L-T debt}_{i,t}}{A_{i,t-1}} = \alpha + \beta_1 \frac{\Delta\text{intangibles}_{i,t}}{A_{i,t-1}} + \beta_2 \frac{\Delta\text{tangibles}_{i,t}}{A_{i,t-1}} + \beta_3 \frac{\Delta\text{working cap.}_{i,t}}{A_{i,t-1}} + \mathbf{X}_{i,t}\xi + \nu_{\text{industry}(i),t} + \epsilon_{i,t}$$

The analysis uses cross-sectional regression, examining the acquisitions at the acquirer firm-year level. The focus is on tracking the variations in acquired intangibles and observing the corresponding changes in the capital structure. The dependent variables in this scenario are the changes in debt (notated as D'), especially long-term debt, as indicated in the illustrative diagram Figure 4.

The study juxtaposes capital structure changes for firms that, through an M&A deal, acquire an additional dollar of intangibles (or tangibles) compared to those that do not, all else being equal. The regression coefficient β_1 can be interpreted as representing the change in debt in dollars correlated with acquiring an additional dollar of intangible assets. Similarly, β_2 can be interpreted as representing the change in debt in dollars correlated with acquiring an additional dollar of tangible assets.

The regression strategy mitigates the common problem of simultaneity in regressing capital structure on intangible as the capital structure also impact the types of investment the firm chooses and thus the assets (Lim *et al.* (2020)). Here, I ask how does firms finance the intangible assets from acquisition. I control for the pre-acquisition capital structure to solve the simultaneity issue. Another challenge in identifying this correlation is the potential

for other omitted variable. To mitigate this, several control variables are added, including tangible assets from the acquisition, rating-specific credit spread, Q factor, firm size, firm profitability, tangible assets of the firm, cash on hand, acquired cash from the target, and operating earnings. All balance sheet control variables are used with a one-period lag and normalized by total assets from the acquirer before the acquisition. Additionally, an industry-year fixed effect is incorporated to account for unobserved heterogeneity across industries over time. The standard errors are clustered at the industry and year level.

Summary statistics pertaining to the analysis are presented in Table 2. On average the deal size is 61% of the acquirer's total assets.

4. Core Results

First, I demonstrate that intangibles can support debt to an extent comparable to tangibles. The regression results in Table 4 columns (1) to (4), reveal the impact of identifiable intangibles and tangible assets on net debt issuance. In column (4), the preferred interpretation, each dollar increase in identifiable intangibles is associated with a 0.22-dollar increase in net debt issuance, while each dollar rise in tangible assets corresponds to a 0.34-dollar increase. These coefficients are statistically significant individually, but there is no significant difference between them. Additionally, as more controls are added from column (2) to (4), the coefficient values remain relatively stable, suggesting limited concern regarding omitted-variable bias.

Furthermore, Table 5 differentiates debt types into bank debt and bond debt based on issuance data. Table 5 columns (1) to (4) shows the impact of identifiable intangibles and tangible assets on new long-term debt issuance. The regression results in column (4) is the preferred specification which suggests a correlation between a dollar increase in identifiable intangibles and a 0.22-dollar increase in new long-term debt issuance, and similarly, a dollar increase in tangible assets is associated with a 0.35-dollar increase in new long-term debt issuance. These coefficients do not significantly differ, supporting the finding that intangibles

can support debt to a comparable extent as tangibles. Also, the coefficients are relatively stable as more controls and fixed-effects are added through columns (1) to (4). The finding is contrary to the prevailing belief that the rise of intangibles may hinder the role of bank loans. For columns (5) to (8), I repeat the analysis but regress new long-term bond issuance on the number of intangibles and tangible assets acquired from M&A. The effect of intangibles and tangible assets on new long-term bond issuance is much smaller than that of bank loans. But similar to the findings with bank debt, the coefficients do not significantly differ.

Regarding the pledgeability of intangibles, the conventional view suggests that more intangible assets may complicate borrowing due to difficulties in using them as collateral. However, if borrowing primarily relies on cash flow, the tangibility of assets may be less significant. To explore this further, I distinguish debt into cash flow-based and asset-based debt. As shown in columns (1) to (4) of Table 6, a dollar increase in identifiable intangibles is associated with a 23% increase in cash flow-based debt, but a dollar increase in tangible asset is associated with a 14% increase in cash flow-based debt. This result indicates that intangible assets provide substantial support for cash flow-based debt.

Examining loan issuance descriptions in the DealScan database provides insights into how debts are secured. Analyzing loans issued or amended during or within one year post the M&A transaction reveals that loans using intangible or tangible assets as collateral comprise a significant portion. Figure 6 illustrates that nearly 60% of loans using intangibles as collateral are cash flow-based, often paired with other assets. This sheds light on the utilization of intangibles as collateral. Loans secured by tangibles, on the other hand, are predominantly collateralized with tangible assets alone (40%) or in combination with other assets (40%), with only a minority relying on cash flow (20%). Given the rarity of loans solely collateralized with intangible assets, further examination of the assets paired with intangibles in asset-based lending reveals that accounts receivable, inventory, and property and equipment are the most commonly associated assets for security (see Figure 7 (a)).

5. Types of Intangibles

In this section, I delve into the diverse nature of different kinds of intangible assets. It's evident that intangibles constitute a broad category that encompasses an array of assets, such as customer relationships, brands, technology, and various licenses, etc. It would be unrealistic to assume that all these assets influence lending in the same manner. However, understanding these diverse types of intangibles can be complex and pose a challenge to researchers. In the first part, I aim to present a conceptual framework for understanding intangible assets.

5.1 A Framework for Intangibles

Let's start by defining "intangible capital", which refers to "capital without physical presence". This description is somewhat indirect and could be vague. Researchers often consider the role of intangible capital in the production process, pondering where it fits in. Therefore, we'll start with the most universal type of collective production function:

$$Y = F(A, K, L) \tag{1}$$

Here, Y stands for output measured in terms of widgets produced, A is Total Factor Productivity (TFP), K is capital, and L is labor. In this scenario, K implicitly encompasses all kinds of capital, tangible and intangible alike. It's essential to note that intangible capital should not be part of A. A pertinent question that arises here is, what about brands? We all agree that brands represent valuable assets for firms. In 2021, the top 100 brands in the US economy were worth a staggering \$4.14 trillion (Bronnenberg *et al.* (2022)). It's crucial to recognize that intangibles like brands do not directly enter the production function in aiding firms to manufacture more units of widgets but allow firms to charge higher prices or sell more units at the same price. Other intangibles like customer relationships, business relationships, etc., share the same feature. These intangibles undeniably generate cash flow

for firms.

5.2 Model for Intangibles and Debt Capacity

I provide a theoretical framework to illustrate how demand-shifter intangibles and production intangibles have different implications for debt capacity.

The model has two time periods, $t = 0, 1$. There is a single firm with two production capital tangible capital (k_T) and production intangible capital (k_N). Production intangible capital refers to the subset of intangible capital that the firm uses in production, such as patents, technology, and organizational capital. Demand-shifter intangibles (B) are intangibles that are important for firms to generate cash flow but do not directly enter into the production function to produce more widgets. The main focus of this model is to illustrate how intangibles impact the optimal debt of the firms and I take the stock of intangibles as exogenous. The innovative part of this model is to shed light on the heterogeneous characteristics of various types of intangibles. Intangible capital is a complicated hogepodge of many assets. I start at the ground level with concrete micro categories of intangible and strive to provide a framework to help economists think about intangibles. Here, I clearly separate out the types of intangibles based on the production function.

The production quantity is a function of tangible capital (k_T), PP&E, and production intangible capital (k_N).

$$q \equiv f\left(k_N, k_T\right)$$

The firm faces a demand curve in the form of

$$p\left(q, B, \epsilon\right) \equiv p^* - \frac{z}{B}q + \epsilon = \begin{cases} p^* + \varepsilon & z = 0 \text{ with prob } \phi \\ p^* - \frac{1}{B}q + \varepsilon & z = 1 \text{ with prob } 1 - \phi \end{cases}$$

where p^* is the prevailing price in the absence of any shocks, z is a demand shock that reflects the market condition, q is the production quantity, B is the stock of demand-

based intangibles, ε is the idiosyncratic shock the firm experience and follows the uniform distribution $U[0,1]$. A negative market shock occurs with a probability $1-\phi$, and a higher B shelters the firm from the negative market condition by partially offsetting the shock. Also, a larger quantity of customer base also reduces the price impact of a large number of outputs when the market condition is tight. I model the demand curve this way to reflect the key findings in Larkin (2013) that firms with high brand perception experience better operating performance compared to their less consumer-valued peers during recessions.

The firm produces cash flow in period $t=1$ which simply equals $p*q$. The firm's earnings in time $t=1$ are subject to the corporate tax rate τ, which creates the debt tax shield that incentivizes the firm to issue debt.

In period $t=0$, the firm issues debt at face value (F) and pays out the proceeds $(D(F))$ as dividends to shareholders. The firm pays out the debt at face value F at time period $t=1$. If the firm fails to repay the full amount and defaults on its debt, it incurs a bankruptcy cost of C. The lender then gets paid the cash flow from period one and minus the bankruptcy cost.

The amount pays to the debt holder at time $t=1$ is

$$\min\{F, pq-C\}$$

Debt holders are senior to equity holders. The amount pays to the equity holder at time $t=1$ is

$$\max\{(1-\tau)pq-F, 0\}$$

The firm chooses its capital structure to maximize initial equity value. For simplification purposes, here, I do not discount the $t=1$ payment.

$$V=\max_{F\geq 0}\{D(F)+\mathbb{E}[\max((1-\tau)pq-F+\tau F, 0)]\}$$

where

$$D(F) = \mathbb{E}[\min(F, pq - C)]$$

Let's assume that the lender is risk-neutral. Then it must be that $\mathbb{E}[D(F)] = D$.

The goal is to understand how the amount of demand-shifter intangibles changes the debt capacity. I first solve for a closed-form solution for the optimal debt (see Appendix E) and conduct comparative static on the value of demand-shifter intangible and frequency of negative demand shocks in the economy.

I have two major findings. First, the value of demand-shifter intangible increases, and the optimal debt also increases (see Figure 8 (a)). Higher demand-shifter intangible means the customers are still willing to purchase from the firm during downturns. The firm sheds price less than the firm without much customer relation during downturns. Thus, the cash flow generated by the high demand-shifter intangible firms is more stable than the ones without, and thus, the firm has higher optimal debt capacity. Second, the effect of demand-shifter intangibles keeps diminishing as the market environment gets more stable in terms of less negative shocks. In Figure 8 (b), the vertical difference between the two lines shows firm with higher customer-based intangibles always have higher optimal debt in a given market environment, and this gap keeps diminishing as the market has less frequent negative shocks.

5.3 Connecting Theory with Empirics

Therefore, I present a framework that categorizes intangibles into production intangibles and demand-shifter intangibles. Production intangibles directly contribute to the firm's production of more widgets. In contrast, demand-shifter intangibles do not directly contribute to production, but help firms sell more products at larger quantities or higher prices (refer to Table 7 for classification).

Next, I classify identifiable intangibles based on their characteristics as either production intangibles or demand-shifter intangibles. Then, I conduct the same regression as in Table

4, but splitting intangibles into the aforementioned two categories.

Table 8's results in column (3) show that one unit of demand-shifter intangibles correlates with a \$0.45 increase in net debt issuance (a highly significant coefficient). In column (6), production-based intangible also correlates with an increase in net debt issuance, but the increase is smaller, at \$0.14. In column (9), I put both production-based intangibles and demand-shifter intangibles into the same regression and find that the coefficient for demand-shifter intangibles does not change much, but the coefficient for production-based intangibles gets smaller and loses significance. I also confirm that the coefficients are different with a F-test, and the difference is statistically significant. The results suggest that demand-shifter intangibles induce more debt than production capital intangibles.

6. Enduring Impact

I present the time trend plot in Figure 10. In Figure 10 (a) I use the same baseline regression structure but regress intangibles on the change in the net long-term book debt issuance with four-year lag to 5-year lead. As expected, the target intangible significantly correlates with the net long-term book debt change during the acquisition year. There is also no statistical reversion even after five years. The evidence suggests the change in the debt level persists in the long term.

7. Robustness Checks

I conducted several robustness checks for my core empirical finding that intangibles can support debt. Due to data limitations, I can only perform the checks on subsets of my sample. But the core results passed the robustness checks.

7.1 Intangible Q

In my baseline specifications, I control for Q. Peters and Taylor (2017) suggest a measure of a new Tobin'q proxy that accounts for intangible capital and argues the proxy is a better proxy for the firm's investment opportunities. In Table 9, I re-run the baseline regression but use the new proxy instead of the commonly used Q measure. My main findings stay the same.

7.2 Initial Capital Structure of the Target

In my baseline specification, I consider the net debt issued or acquired during acquisition acquisitions to be caused by the assets acquired after controlling for a stream of variables. The capital structure change of the acquirer firm is purely a choice by the acquirer and is induced by the target's assets. Thus, I deliberately omitted variables related to the pre-acquisition capital structure of the target firm.

However, the situation is slightly tricky if Target already has debt. For example, some debt holders of the target firm might already claim some tangible or intangible assets, and what to do about the debt is not purely a choice of the acquirer firm. Thus, I add additional controls, including the ratio of debt to intangible assets and debt to tangible assets of the target beforehand; see the results in Table 10. My main findings stay the same.

8. Conclusion

In this paper, I investigate the impact of intangible capital on firms' capital structure decisions. Utilizing purchase price allocation data from M&A transactions, I obtain the most precise measure of asset valuation, including detailed categories of intangible assets and tangible assets.

By examining the setting of M&A events, I analyze how the increase in intangible and tangible assets from the target firm influences the capital structure decisions of the acquirer

firm. Specifically, I compare the capital structure of acquirers with similar characteristics before and after acquiring additional units of tangible and intangible assets.

The study reveals several key findings. First, contrary to common belief, intangible assets demonstrate a comparable ability to support debt as tangible assets. Second, intangibles are strongly associated with firms having a higher proportion of cash flow-based debt rather than asset-based debt. Further analysis of bank loans issued after acquisitions and collateral utilization reveals that intangibles are predominantly used in cash flow-based debt and are rarely employed as sole collaterals but rather paired with other tangible assets.

One unique feature of my data is the ability to explore the various types of intangibles. I highlight the heterogeneous nature of intangible assets despite some common characteristics. To understand their impact, I categorize intangibles based on their role in the production function. This categorization allows me to differentiate between intangibles that directly contribute to production and those that act as demand-shifters, affecting cash flows without directly influencing production quantities. Interestingly, demand-shifter intangibles exhibit a positive correlation with higher levels of debt, while production intangibles do not.

To provide insight into the relationship between cash flow-based intangibles and higher debt capacity, I develop a simple model. The model suggests that an increase in demand-shifter intangibles provides protection against negative market demand shocks, partially offsetting the impact of these shocks and reducing the price impact of larger production quantities. Consequently, firms with higher levels of demand-shifter intangibles experience more stable cash flows during market downturns, leading to higher debt capacity. Furthermore, this effect is strengthened in the presence of more frequent negative shocks in the market.

Figures and Tables

Figure 1: **Various Types of Intangibles** This graph illustrates the various major types of intangibles as defined by US GAAP

Figure 2: **Purchase Price Allocation Example.** The figure is a screenshot from the Men's Wearhouse, Inc.'s 8-K/A filing on 2014-09-02 in report of its acquisition of Jos. A. Bank Clothiers, Inc.

Cash	$ 328.9
Accounts receivable	7.1
Inventories	379.3
Other current assets	29.3
Property and equipment	174.8
Goodwill	744.7
Intangible assets	621.2
Accounts payable, accrued expenses and other current liabilities	(177.0)
Other liabilities (mainly deferred income taxes)	(288.0)
Total purchase price	1,820.3
Less: Cash acquired	(328.9)
Total purchase price, net of cash acquired	$ 1,491.4

(a) Purchase price allocation

Intangible assets consist of four separately identified assets. First, we identified the Jos. A. Bank tradename as an indefinite-lived intangible asset with a fair value of $539.1 million. The Jos. A. Bank tradename is not subject to amortization but will be evaluated at least annually for impairment. Second, we identified a customer relationship intangible asset with a fair value of $53.0 million which we expect to amortize over a useful life of seven years. Third, we recognized an intangible asset of $24.4 million for favorable Jos. A. Bank leases (as compared to prevailing market rates) which will be amortized over the remaining lease terms, including an assumed renewal. Lastly, we recognized an intangible asset related to the Jos. A. Bank franchise store agreements of $4.7 million which we expect to amortize over 25 years. The allocation of the purchase price to intangible assets as well as their estimated useful lives is preliminary and may be adjusted.

(b) Detailed breakdown of the purchase price allocation to various identifiable assets in note (iii)

Figure 3: **More Example of Identiable Intangibles Valuation** The target is Zynga Inc, a global video game developer and publisher platform

	Preliminary Fair Value *(in 000's)*
Game IP	$ 3,900,000
IPR&D	350,000
Corporate trademark	150,000
Users	200,000
Hyper-casual developer relationships	100,000
Total	$ 4,700,000

Figure 4: **Illustration of Capital Structure Following an Acquisition** This chart illustrates the empirical approach used in the main analysis. The top row shows the balance sheets of the acquirer and target before acquisitions. The bottom row shows the consolidated balance sheet post-acquisition.

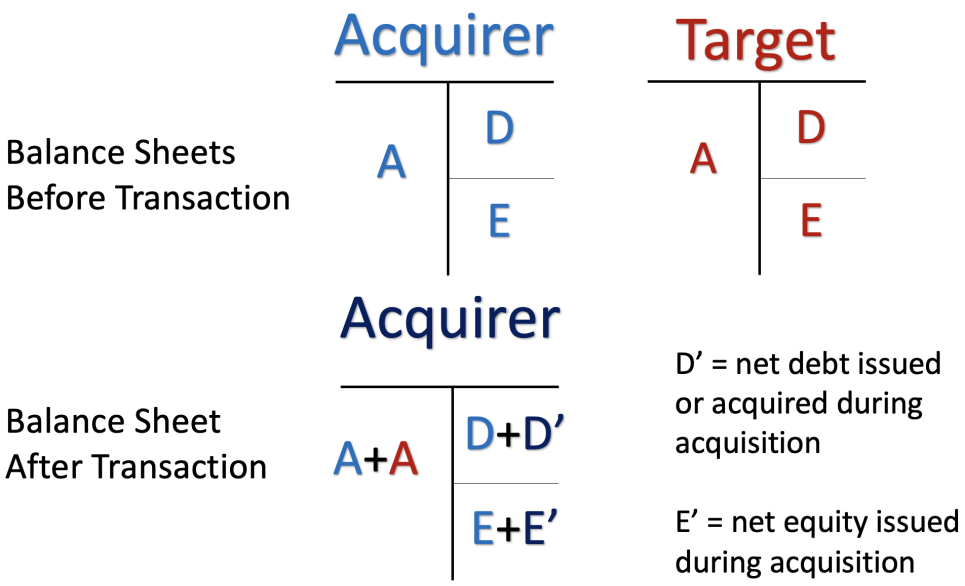
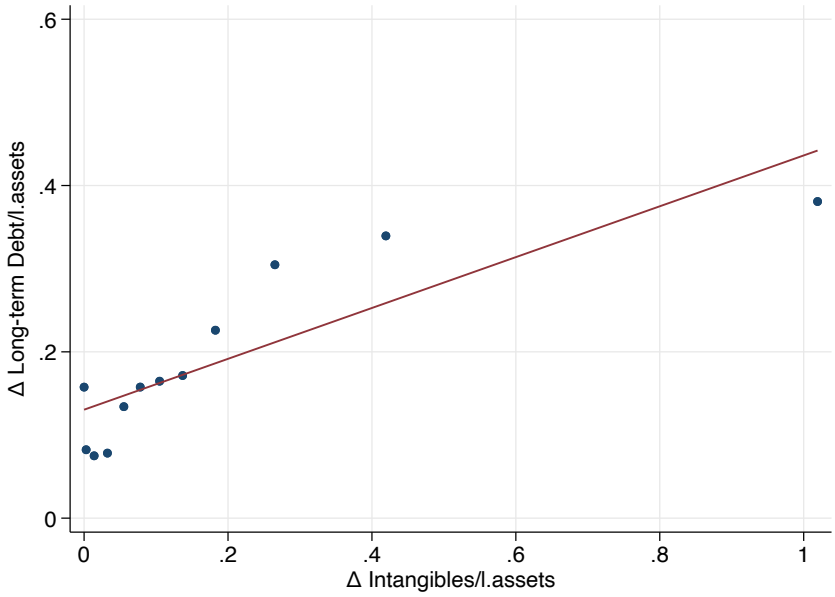
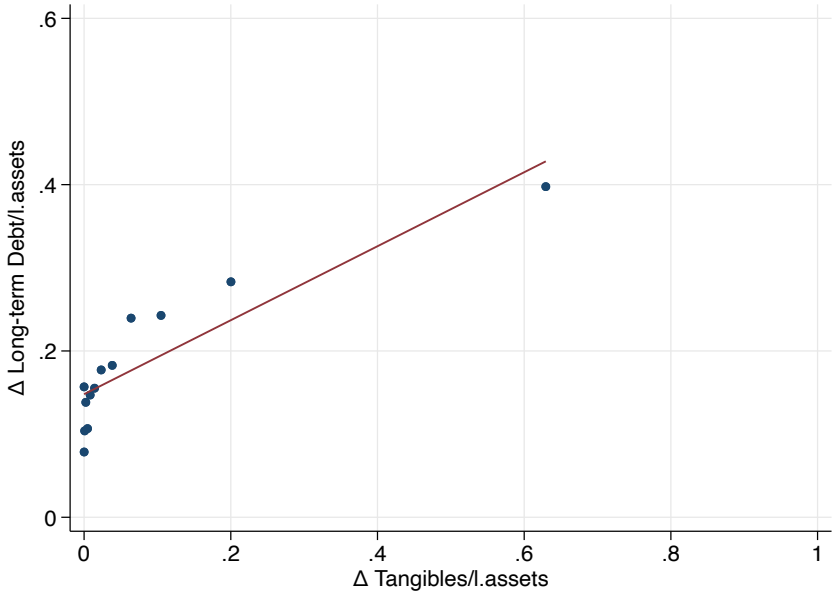


Figure 5: **Baseline Regressions in Binscatter Plots**



(a) Intangibles



(b) Tangibles

Figure 6: **Intangible and Tangible Assets as Collateral** This chart plots the frequency of other types of assets paired with intangible assets (or tangible assets) for loans. The sample is new loan facilities or newly-amended loan agreements within one year after the acquisition transaction from DealScan.

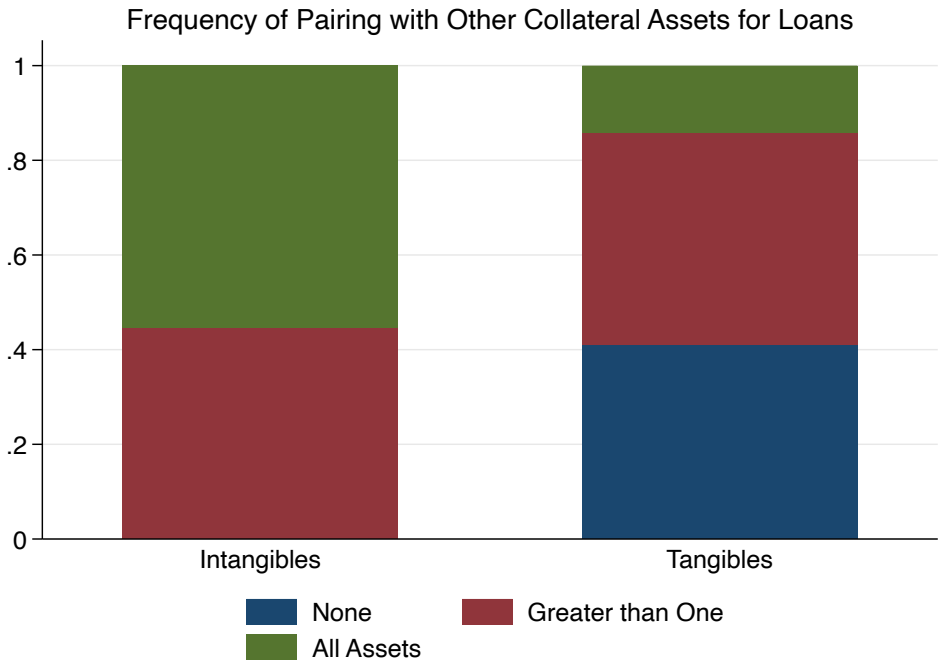
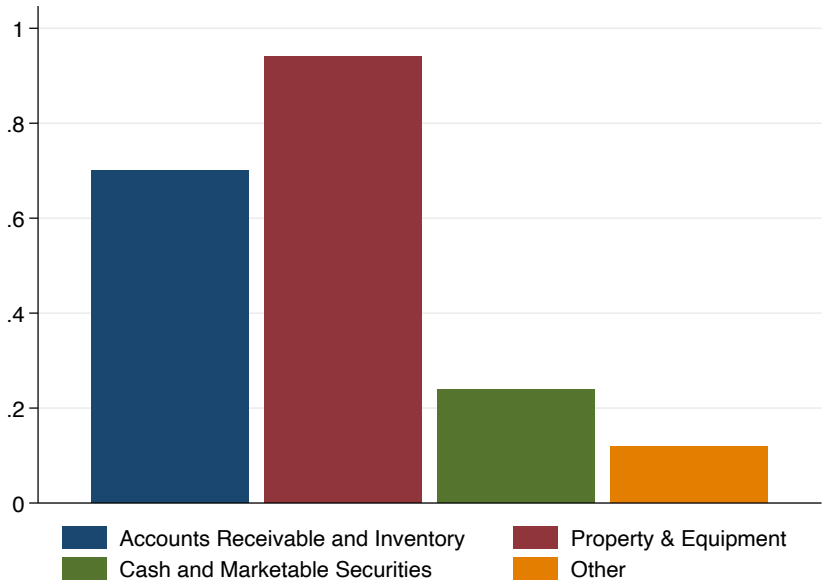
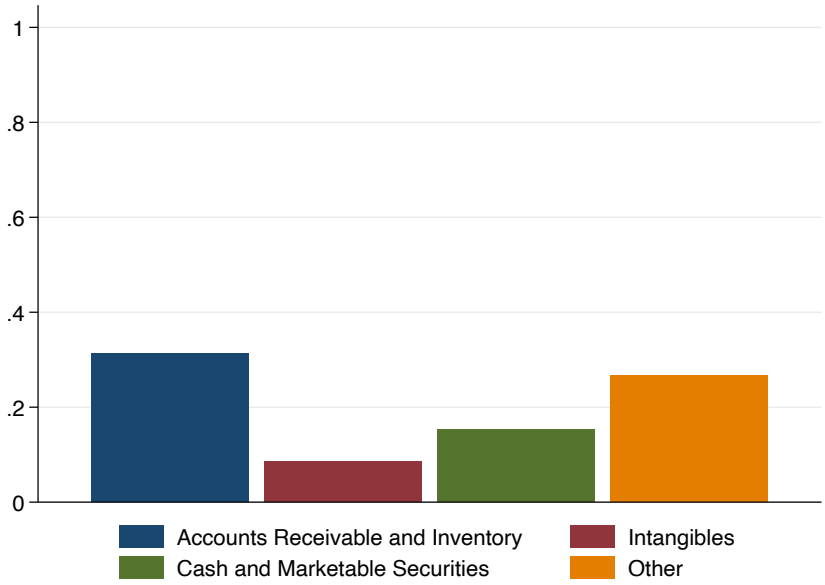


Figure 7: **Types of Other Assets Paired with Intangible and Tangible Assets for Loan Collateral** This chart plots the frequency of other types of assets paired with intangible assets (or tangible assets) for loans. The sample is new loan facilities or newly-amended loan agreements within one year after the acquisition transaction from DealScan.

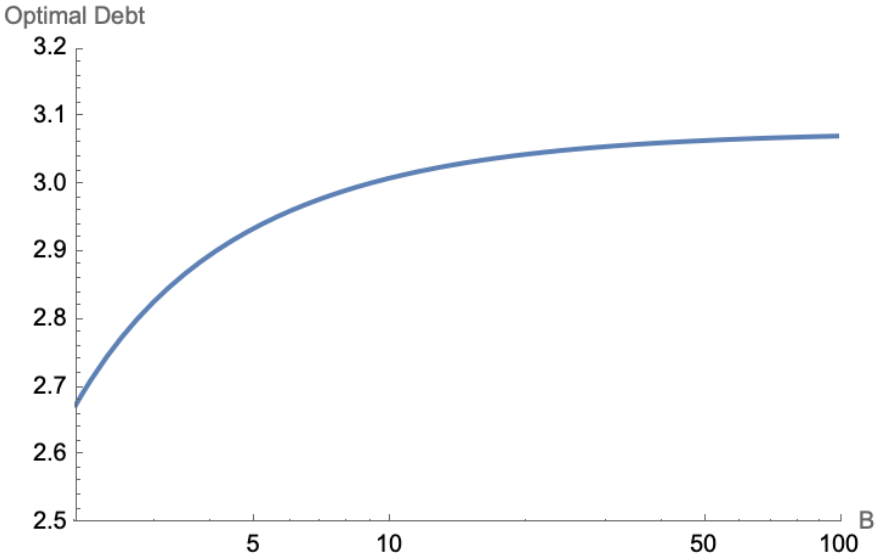


(a) Intangibles

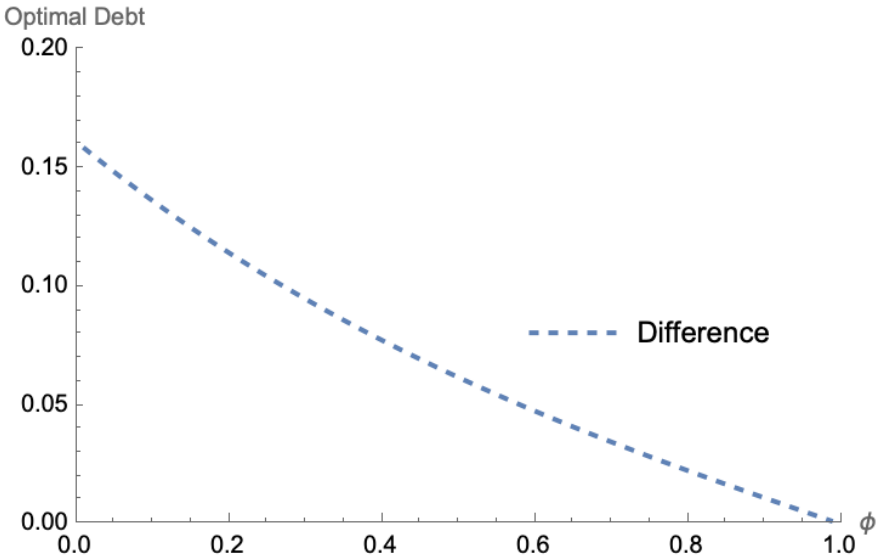


(b) Tangibles

Figure 8: **Comparative Statics from Model** This chart plots the comparative statics results generated from the model. See Appendix E for more details of the model solution and parameters used.



(a) Impact of demand-shifter intangibles on optimal debt



(b) Impact of market condition by stock of demand-shifter intangibles on optimal debt

Figure 9: **Net Debt Issuance by Types of Intangibles** This chart plots the regression coefficients from regressing net debt issuance on various categories of intangibles while controlling for all the controls and fixed-effects as in the baseline regression.

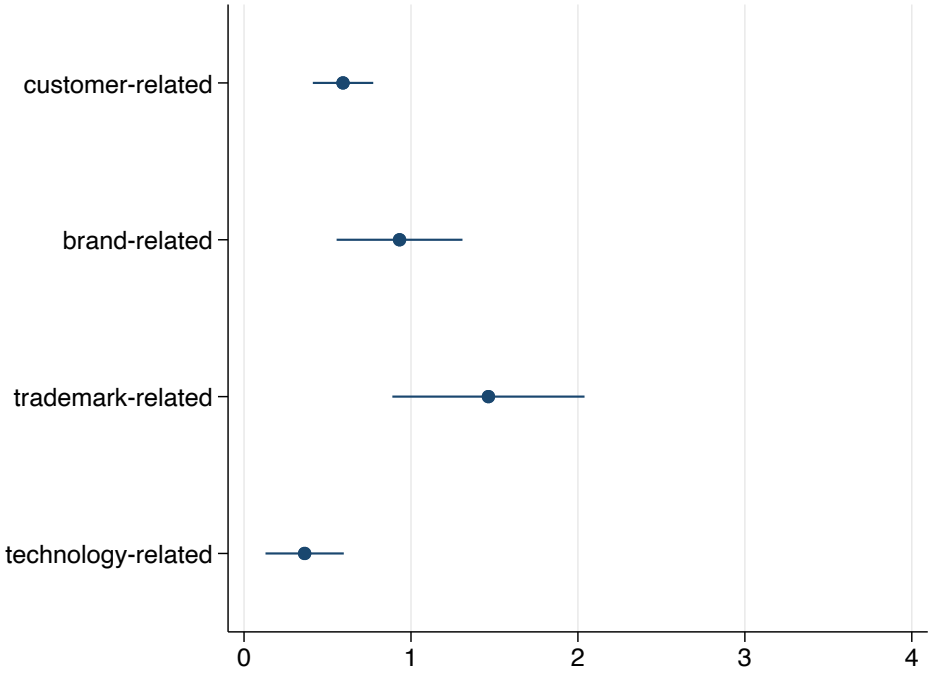


Figure 10: **Enduring Impact** This chart plots the regression coefficients from regressing 4-year lag and 5-year lead of the net long-term debt issuance on intangibles acquired during acquisition while controlling for all the controls and fixed-effects as in the baseline regression.

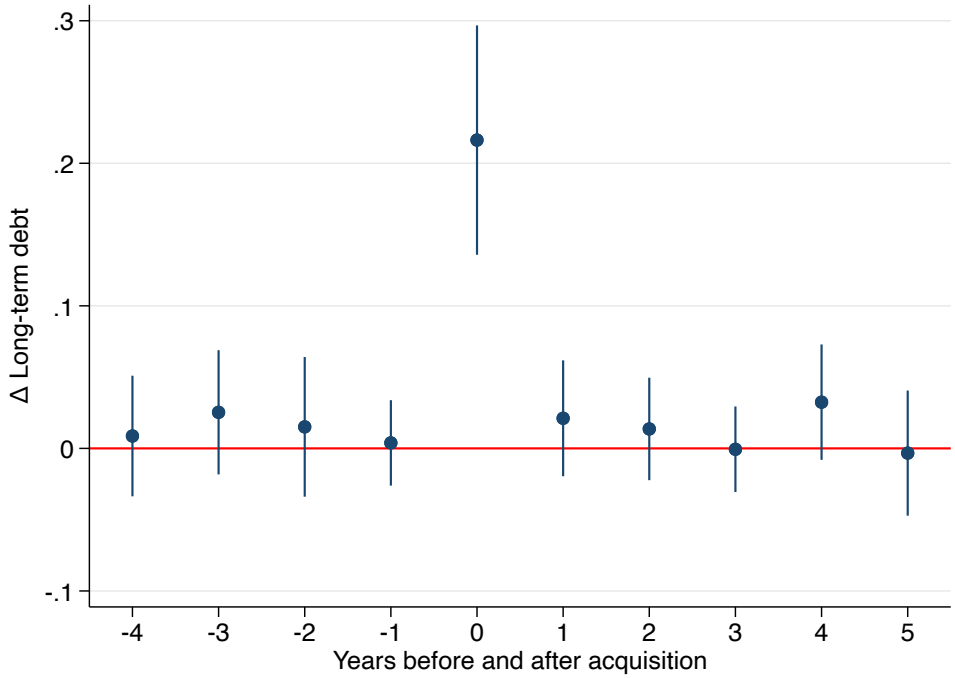


Table 1: **Proportion of Compustat Firms Involved in Acquisition Activities**

This figure illustrates the percentage of Compustat firms engaging in acquisition activities that are included in the purchase price allocation sample. The industries presented are the Fama-French 12 industries, excluding the financial industry.

industry	coverage (%)
Consumer NonDurables	10.9
Consumer Durables	11.0
Manufacturing	14.8
Oil, Gas, and Coal Extraction and Products	8.02
Chemicals and Allied Products	8.22
Business Equipment	19.8
Telephone and Television Transmission	11.9
Utilities	6.77
Wholesale, Retail, and Some Services	9.91
Healthcare, Medical Equipment, and Drugs	10.8
Other	10.8

Table 2: **Summary Statistics**

The presented table displays the summary statistics for the different variables utilized in the regression analysis. See the detailed definitions of the variables in Appendix B and see detailed information on the categorization of debt in Appendix C.

	p25	p50	p75	Mean	SD	N
Net debt issuance/l.assets	-0.00	0.03	0.24	0.16	0.30	3112
Net long-term issuance/l.assets	0.00	0.06	0.28	0.19	0.31	3167
Net equity issuance/l.assets	0.01	0.06	0.38	0.57	1.47	3119
New debt issuance/l.assets	0.00	0.17	0.52	0.38	0.55	2855
Δ Asset-backed debt/l.assets	0.00	0.00	0.17	0.16	0.32	2855
Δ Cash flow-backed debt/l.assets	0.00	0.00	0.22	0.18	0.33	2855
Δ Identifiable intangibles/l.assets	0.00	0.05	0.18	0.18	0.37	3187
Δ Tangibles/l.assets	0.00	0.01	0.06	0.08	0.21	3187
Δ Working capital/l.assets	0.00	0.01	0.05	0.06	0.15	3187
Deal size/l.assets	0.16	0.32	0.66	0.70	1.43	3187
Log assets	4.82	6.37	7.86	6.37	2.28	3228
Q	0.92	1.30	2.00	1.68	1.28	2879
Total q	0.55	0.95	1.67	1.55	2.47	3000
Credit-spread	0.03	0.03	0.05	0.04	0.02	3228
Cash/l.assets	0.05	0.16	0.36	0.29	0.40	3187
EBITDA/l.assets	0.03	0.12	0.19	-0.01	0.57	3158
Net cash receipts/l.assets	0.03	0.11	0.17	0.05	0.32	2974
PPE/l.assets	0.06	0.14	0.33	0.27	0.32	3164

Table 3: **Summary Statistics for Identifiable Intangibles**

The presented table displays the summary statistics for the different identifiable intangible variables used in the analysis, all scaled by lagged assets of the acquirer. See the detailed definitions of the variables in Appendix B and see detailed information on the categorization of debt in Appendix C.

	p25	p50	p75	Mean	SD	N
Δ Identifiable intangibles/l.assets	0.00	0.05	0.18	0.18	0.37	3187
Δ Intangibles (production-based)	0.00	0.00	0.06	0.08	0.22	3187
Δ Intangibles (demand-shifter)	0.00	0.00	0.08	0.08	0.18	3187
Customer-related intangibles	0.00	0.00	0.05	0.05	0.12	3187
Brand-related intangibles	0.00	0.00	0.01	0.02	0.06	3187
Trademark intangibles	0.00	0.00	0.00	0.01	0.03	3187
Patent intangibles	0.00	0.00	0.00	0.00	0.01	3187
Technology-related intangibles	0.00	0.00	0.02	0.03	0.08	3187
Business relation. intangibles	0.00	0.00	0.00	0.00	0.01	3187
Contract-related intangibles	0.00	0.00	0.00	0.02	0.08	3187
Human capital-related intangibles	0.00	0.00	0.00	0.00	0.01	3187
Goodwill intangibles	0.03	0.13	0.29	0.34	0.82	3187
Misc intangibles	0.00	0.00	0.00	0.00	0.02	3187

Table 4: **Regression Results on the Impact of Intangibles on Net Long-term Debt**

This table presents the results of the regression analysis results investigating the impact of intangibles on net long-term debt issuance. Columns (1) through (4) present the outcome variable of net debt issuance, which is defined as (dltt-l.dltt)/l.at. See the detailed definitions of the variables in Appendix B. Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	(1)	(2)	(3)	(4)
Δ Intangibles	0.15***	0.14***	0.24***	0.22***
	(0.028)	(0.028)	(0.041)	(0.041)
Δ Tangibles	0.35***	0.33***	0.35***	0.34***
	(0.045)	(0.045)	(0.065)	(0.072)
Δ Working capital		0.11**	0.15*	0.11
		(0.056)	(0.084)	(0.087)
Controls			X	X
Industry × year FE				X
Observations	3167	3167	2554	2529
R^2	0.110	0.112	0.170	0.248
F-stats: intan=tan				2.67
F-stats: p-val				.104

Table 5: **Regression Results on the Impact of Intangibles on New Long-term Debt Issuance by Debt Instrument Type**

This table presents the results of the regression analysis investigating the impact of intangibles on new debt issuance by debt instrument type. Column (1) to (4) present the outcome variable of new bank debt and Column (5) to (8) presents the outcome variable of new bond debt. Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	Bank debt				Bond debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Intangibles	0.19***	0.15***	0.25***	0.22***	0.0017	0.0043	0.030***	0.033***
	(0.037)	(0.037)	(0.058)	(0.057)	(0.0068)	(0.0070)	(0.010)	(0.010)
Δ Tangibles	0.32***	0.27***	0.32***	0.35***	0.082***	0.086***	0.079***	0.066***
	(0.061)	(0.061)	(0.092)	(0.10)	(0.015)	(0.016)	(0.023)	(0.023)
Δ Working capital		0.27***	0.32**	0.20		-0.021	0.031	0.035
		(0.085)	(0.15)	(0.14)		(0.018)	(0.024)	(0.027)
Controls			X	X			X	X
Industry × year FE				X				X
Observations	2855	2855	2313	2291	2855	2855	2313	2291
R^2	0.065	0.074	0.119	0.219	0.031	0.032	0.172	0.261
F-stat: intan=tan				1.14				1.6
F-stat: p-value				.287				.207

Table 6: **Regression Results on the Impact of Intangibles on New Debt Issuance by Collateral Type**

This table presents the results of the regression analysis investigating the impact of intangibles on new debt issuance by collateral type. Column (1) to (4) present the outcome variable of new cash flow-based debt, and Column (5) to (8) present the outcome variable of new asset-based debt. The debt is classified as cash flow-based if it is backed by blanket lien or unsecured, and is classified as asset-based if it is backed by real estate, fixed asset, cash, or accounts receivable. The classification is based on Lian and Ma (2021). See detailed information on the categorization of debt in Appendix C. Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	Cash flow-based Debt				Asset-based Debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Intangibles	0.20***	0.19***	0.25***	0.23***	0.10***	0.073***	0.11***	0.11**
	(0.028)	(0.028)	(0.039)	(0.041)	(0.027)	(0.027)	(0.041)	(0.042)
Δ Tangibles	0.20***	0.18***	0.17***	0.14**	0.28***	0.24***	0.29***	0.32***
	(0.039)	(0.040)	(0.063)	(0.068)	(0.049)	(0.049)	(0.075)	(0.081)
Δ Working capital		0.091	0.15*	0.13		0.23***	0.16	0.11
		(0.062)	(0.092)	(0.099)		(0.066)	(0.11)	(0.11)
Controls			X	X			X	X
Industry × year FE				X				X
Observations	2855	2855	2313	2291	2855	2855	2313	2291
R^2	0.078	0.079	0.121	0.193	0.055	0.065	0.106	0.196
F-stat: intan=tan				1.12				5.11
F-stat: p-value				.29				.025

Table 7: **Intangible Categorization**

The various intangible assets are categorized based on the framework presented in Section 5.1. Production intangible capital refers to the subset of intangible capital that the firm uses in production, such as patents, technology, and organizational capital. Demand-shifter intangibles are intangibles that are important for firms to generate cash flow but do not directly enter into the production function to produce more widgets.

Production	Demand-shifter
Patent	Customer relationship
Software	Brand
Technology	Trademark
IP R&D	Customer list
License	Customer contract
Organizational capital	Business relationship
Know-how/ trade secrets	Database
Copyrighted material	Domain
R.O.U	Franchise agreement
Blueprint	Non-compete agreement
Employee relation	Backlog

Table 8: Regression Results on the Impact of Intangibles on Capital Structure by Type of Intangibles

This table presents the results of the regression analysis investigating the impact of intangibles on capital structure by type of intangibles. Columns (1) through (9) present the outcome variable of net long-term debt issuance, which is defined as (dltt-l.dltt)/l.at. Intangibles are classified into production intangibles and demand-based intangibles, see Table 7 for details. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Intangibles (demand-shifter)	0.38***	0.46***	0.45***				0.38***	0.45***	0.44***
	(0.056)	(0.068)	(0.070)				(0.054)	(0.067)	(0.069)
Δ Intangibles (production-based)				0.072*	0.16***	0.14**	0.0058	0.12**	0.093
				(0.042)	(0.055)	(0.055)	(0.043)	(0.057)	(0.056)
Δ Tangibles	0.34***	0.37***	0.36***	0.34***	0.37***	0.36***	0.34***	0.36***	0.35***
	(0.044)	(0.064)	(0.072)	(0.044)	(0.063)	(0.069)	(0.043)	(0.064)	(0.072)
Δ Working capital	0.080	0.12	0.081	0.19***	0.25***	0.20**	0.079	0.10	0.071
	(0.059)	(0.088)	(0.090)	(0.057)	(0.083)	(0.084)	(0.058)	(0.088)	(0.089)
Controls		X	X		X	X		X	X
Industry × year FE			X			X			X
Observations	3167	2554	2529	3167	2554	2529	3167	2554	2529
R^2	0.133	0.178	0.259	0.089	0.133	0.220	0.133	0.183	0.261
F-stat: intan=tan									16.78
F-stat: p-value									0

Table 9: **Regression Results on the Impact of Intangibles on Net Long-term Debt Robustness Check with Total Q**

This table presents the results of the regression analysis results investigating the impact of intangibles on net long-term debt issuance. Columns (1) through (4) present the outcome variable of net long-term debt issuance, which is defined as (dltt-l.dltt)/l.at. Beyond standard controls I used in the baseline regression, total q from (Peters and Taylor (2017)) is used instead of the traditional Q measure. Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	(1)	(2)	(3)	(4)
Δ Intangibles	0.15***	0.14***	0.18***	0.16***
	(0.028)	(0.028)	(0.033)	(0.033)
Δ Tangibles	0.35***	0.33***	0.34***	0.32***
	(0.045)	(0.045)	(0.060)	(0.070)
Δ Working capital		0.11**	0.10	0.10
		(0.056)	(0.072)	(0.072)
Controls			X	X
Industry × year FE				X
Observations	3167	3167	2634	2615
R^2	0.110	0.112	0.140	0.221
F-stats: intan=tan				4.93
F-stats: p-val				.027

Table 10: **Regression Results on the Impact of Intangibles on Net Long-term Debt Issuance Robustness Check with Target Leverage Controls**

This table presents the results of the regression analysis results investigating the impact of intangibles on net long-term debt issuance. Columns (1) through (4) present the outcome variable of net debt issuance, which is defined as (dltt-l.dltt)/l.at. The Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	(1)	(2)	(3)	(4)
Δ Intangibles	0.15***	0.14***	0.23***	0.22***
	(0.028)	(0.028)	(0.043)	(0.048)
Δ Tangibles	0.35***	0.33***	0.29***	0.28**
	(0.045)	(0.045)	(0.096)	(0.11)
Δ Working capital		0.11**	0.097	0.072
		(0.056)	(0.090)	(0.097)
Controls			X	X
Industry × year FE				X
Observations	3167	3167	1399	1360
R^2	0.110	0.112	0.175	0.259
F-stats: intan=tan				.25
F-stats: p-val				.615

References

Babus A., Marzani M. and Moreira S. (2023) Innovation for innovators: The financing of intangibles, in *AEA Papers and Proceedings*, vol. 113, pp. 268–73, American Economic Association.

Belo F., Gala V. D., Salomao J. and Vitorino M. A. (2022) Decomposing firm value, *Journal of Financial Economics* **143**(2), 619–639.

Bronnenberg B., Dube J.-P. and Syverson C. (2022) Marketing investment and intangible brand capital, *Journal of Economic Perspectives* **36**(3), 53–74.

Caggese A. and Pérez-Orive A. (2022) How stimulative are low real interest rates for intangible capital?, *European Economic Review* **142**, 103987.

Chappell N. and Jaffe A. (2018) Intangible investment and firm performance, *Review of Industrial Organization* **52**, 509–559.

Chava S. and Roberts M. R. (2008) How does financing impact investment? the role of debt covenants, *The journal of finance* **63**(5), 2085–2121.

Ciaramella L., Heller D. and Leitzinger L. (2022) Intellectual property as loan collateral, *Available at SSRN* .

Corrado C., Hulten C. and Sichel D. (2005) Measuring capital and technology: an expanded framework, in *Measuring capital in the new economy*, pp. 11–46, University of Chicago Press.

Corrado C. A. and Hulten C. R. (2010) How do you measure a" technological revolution"?, *American Economic Review* **100**(2), 99–104.

Crouzet N. and Eberly J. (2021) Intangibles, markups, and the measurement of productivity growth, *Journal of Monetary Economics* **124**, S92–S109.

Crouzet N. and Eberly J. C. (2019) Understanding weak capital investment: The role of market concentration and intangibles, Tech. rep., National Bureau of Economic Research.

Döttling R. and Ratnovski L. (2023) Monetary policy and intangible investment, *Journal of Monetary Economics* **134**, 53–72.

Eisfeldt A. L., Kim E. and Papanikolaou D. (2020) Intangible value, Tech. rep., National Bureau of Economic Research.

Eisfeldt A. L. and Papanikolaou D. (2013) Organization capital and the cross-section of expected returns, *The Journal of Finance* **68**(4), 1365–1406.

Eisfeldt A. L. and Papanikolaou D. (2014) The value and ownership of intangible capital, *American Economic Review* **104**(5), 189–94.

Ewens M., Peters R. H. and Wang S. (2021) Measuring intangible capital with market prices, Tech. rep., National Bureau of Economic Research.

Falato A., Kadyrzhanova D., Sim J. and Steri R. (2020) Rising intangible capital, shrinking debt capacity, and the us corporate savings glut, *Journal of Finance, forthcoming* .

Falato A., Kadyrzhanova D., Sim J. and Steri R. (2022) Rising intangible capital, shrinking debt capacity, and the us corporate savings glut, *The Journal of Finance* **77**(5), 2799–2852.

Giglio S. and Severo T. (2012) Intangible capital, relative asset shortages and bubbles, *Journal of Monetary Economics* **59**(3), 303–317.

Howes C., von Ende-Becker A. *et al.* (2022) Monetary policy and intangible investment, *Economic Review* **107**(2).

Kiyotaki N. and Moore J. (1997) Credit cycles, *Journal of political economy* **105**(2), 211–248.

Larkin Y. (2013) Brand perception, cash flow stability, and financial policy, *Journal of Financial Economics* **110**(1), 232–253.

Li Y. (2023) Fragile new economy: Intangible capital, corporate savings glut, and financial instability, *American Economic Review* .

Lian C. and Ma Y. (2021) Anatomy of corporate borrowing constraints, *The Quarterly Journal of Economics* **136**(1), 229–291.

Lim S. C., Macias A. J. and Moeller T. (2020) Intangible assets and capital structure, *Journal of Banking & Finance* **118**, 105873.

Loumioti M. (2012) The use of intangible assets as loan collateral, *Available at SSRN 1748675* .

Mann W. (2018) Creditor rights and innovation: Evidence from patent collateral, *Journal of Financial Economics* **130**(1), 25–47.

Myers S. C. and Majluf N. S. (1984) Corporate financing and investment decisions when firms have information that investors do not have, *Journal of financial economics* **13**(2), 187–221.

Peters R. H. and Taylor L. A. (2017) Intangible capital and the investment-q relation, *Journal of Financial Economics* **123**(2), 251–272.

Xiaolan M. Z. (2014) Who bears firm-level risk? implications for cash flow volatility, *Implications for Cash Flow Volatility (October 31, 2014)* .

A. Appendix

B. Variable definitions

Variable	Definition
Net debt issuance	(dltt-dlc-(l.dltt-l.dlc))/lat
Net equity issuance	(seq-re-(l.seq-l.re))/lat
Spread	firm-level rating specific credit spread
Q	mkval+dlc+dltt)/at
Size	ln(at)
Cash on-hand	ch_lat = che/lat
Operating earnings	ebitda/lat
Cashflow	(oancf+xint)/lat
PPE/lat	ppent/lat
Leverage	book leverage

C. Categorization of Debt

The debt structure is classified into categories using descriptions in text format from the Capital IQ debt structure database (Chen and Ma, 2021). The two main categories are asset-based and cash flow-based.

Asset-based debt is secured by specific assets, including physical assets such as real estate, equipment, inventory, and other separable assets such as receivables or patents. In the event of default, creditors receive payoffs based on the liquidation value of these assets. Examples include commercial mortgages and asset-based loans.

Cash flow-based debt is based on the value of cash flows generated from the company's continuing operations. In the event of default, creditors receive payoffs based on the cash flow value from the restructured company's continuing operations. Examples include most corporate bonds and a significant portion of corporate loans, such as most syndicated loans.

D. Purchase Price Allocation

Purchase price allocation is the allocation of the purchase price of the business into assets and liabilities during business combinations. Accounting rules of the business combination process necessitate the acquirer to recognize the tangible assets and identifiable intangible assets acquired separately from goodwill and to properly classify and measure them (ASC 805 Business Combinations).

Generally, after allocating the purchase price to each identifiable asset and liabilities category, the residual unidentifiable intangibles are goodwill. Organizational capital and human capital that are not related to the non-compete agreement and workforce contracts are included in goodwill.

After the business combination takes place, the assets and liabilities from the purchase price allocation are recorded on a consolidated balance sheet to reflect the combined business. The detailed purchase price allocation breakdown then shows us a comprehensive picture of intangible assets.

The assets are evaluated at fair value during business combinations. Fair value is "the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date." Thus, the fair value of the intangibles is not about recording the cost of acquiring the intangible assets. The core concern lies in understanding the economic value to the firm, or to put it in another way, to project counterfactual cash flow in a state of the world where the company does not own the intangible asset.

Under this rule, the identifiable intangibles asset price in the purchase price allocation is closer to market value rather than the book value (Ewens *et al.* (2021)). The fair value valuation requirement for business combinations for the asset is different from what is done for typical book assets reported on the balance sheet, such as the book value for property, plants, and equipment. These are evaluated at historical costs.

Both private firms and public firms are subject to the accounting rules in the business combination process. Private firms are eligible to adopt a "private company alternative," which simplifies some accounting procedures. In both cases, third-party valuation and accounting professionals conduct the valuation work.

The main advantages of retrieving the intangibles data from purchase price allocation are threefold. First, it covers all the identifiable intangibles the firm owns as well as the unidentifiable intangibles rather than just selected categories. Second, all the appraisal work is done at around the acquisition time, thus avoiding the stale value problem. Third, the valuation at M&A provides a market price for intangibles.

D.1 Intangibles Accounting Background

The definition of intangible assets is very broad. Before understanding intangible assets, we should discuss the definition of assets because the meaning of intangible assets boils down to assets that lack tangibility. According to US GAAP, an asset is the present right of an entity to an economic benefit. Intangible assets lack physicality but nevertheless benefit the

organization.[3] The general definitions for assets and intangible assets and are why items such as backlogs, non-compete agreements, and right of use are also considered intangible assets beyond assets such as patents, trademarks, and technology.

There are two main categories of intangible assets: identifiable intangibles and unidentifiable intangibles. The identifiable intangibles are intangibles that are separable from the entity that holds them or results of contractual or legal rights (ASC 805-20-55). Some examples are customer relationships, brands, patents, trademarks, technology, and various use rights. Unidentifiable intangibles are intangibles that cannot be identified in practice. In particular, these intangibles cannot be easily separated from the business, and examples include organizational capital and human capital. For my study, they are identified in goodwill.

D.2 Tax Incentive

In the sample under consideration, the influence of tax incentives is relatively weak.

Primarily, the tax basis deriving from Mergers and Acquisitions (M&As) is classified into two types: carry-over basis and stepped-up basis. The carry-over basis signifies the continuation of the target's original tax base. Hence, if the transaction tax basis adopts a carry-over format, tax accounting is unaffected by the purchase price allocation. The majority of the sample in this study operates on a carry-over basis. A mere 10% or less of my sample employs the stepped-up basis, which mirrors the valuation of the purchase price.

One might conjecture that tax incentives could provoke a manipulation in the distribution of intangibles across different categories. This arises from the fact that distinct types of assets follow diverse amortization schedules. Consequently, firms may prefer to channel a higher valuation into intangibles with shorter useful lives, leading to booking a higher upfront amortization expense and consequent tax savings. However, this concern is mitigated by the tax treatment of intangibles, which imposes a compulsory straight-line 15-year amortization on all intangibles, including goodwill (in compliance with Section 197 of the Internal Revenue Code - IRC). Therefore, no tax incentive exists to distort the amount of intangibles across categories.

D.3 Financial Accounting Incentive

Given the interplay of contradictory incentives, it is unlikely that a systematic bias, either downward or upward, would occur in the valuation of unidentifiable intangibles due to managerial concerns regarding the value of goodwill. Firstly, managers might show a proclivity to attribute a larger value to goodwill compared to other intangibles. In financial statements,

[3] With the exception of financial assets which are tangible assets.

goodwill undergoes impairment testing, while other identifiable intangibles follow a regular amortization schedule. Assigning a larger portion to goodwill can curtail the amortization expense and augment net income after the acquisition, which results in an increased earnings per share. Conversely, managers might also be incentivized to assign less value to goodwill and emphasize identifiable intangibles to evade criticism for overpayment. Thus, financial accounting incentives push managers in conflicting directions with regard to intangible valuation.

It is crucial to note that the procedure for intangible valuation occurs at arm's length and is fortified with mechanisms to prevent manipulation. It is conducted by third-party acquisition accountants and the resulting report is subjected to audit supervision. Moreover, specific acquisition accounting rules exist to identify a comprehensive range of intangible assets.

D.4 Valuation of Intangibles

Three widely adopted approaches for intangibles valuation are market price, discounted cash flow (DCF) analysis, and replacement cost. The objective is to utilize actual transaction data in order to achieve a measure of market value. Despite this, the process remains complex, ambiguous, subjective, and labor-intensive. Classical measurement error may induce attenuation bias, which contradicts the findings of this study.

D.5 Categories of Intangibles

Table 11: **List of Identifiable Intangibles**

This table shows examples of identifiable intangibles from various categories defined by US GAAP ASC 805-20-55.

Category	Examples of identifiable intangibles
Marketing-related intangible assets	
	Newspaper mastheads
	Trademarks, service marks, trade names, collective marks, certification marks
	Trade dress
	Internet domain names
	Noncompetition agreements
Customer-related intangible assets	
	Customer lists
	Customer contracts and related customer relationship
	Noncontractual customer relationships
	Order or production backlogs
Artistic-related intangible assets	
	Plays, operas, ballets
	Books, magazines, newspapers, and other literary works
	Musical works such as compositions, song lyrics, and advertising jingles
	Photographs, drawings, and clip art
	Audiovisual material including motion pictures, music videos, television programs
Contract-based intangible assets	
	License, royalty, standstill agreements
	Advertising contracts
	Lease agreements
	Construction permits
	Construction contracts
	Management, service, or supply contracts
	Broadcast rights
	Franchise rights
	Operating rights
	Use rights
	Servicing contracts
	Employment contract
Technology-based intangible assets	
	Patent technology
	Computer software and mask works
	Unpatent technology
	Databases
	Trade secrets

E. Details on the Model

Three steps:

1. Solve explicitly for $D(F)$
2. Then solve for r such that the condition
$$\mathbb{E}[D(F)] = \frac{1}{1+r}F$$
holds
3. Solve the maximization problem of the firm, taking into account the endogeneity of r

Let's say debt holder is always paid in full when $z = 0$, and occassionally not paid in full if $z = 0$ and bad εshock.

I first solve for $D(F)$ using independence of z and ϵ.

$$\begin{aligned}
D(F) &= \mathbb{E}[\min(F, pq - C)] \\
&= \mathbb{E}\left[\min\left\{F, \left(p^* - \frac{z}{B}q + \varepsilon\right)q - C\right\}\right] \\
&= \mathbb{P}(z=0)\,\mathbb{E}[\min\{F, (p^*+\varepsilon)q - C\} \mid z = 0] \\
&\quad + \mathbb{P}(z=1)\,\mathbb{E}\left[\min\left\{F, \left(p^* - \frac{z}{B}q + \varepsilon\right)q - C\right\} \mid z = 1\right] \\
&= \phi\mathbb{E}[\min\{F, (p^*+\varepsilon)q - C\}] \\
&\quad + (1-\phi)\,\mathbb{E}\left[\min\left\{F, \left(p^* - \frac{1}{B}q + \varepsilon\right)q - C\right\}\right] \\
&= \phi\left[\mathbb{P}(\varepsilon > \varepsilon_1)\int_{\varepsilon_1}^{1} F df(\varepsilon \mid \varepsilon > \varepsilon_1) + \mathbb{P}(\varepsilon < \varepsilon_1)\int_0^{\varepsilon_1}((p^*+\varepsilon)q - C)\,df(\varepsilon \mid \varepsilon < \varepsilon_1)\right] \\
&\quad + (1-\phi)\left[\mathbb{P}(\varepsilon > \varepsilon_2)\int_{\varepsilon_2}^{1} F df(\varepsilon \mid \varepsilon > \varepsilon_2) + \mathbb{P}(\varepsilon < \varepsilon_2)\int_0^{\varepsilon_2}\left(\left(p^* - \frac{1}{B}q + \varepsilon\right)q - C\right)df(\varepsilon \mid \varepsilon < \varepsilon_2)\right]
\end{aligned}$$

Let's analyze this term-by-term.

1. This term corresponds to re-payment conditional on $z = 0$ (the good state)
$$\int_{\varepsilon_1}^{1} F df(\varepsilon \mid \varepsilon > \varepsilon_1) = F\int_{\varepsilon_1}^{1} df(\varepsilon \mid \varepsilon > \varepsilon_1) = F \text{ with } \mathbb{P}(\epsilon > \epsilon_1) = 1 - \epsilon_1$$
2. Let's do the second term
$$\begin{aligned}
\int_0^{\varepsilon_1}((p^*+\varepsilon)q - C)\,df(\varepsilon \mid \varepsilon < \varepsilon_1) &= p^\star q + q\int_0^{\varepsilon_1}\varepsilon df(\varepsilon \mid \varepsilon < \varepsilon_1) - C \\
&= p^\star q + q\left[\frac{1}{2}\epsilon^2\right]_0^{\varepsilon_1} - C \\
&= p^\star q + q\frac{1}{2}\varepsilon_1^2 - C
\end{aligned}$$
3. The third term
$$\int_{\varepsilon_2}^{1} F df(\varepsilon \mid \varepsilon > \varepsilon_2) = F$$
4. The fourth term
$$\int_0^{\varepsilon_2}\left(\left(p^* + \frac{1}{B}q + \varepsilon\right)q - C\right)df(\varepsilon \mid \varepsilon < \varepsilon_2) = p^*q + \frac{1}{B}q^2 - C + q\frac{\varepsilon_2^2}{2}$$

Now, I combine these terms to get

$$D(F) = \phi \left[\overbrace{(1-\varepsilon_1) F}^{\text{No-Default}} + \overbrace{\varepsilon_1 \left(p^\star q + q\frac{1}{2}\varepsilon_1^2 - C \right)}^{\text{Default}} \right] \qquad \text{Good State}$$

$$+ (1-\phi) \left[\underbrace{(1-\varepsilon_2) F}_{\text{No-Default}} + \underbrace{\varepsilon_2 \left(p^* q + \frac{1}{B} q^2 - C + q\frac{\varepsilon_2^2}{2} \right)}_{\text{Default}} \right] \qquad \text{Bad State}$$

The equilibrium condition is that

$$\frac{1}{1+r} F = D(F)$$

Let's see what it looks like

$$\frac{1}{1+r} F = \phi \left[(1-\varepsilon_1) F + \varepsilon_1 \left(p^\star q + q\frac{1}{2}\varepsilon_1^2 - C \right) \right] + (1-\phi) \left[(1-\varepsilon_2) F + \varepsilon_2 \left(p^* q + \frac{1}{B} q^2 - C + q\frac{\varepsilon_2^2}{2} \right) \right]$$

$$F = (1+r) \left(\phi \left[(1-\varepsilon_1) F + \varepsilon_1 \left(p^\star q + q\frac{1}{2}\varepsilon_1^2 - C \right) \right] + (1-\phi) \left[(1-\varepsilon_2) F + \varepsilon_2 \left(p^* q + \frac{1}{B} q^2 - C + q\frac{\varepsilon_2^2}{2} \right) \right] \right)$$

$$1 + r = \frac{F}{\phi \left[(1-\varepsilon_1) F + \varepsilon_1 \left(p^\star q + q\frac{1}{2}\varepsilon_1^2 - C \right) \right] + (1-\phi) \left[(1-\varepsilon_2) F + \varepsilon_2 \left(p^* q + \frac{1}{B} q^2 - C + q\frac{\varepsilon_2^2}{2} \right) \right]}$$

Let ε_1 be the solution to the following equation (case where shock is such that proceeds can just pay face value conditional on $z = 0$):

$$F = (p^* + \varepsilon_1) q - C$$
$$\varepsilon_1 = \frac{F + C}{q} - p^*$$

let ε_2 be the solution to the following equation (case where the shock is such that the proceeds can just pay face value conditional on $z = 1$):

$$F = \left(p^* - \frac{1}{B} q + \varepsilon_2 \right) q - C$$
$$\varepsilon_2 = \frac{F + C}{q} - p^* + \frac{1}{B} q$$

Now solve the maximization problem problem of the firm. First, I want to explicitly characterize the following expression:

$$\max_{F \geq 0} \left\{ D(F) + \mathbb{E} \left[\max \left((1-\tau) pq - F + \tau F, 0 \right) \right] \right\}$$

Start with the expectation term

$$
\begin{aligned}
&\mathbb{E}\left[\max\left(\left(1-\tau\right)pq-F+\tau F,0\right)\right]\\
=&\mathbb{P}\left(z=0\right)\mathbb{E}\left[\max\left(\left(1-\tau\right)pq-F+\tau F,0\right)\mid z=0\right]+\mathbb{P}\left(z=1\right)\mathbb{E}\left[\max\left(\left(1-\tau\right)pq-F+\tau F,0\right)\mid z=1\right]\\
=&\mathbb{P}\left(z=0\right)\mathbb{E}\left[\max\left(\left(1-\tau\right)\left(p^{*}+\varepsilon\right)q-F+\tau F,0\right)\right]+\mathbb{P}\left(z=1\right)\mathbb{E}\left[\max\left(\left(1-\tau\right)\left(p^{*}-\frac{1}{B}q+\varepsilon\right)q-F+\tau F,0\right)\right]\\
=&\phi\left[\mathbb{P}\left(\varepsilon>\varepsilon_{3}\right)\int_{\varepsilon_{3}}^{1}\left(\left(1-\tau\right)\left(p^{*}+\varepsilon\right)q-F+\tau F\right)df\left(\varepsilon\mid\varepsilon>\varepsilon_{3}\right)\right]+\left(1-\phi\right)\left[\mathbb{P}\left(\varepsilon>\varepsilon_{4}\right)\int_{\varepsilon_{4}}^{1}\left(\left(1-\tau\right)\left(p^{*}-\frac{1}{B}q+\varepsilon\right)q-F+\tau F\right)df\left(\varepsilon\mid\varepsilon>\varepsilon_{4}\right)\right]\\
=&\phi\left[\mathbb{P}\left(\varepsilon>\varepsilon_{3}\right)\left(\left(1-\tau\right)p^{*}q-F+\tau F+\left(1-\tau\right)q\int_{\varepsilon_{3}}^{1}\varepsilon df\left(\varepsilon\mid\varepsilon>\varepsilon_{3}\right)\right)\right]\\
&+\left(1-\phi\right)\left[\mathbb{P}\left(\varepsilon>\varepsilon_{4}\right)\left(\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)-F+\tau F+\left(1-\tau\right)q\int_{\varepsilon_{4}}^{1}\varepsilon df\left(\varepsilon\mid\varepsilon>\varepsilon_{4}\right)\right)\right]\\
=&\phi\left[\left(1-\varepsilon_{3}\right)\left(\left(1-\tau\right)p^{*}q-F+\tau F+\left(1-\tau\right)q\frac{1-\varepsilon_{3}^{2}}{2}\right)\right]+\left(1-\phi\right)\left[\left(1-\varepsilon_{4}\right)\left(\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)-F+\tau F+\left(1-\tau\right)q\frac{1-\varepsilon_{4}^{2}}{2}\right)\right]
\end{aligned}
$$

Let ε_3 be the solution to the following equation$\left(1-\tau\right)\left(p^{*}+\varepsilon_{3}\right)q-F+\tau F=0$

$$
\begin{aligned}
\left(1-\tau\right)\left(p^{*}+\varepsilon_{3}\right)q&=F-\tau F\\
\varepsilon_{3}&=\frac{F-\tau F-\left(1-\tau\right)p^{*}q}{\left(1-\tau\right)q}\\
\varepsilon_{3}&=\frac{\left(1-\tau\right)F-\left(1-\tau\right)p^{*}q}{\left(1-\tau\right)q}\\
\varepsilon_{3}&=\frac{F}{q}-p^{*}
\end{aligned}
$$

Let ε_4 be the solution to the following equation: $\left(1-\tau\right)\left(p^{*}-\frac{1}{B}q+\varepsilon_{4}\right)q-F+\tau F=0$

$$
\begin{aligned}
\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)+\varepsilon_{4}\left(1-\tau\right)q-F+\tau F&=0\\
\varepsilon_{4}\left(1-\tau\right)q&=F-\tau F-\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)\\
\varepsilon_{4}&=\frac{\left(1-\tau\right)F-\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)}{\left(1-\tau\right)q}\\
\varepsilon_{4}&=\frac{F}{q}-p^{*}+\frac{1}{B}q
\end{aligned}
$$

Combine all the elements

$$\max_{F\geq0}\left\{D\left(F\right)+\mathbb{E}\left[\max\left(\left(1-\tau\right)pq-F+\tau F,0\right)\right]\right\}$$

$$
\begin{aligned}
\max_{F\geq0}\quad&\phi\left[\left(1-\varepsilon_{1}\right)F+\varepsilon_{1}\left(p^{\star}q+\frac{1}{2}q\varepsilon_{1}^{2}-C\right)\right]+\left(1-\phi\right)\left[\left(1-\varepsilon_{2}\right)F+\varepsilon_{2}\left(p^{*}q+\frac{1}{B}q^{2}+\frac{1}{2}q\varepsilon_{2}^{2}-C\right)\right]\\
&+\phi\left[\left(1-\varepsilon_{3}\right)\left(\left(1-\tau\right)p^{*}q-F+\tau F+\left(1-\tau\right)q\frac{1-\varepsilon_{3}^{2}}{2}\right)\right]+\left(1-\phi\right)\left[\left(1-\varepsilon_{4}\right)\left(\left(1-\tau\right)\left(p^{*}q-\frac{1}{B}q^{2}\right)-F+\tau F+\left(1-\tau\right)q\frac{1-\varepsilon_{4}^{2}}{2}\right)\right]
\end{aligned}
$$

I then use Mathematica to solve for the closed-form solution for F. The optimal F has the following closed-form solution:

$$F = \frac{q^2}{3\left(1+\phi-\tau\phi\right)}\left(\frac{-3+3\phi}{B}+\frac{-3C}{q^2}+\frac{3+3p-\tau-2\phi+3p\phi+2\tau\phi-3p\tau\phi}{q}\right)$$
$$\pm\sqrt{\left(-4\mathbb{A}\left(\frac{3\left(1+\phi-\tau\phi\right)}{2q^2}\right)+\left(\frac{3-3\phi}{B}+\frac{3C}{q^2}+\frac{-3-3p+\tau+2\phi-3p\phi-2\tau\phi+3p\tau\phi}{q}\right)^2\right)}$$

where

$$\mathbb{A}=\left(\frac{3C-3pq-3C\phi+3pq\phi}{B}+\frac{3p^2-\phi+3p^2\phi+\tau\phi-3p^2\tau\phi}{2}+\frac{3C^2}{2q^2}+\frac{-2C-3Cp}{q}+\frac{3q^2-3q^2\phi}{2B^2}+2p+\tau-p\phi+p\tau\phi\right)$$

I get two solutions for the optimal debt. There are solutions here that get at the local maximum, not the global maximu. I pick the larger root of the two because the firm benefits from a debt tax shield, and the larger root provide more of that. But qualitatively my comparative static results are not sensitive to this choice.