Financing Intangibles *

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Abstract

This paper utilizes a large sample of detailed asset valuation data from M&A transactions to examine the impact of intangible assets on firms' debt usage. My analysis reveals that tangible assets provide better support for debt than intangibles; nonetheless, the disparity is considerably smaller than previously thought. Intangible assets can support debt financing, 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 optimal debt levels than production-based intangibles.

Keywords: Intangible Assets, Leverage, Firm Financing, Acquisition

JEL classifications: G32, G34

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1 Introduction

In the modern economy, intangible assets play an important role, accounting for approximately 34% of firms' capital input in recent years, as estimated by Corrado and Hulten (2010). These assets, commonly associated with innovative properties, computerized information, and economic competencies (Corrado et al. (2009)), are pivotal indicators of business success, encompassing aspects such as growth (Chappell and Jaffe (2018)), productivity, profitability, and financial soundness (Eisfeldt et al. (2020)).

The debt financing of intangible assets by firms is a key focus of research. In the macro-finance literature, researchers are concerned that more intangible assets may lead to a diminished debt capacity for firms (Falato et al. (2022); Giglio and Severo (2012); Döttling and Ratnovski (2023); Caggese and Pérez-Orive (2022); Howes et al. (2022); Li (2023)). The prevailing assumption in theoretical models is that intangible assets cannot support debt while tangibles can support debt up to their value. My empirical analysis reveals that tangible assets indeed provide better support for debt than intangibles. Nonetheless, the disparity is considerably smaller than commonly assumed in theoretical frameworks. It's not a binary distinction between not pledgeable and fully pledgeable, but rather a difference of 24% and 43%.

This paper seeks to empirically address the discrepancy described above by investigating the financing of intangible assets in the context of merger and acquisition (M&A) transactions. M&A transactions offer a unique opportunity to explore this question for several reasons. Firstly, the valuation process reveals precise and comprehensive estimations of intangible assets, categorized in detail at the firm level. Secondly, M&A transactions occur with relative frequency which facilitates statistical analysis. Lastly, the nature of M&A enables the utilization of a regression design that helps get closer to the identification of the impact of intangibles on firms' financing.

My analysis focuses on a novel dataset covering M&A activities qualified as business combinations by non-bank public firms reported in Securities and Exchange Commission (SEC) filings from 2001 to 2022. Following an accounting standard change in early 2001, detailed valuation for intangibles became mandatory.

I collect the market value of assets at the acquisition date in precise categories from the purchase price allocation in the transactions.

My first set of results shows that firms use debt to finance intangible assets in M&A to a lesser extent than they do tangible assets, but the amount is still considerable. Specifically, there is a \$0.24 increase in net long-term debt associated with the purchase of one dollar of intangible assets, compared to a \$0.43 increase linked to a dollar of tangible assets. The difference between these estimates is statistically significant. This finding challenges a common modeling assumption that intangibles cannot support debt (Crouzet and Eberly (2019); Caggese and Pérez-Orive (2022); Li (2023)). Greater intangible assets may result in more constrained borrowing for firms, but the extent of that constraint is limited.

Distinguishing between types of debt – bank loans and bonds – I observe that intangibles and tangible assets support both bank loans and bond financing at similar levels. A dollar of intangibles is associated with a \$0.18 increase in bank loans, while each dollar rise in tangible assets corresponds to a \$0.22 increase in bank loans. The impact on bond usage is comparatively smaller, with a dollar of intangibles associated with a \$0.06 increase in bond debt, and each dollar rise in tangible assets corresponding to a \$0.10 increase in bond debt. Although each coefficient is individually statistically significant, there is no significant difference between intangibles and tangibles in this regard.

In addition to distinguishing between types of debt, I distinguish between the bases on which debt is extended, asset-based and cash flow-based. These two types of debt directly map into the two sources of borrowing constraints in the theories: (1) the liquidation value of assets that firms can pledge as collateral (Shleifer and Vishny (1992); Kiyotaki and Moore (1997); Bernanke et al. (1999)), or (2) cash-flow from firms' operations (Holmstrom and Tirole (1997)). The empirical classification of debt into asset-based and cash flow-based categories is explored by Ivashina et al. (2022) and Lian and Ma (2021). I follow the framework proposed by Lian and Ma (2021). The key distinction is whether the debt directly depends on specific asset values. Cash flow-based debt is tied to the operation's cash flow or going concern value, while asset-based debt relies on the valuation of a particular asset, similar to the "fruit" and "land" borrowing concepts in Kiyotaki and Moore (1997). This distinction is significant because the core reason that it is commonly

believed intangibles should not be able to support debt is from this "asset-based" channel. (1) it was believed asset-based debt is the dominant form of corporate debt, and (2) intangibles have weak pledgeability and thus cannot support asset-based debt. In fact, the empirical literature uses "asset tangibility" as a proxy for pledgeability (Almeida and Campello (2007)). I find that a dollar of intangibles is associated with a \$0.25 increase in cash flow-based debt, whereas each dollar rise in tangible assets corresponds to a \$0.23 increase in cash flow-based debt. Although all these coefficients are individually statistically significant, there is no significant difference between them. Conversely, a dollar of intangibles is linked to a \$0.05 increase in asset-based debt, while each dollar rises in tangible assets corresponds to a \$0.20 increase in asset-based debt. Both individual coefficients in this set of results are statistically significant, and the difference between them is also statistically significant.

I proceed to analyze loan-level data for new loans in M&A to examine how firms use intangibles as collateral. I find that intangibles are often paired with other assets, mainly tangible and current assets, as collateral but rarely used alone. In contrast, tangible assets frequently serve as sole collateral. Among 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, indicating a focus on the going-concern value rather than specific assets. In contrast, only 20% of loans with tangible asset collateral use the entire firm's assets as security. This finding provides a new perspective on work that uses Uniform Commercial Code (UCC) filings to investigate intangibles as collateral (Mann (2018); Appel et al. (2019))[1]. UCC filings are a means whereby creditors notify others about their legal rights to an asset. Given that intangibles are frequently pledged with other assets or with the firm in a blanket lien rather than independently, this approach overlooks the distinct characteristics of intangibles. Specifically, these loans depend on the going-concern value of the company rather than the stand-alone valuation of the assets in loan collateral. Thus, using UCC data may lead to misclassifying cash flow-based lending as asset-based lending.

Intangibles are inherently a hodgepodge of various types of assets, including

[1]Data vendors for IP asset-backed financing such as Relecura and ktMINE collects the data from UCC and thus may subject to the same misclassification issue.

patents, technology, customer relationships, brands, trademarks, etc. Given the variability in the types of intangibles, it is important to categorize them in terms of economic function to gain insights into the amount of debt financing. The types of intangibles can have an important impact on debt financing. To this end, I classify intangibles into two types: production-based intangibles, which directly enhance production by manufacturing more units of products, and demand-shifter intangibles, which primarily impact prices by shifting customer demand for goods. This distinction is to recognize different intangibles serve different economic functions in production and may have different implications for debt financing. The major types of production-based intangibles comprise patents, software, technology, licenses, and organizational capital; the major types of demand-shifter intangibles encompass customer relationships, brands, and trademarks.

Delve into the heterogeneous effect by types of intangibles, I find a dollar increase in demand-shifter intangibles is associated with a \$0.57 increase in long-term debt, whereas each dollar increase in production-based intangibles is only associated with a \$0.16 increase in long-term debt. Both coefficients are statistically significant. Importantly, there is also a statistically significant difference between these two coefficients, which confirms the existence of the heterogeneous effect in the ability to support debt across types of intangibles. To further test this finding, I separately examine the results for the major categories within production-based intangibles and demand-shifter intangibles, and the results are largely consistent – demand-shifter intangibles are associated with higher levels of debt usage compared to production-based intangibles.

To elucidate one possible mechanism, I formulate a simple model to demonstrate that firms possessing more demand-shifter intangibles tend to have a higher optimal debt level. I propose that increased demand-shifter intangibles can mitigate the cash flow volatilities of firms during bad times, motivated by insights in Larkin (2013) that firms with a strong brand perception perform better during recessions. Under this simple model, it is indeed the case that firms with higher demand-shifter intangibles generate more stable cash flow because customers are still willing to purchase from the firm during economic downturns, and the firm shed prices less. I empirically test this channel. I find that acquirer firms that acquired one standard deviation higher demand-shifter intangibles are associated with a reduction of 0.11 in post-acquisition cash-flow volatility, representing a

decrease of 10% compared to the unconditional mean. One prediction from the model is that demand-shifter intangibles are more important in bad economic environments that have more frequent negative shocks. I empirically test the prediction and find results that are consistent. In bad times, one more dollar of demand-shifter intangibles is associated with a \$0.67 increase in long-term debt, while in good times, this number is \$0.51.

The empirical effects are estimated through a cross-sectional regression of M&A transactions, examining how acquiring firms' debt usage changes after the acquisition of target firms' intangible and tangible assets while holding the acquirer's pre-acquisition debt usage constant. This approach addresses the issue of simultaneity – capital structure impacts firm financing, which is inherent in directly regressing debt usage on intangibles. Another identification challenge arises from potential omitted variables, such as internal funds in line with the pecking order theory (Myers and Majluf (1984); Brown et al. (2009)). To mitigate this concern, several control variables are included, such as cash on hand, cash from the target firm, rating-specific credit spread, total Q (Peters and Taylor (2017)), equity market valuation, growth prospects, firm size, firm profitability, tangible assets of the firm, tangible assets from the acquisition, and operating earnings. Additionally, I incorporate industry $\times$ year fixed-effects to account for unobserved heterogeneity across industries over time. Several robustness checks along this line have also been conducted.

This paper intersects with several strands of existing literature. Previous studies have grappled with the complexities entailed in measuring intangible assets, employing a range of methods. Some measure intangibles at the firm level using a perpetual inventory method that discounted 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)). 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. Several papers in the literature that use purchase price allocation data focus on total intangible assets or use small

samples consisting of public firms and public targets (Lim et al. (2020); Ewens et al. (2021)). As far as I am aware, my dataset constitutes one of the most extensive collections of purchase price allocation data to date, including detailed intangible asset valuations in categories.

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); Sun and Xiaolan (2019); Horsch et al. (2021)). In particular, bank finance is an important source of capital for intangible creation (Chava et al. (2013); Hall and Lerner (2010); Nanda and Nicholas (2014)). 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. Hochberg et al. (2018) studies patents-backed financing for venture debt. My study builds upon this research and looks at the debt financing instruments, the type of intangibles, how firms pledge intangibles, and the mechanism whereby intangibles are used as a basis for debt.

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 the limited pledgeability of intangible assets 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 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 check model assumptions against real-world data: I show that intangibles are not inherently associated with less debt capacity for firms, in comparison to tangible assets. This finding suggests the need to revisit existing assumptions to address essential questions in this domain.

2 Data

2.1 Purchase Price Allocation Data

Intangible Assets and Tangible Assets from SEC Filings A challenge to measuring intangible assets is limited data availability. Most intangible assets are not accounted for on a company's balance sheet due to accounting regulations that prevent the capitalization 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, obtaining a comprehensive picture of a company's intangible assets is difficult.

To overcome this problem, I turn to an alternative data source—the purchase price allocation during M&A. This process is the intermediary step to combine the books of the target firm with those of the acquirer, which involves a careful assessment of a target company's assets to determine their market value[3], as part of the consolidation process for the acquiring company's balance sheet. In early 2001, Statement of Financial Accounting Standards (SFAS) 141 and 141R, required the reporting of granular details on intangible assets. 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 subject to audit. Figure 2 and figure 3 shows two examples of the purchase price allocation.

The accounting rules for intangibles follow the United States Generally Accepted Accounting Principles ASC 805, where identifiable intangibles, such as customer relationships, brands, patents, trademarks, and technology, etc., are separately identified and provided for detailed valuation. However, an additional category of unidentifiable intangibles, termed goodwill, constitutes the residual component of an acquired company's value after all values for identifiable have

[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).

[3]The accounting jargon is "fair value" – 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 (ASC 820-10-20). This is essentially market value for economists.

been determined. Unidentifiable intangibles may include organizational capital, the workforce in place, synergies, etc. Most of these lie beyond the scope of this study as my methodology cannot capture these values, although the workforce in place is part of human capital, which I can partially capture through the non-compete agreements. However, I do not account for organizational capital, the most important unidentifiable intangible, due to data limitations and the challenges of accurately separating organizational capital. Hence, I confine my analysis to identifiable intangibles which are conducive to precise measurement. Detailed information on the categories of intangible assets can be found in Appendix A[4].

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 stale book values. Thirdly, the reporting adheres to standardized accounting rules, enabling systematic collection and evaluation. Finally, the incentive for manipulating intangible asset values for reporting purposes is relatively weak (see discussions on tax incentive in Section 8[5]).

2.2 Sample Construction

I begin with all the mergers and acquisitions carried out by US public companies from 2001 to 2022 recorded by DealStats. This platform gathers 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 separate tables. DealStats captures this information in textual form, which allows me to use natural language processing to extract the relevant data and to gain a granular breakdown of the intangible assets in various categories.

Next, I further narrow down the sample to all M&A transactions that qualify as business combinations conducted by non-bank public firms, ensuring access

[4]Several earlier papers uses purchase allocation data to study intangibles. Ewens et al. (2021) analyzed the estimated total intangible value of the firm as a whole and Lim et al. (2020) focuses on a smaller sample (looking at public firms' acquisition of public targets). I provide the most comprehensive collection with breakdowns of intangibles into detailed categories.

[5]More details on intangibles and purchase price allocation see Appendix D.

to textual purchase price allocation data. The focus on non-bank firms is because the assets (e.g. securities and loans) and liabilities (e.g. deposits) of banking institutions differ from those of other firms. The final dataset includes purchase price allocation data from 5,140 deals spanning over two decades.

The analysis incorporates annual balance sheet information from Compustat, detailed M&A deal-level data, and debt-level data from Capital IQ, Mergent FISD and DealScan. I use Compustat to analyze the change in debt usage among the acquirer firms from their financial statements. For debt specifics, I use the Capital IQ Capital Structure Debt database and complement it with bond information from Mergent FISD. The classification of cash flow-based debt and asset-based debt follows Lian and Ma (2021), as outlined in Appendix B. To gather information on loan collateral, I turn to DealScan.

The matching of M&A deal-level information with Compustat and Capital IQ debt detail is performed using CIK, and additional checks are conducted using the acquirer names 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)). The linking table is updated until 2018; I extend it using a similar string-matching algorithm.

Finally, to treat cases that involve firms acquiring multiple targets within a year, I aggregate deal-level data into acquirer firm-year level. After matching with Compustat and Capital IQ, the final dataset includes approximately 3,800 firm and year combinations. To address outliers and data errors, I winsorize all variables at the 1st and 99th percentiles.

3 Empirical Strategy

3.1 Illustrative Framework

My baseline analysis involves two steps. Firstly, I discover the value of different categories of intangible capital held by the target firm by examining purchase price allocation data. Secondly, I track changes in the acquirers' use of debt both before and after the acquisition to understand how companies are financing the acquisition. It's important to note that while the way firms finance the acquisition

is linked to the deal structure, the study does not specifically focus on the deal structure itself. Generally, deal structures involve cash and stock, with cash offers often requiring debt financing since acquirers typically have limited cash and liquid assets (Faccio and Masulis (2005), Bharadwaj and Shivdasani (2003)). In this context, even if a deal appears to be a cash transaction on the surface, my analysis is geared toward uncovering the ultimate method of financing.

In Figure 4, I use a graph to depict the analytical approach visually. The top row shows the balance sheets of the acquirer and target before the transaction, with assets on the left, and liabilities and equity on the right for each entity. The bottom row illustrates the balance sheet of the consolidated business after the transaction.

Following the transaction, the assets of the acquirer comprise both the original assets and those acquired from the target. The liabilities encompass pre-transaction debt and the net debt incurred or acquired during the acquisition process. The equity consists of the pre-transaction equity and net equity issued during the acquisition.

Regarding the target's pre-transaction debt, the acquirer can choose to settle it, assume and refinance the debt, or assume the debt without refinancing. The pre-deal equity is disbursed as the acquirer firm assumes ownership. This project examines the change in debt (Δ debt) and its relationship with the assets (i.e. tangible, intangible, and working capital) acquired.

4 Regression Specification

I begin my analysis by illustrating the relationship between various acquired assets in M&A and debt financing. I use the following regression specification:

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

This cross-sectional regression examines the acquisitions at the acquirer firm-year level instead of at the deal level because sometimes acquirers conduct more than one acquisition in a year. In these cases, I sum all the assets acquired from

M&As in a given year. The focus is on tracking the changes in acquired intangibles [6] observing the corresponding changes in debt usage. The dependent variables of focus are the changes in the level of debt (notated as D'), especially long-term debt, as indicated in the illustrative diagram in Figure 4. Occasionally, companies utilize a bridge loan for short-term financing during transactions but promptly settle it using cash from the target balance sheet or proceeds from other financing methods such as additional debt financing or equity issuance. By using the long-term debt changes, I specifically focus on the portion of debt that firms do not offset immediately following a transaction.

The study focuses on debt usage differences for firms that, through an M&A deal, acquire an additional dollar of intangibles compared to those that do not, all else being equal. The regression coefficient β_1 represents the change in debt in dollars correlated with acquiring an additional dollar of intangible assets. Similarly, β_2 represents the change in debt in dollars correlated with acquiring an additional dollar of tangible assets. I compare the two coefficients with a F-test. If there is no statistically significant difference between the two coefficients, it suggests intangible assets and tangible assets support debt comparably.

My goal is to understand the impact of intangibles on the acquirer's debt usage. An ideal experiment would be to compare the debt usage of the same firm with or without the purchase of additional intangibles. Given the impossibility of that framework, I run the proposed regression analysis. The challenge in identifying this correlation is the potential for omitted variables. To mitigate this, several control variables are added, including tangible assets from the acquisition, acquired cash from the acquisition, rating-specific credit spread, firm profitability, cash on hand, tangible assets, operating earnings, leverage ratio, the natural logarithm of assets, and the Tobin's Q. All balance sheet control variables are normalized by total assets from the acquirer before the acquisition and enter into the regression with a one-period lag. 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.

The regression strategy mitigates the common problem of simultaneity in regressing capital structure on intangibles as the capital structure also impacts the

[6] I run regressions on all three types of assets but only focus on interpreting the coefficients for intangibles and tangibles.

types of investment the firm chooses (Myers (1977); Jensen and Meckling (1976)) and thus the assets acquired. Here, I ask how firms finance the intangible assets from acquisition, keeping the pre-acquisition leverage ratio fixed to mitigate the simultaneity issue.

Due to the difficulty in isolating the exact debt changes associated with multiple deals within one year, I conduct the analysis at the firm-year level. This way I capture all the debt changes that are possibly related to the acquisitions but at the cost of certain measurement issues, such as the case of acquirer firms engaging in additional PP&E purchases or R&D development on the side, which would bias my estimates. In the robustness checks session (Section 8), I will show some tests around this, and also robustness checks with some other additional control variables.

4.1 Summary Statistics

Table 2 presents the summary statistics for the outcome variables, purchase price allocation variables, and control variables used in the main analysis and the robustness checks. The main outcome variable is the change in long-term debt (`dltt`) from the balance sheet.

The control variables include variables that may correlate with both the decision to acquire the target firm with specific assets and debt usage. Additionally, I incorporate additional variables suggested by empirical literature examining the capital structure and debt financing (e.g. Rajan and Zingales (1995); Frank and Goyal (2009); Martynova and Renneboog (2009)).

I do not exclude observation from the overall sample because of missing accounting variables.

5 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 specification, each dollar increase in identifiable intangibles is

associated with a 0.24-dollar increase in long-term debt, while each dollar rise in tangible assets corresponds to a 0.43-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. In Figure 5 panel (a) and (b), I also present the results in bin-scatter graphs.

Furthermore[7], Table 5 differentiates debt types into bank debt and bond debt based on firms' debt structure data. Table 5 columns (1) to (4) shows the impact of identifiable intangibles and tangible assets on two major debt instruments. The regression results in column (4) are from the preferred specification, which suggests a correlation between a dollar increase in identifiable intangibles and a 0.18-dollar increase in bank debt, and similarly, a dollar increase in tangible assets is associated with a 0.22-dollar increase in bank debt. 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 rise of intangibles does not weaken the usage of bank debt. For columns (5) to (8), I repeat the analysis but regress changes in bond debt on the number of intangible and tangible assets acquired from M&A. This set of results shows a dollar increase in intangible assets is associated with a \$0.06 increase in bond debt and a dollar increase in tangible assets is associated with a \$0.10 increase in bond debt. The effect of both intangible and tangible assets on bond debt is much smaller than that of bank debt. However, just as with findings regarding bank debt, the coefficients do not differ significantly. Intangibles support debt to a comparable extent as tangible assets in both the private debt market and the public debt market. The private debt market is overall a much more important source of financing than the public debt market for M&A activities.

Regarding the pledgeability of intangibles, the conventional view suggests that higher levels of intangible assets may complicate borrowing due to difficulties in

[7]The findings presented here are based on firm-level debt structure data. At the debt level, precise categorization into long-term versus short-term is challenging, unlike the classification conducted on a case-by-case basis by firm accountants in the firm balance sheet. This discrepancy may lead to gaps in estimates. I do not consider "bridge loan" in this analysis.

using them as collateral. However, if borrowing primarily relies on cash flow, the tangibility of assets may be less significant in affecting the overall debt usage. To explore this further, I separate debt into cash flow-based and asset-based following (Lian and Ma (2021)). As shown in columns (1) to (4) of Table 6, a dollar increase in identifiable intangibles is associated with a $0.25 increase in cash flow-based debt, but a dollar increase in tangible asset is associated with a $0.23 increase in cash flow-based debt. This result indicates that intangible assets provide substantial support for cash flow-based debt, to an extent comparable to tangible assets. In columns (5) to (8), I show the results from the asset-based debt. In the preferred specification in column (8) a dollar increase in identifiable intangibles is associated with a $0.05 increase in asset-based debt, but a dollar increase in tangible assets is associated with a $0.20 increase in asset-based debt. The coefficient for the intangible asset is weakly significant and the economic magnitude is very small, while the coefficient for tangible assets is statistically significant and economically sizable. This result suggests for asset-based debt where pledgeability and the valuation of the collateral on a standalone basis are critical, it is correct to assume intangibles cannot support debt. This result seemingly contradicts the findings in the previous literature discussing the legibility of intangible assets (Loumioti (2012); Mann (2018)).

To explore how intangibles are used as collateral, I use loan-level details in the DealScan database to gain insights. Specifically, I look at loans originated or amended around the time of the M&A transaction and check the assets used as collateral. In Figure 6, the bar on the left-hand-side shows the results for loans with intangible assets listed as collateral, and the bar on the right-hand-side shows the results for loans with tangible assets listed as collateral. The contrast between the two bars is very striking. For loans using intangibles as collateral security, in 60% of the cases, intangibles are used as security along with all assets of the firm. Forty percent of loans using intangibles as collateral are paired with other assets. No loan in the entire sample uses intangibles as sole 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 collateralized along with all assets of the firm (20%).

A loan with an asset that is used as collateral on its own or paired with other assets is fundamentally different from a loan that is secured on "all assets" of the

firm (Lian and Ma (2021)). In the first type, the debt is based on the liquidation value of this asset, and creditors have claims on it in default resolution to establish priority. But the second type is about the lenders taking security in "all assets" of the firm as a whole through blanket liens (excluding liquidation value of specific assets pledged in asset-based lending). The debt is based on the continuation value of the business, especially in a world where the typically going-concern value of the business is significantly larger than the liquidation value of specific assets the going-concern value of the business rather than the exact value of the asset is the focus.[8]. This result suggests that intangible and tangible assets are used very differently as collateral. In Figure 7, I show the frequency of other types of assets that are paired with intangibles or tangibles in serving as loan collateral. Intangible assets are most frequently paired with tangibles, which suggests there may be some complementary between these two assets in serving as collateral.

This result also highlights a potential weakness in the literature that uses data from the Uniform Commercial Code (UCC), a filing record that informs other creditors about a debt's assets being used as collateral for a secured transaction, to study intangibles as collateral. In UCC, the 60% of the cases where intangibles are used along with all other assets in serving as the collateral would be classified into asset-based lending, whereas they are, in fact, cash flow-based lending. The remaining 40% of cases where intangibles are paired with other assets – tangible assets, inventory and accounts receivable – as collateral are also classified into asset-based lending, even though the full picture is more complex. It is precisely in this complexity that the uniqueness of intangible assets lies. There are indeed some special characteristics of intangible assets that make them less good collateral assets than tangible assets.

Even though intangibles do not impact the amount of debt firms have, they do impact the way lenders establish priority in getting the payment in default resolution (Benmelech et al. (forthcoming)). The results show the differences between intangibles and tangible assets in their roles as collateral. The high proportion of cases where intangible assets are paired with tangible assets in

[8]I show examples of pledged with all assets in the Appendix, versus cases where individual value of collateral matters. Very famous cases such as United Airline pledging it's frequent flier program during COVID, are cash flow-based, rather than asset-based, which is rather clear from close examination of the credit agreements

serving as collateral suggests some complementary between the two. Moreover, the data may suggest great uncertainty as to the extent to which intangibles can be resold on a standalone basis in a liquidation, even for identifiable intangibles that are, by definition, separable from the firm[9].

6 Types of Intangibles

In the literature of intangibles, researchers tend to address intangible assets as a group. However, it is evident that intangibles constitute a broad category that encompasses an array of assets, such as customer relationships, brands, technology, various licenses, etc. It would be unrealistic to assume that all these assets impact lending similarly. However, understanding these diverse types of intangibles can pose a challenge to researchers. In this section, after presenting a conceptual framework for understanding intangible assets, I delve into the diverse types thereof.

6.1 A Proposed Economic Framework for Intangibles

"Intangible assets" are generally defined as "assets without physical presence". However, this description is indirect and vague. I consider the role of intangible assets in the production function framework and think about where they fit into the economic input-output equation. Therefore, we'll start with a general form of aggregate production function:

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

Here, Y stands for output, A is total factor productivity (TFP), K is capital, and L is labor. K encompasses all kinds of capital, tangible and intangible alike, that helps the firm produce more units of product. The intangible assets now fit

[9] Kermani and Ma (2023) documents high liquidation recovery rates of book intangibles in specific industries such as airlines, mining, and recreation apparel for transferable licenses and usage rights, patents, and data. However, according to industry experts and reports, the market for intangible collateralized debt, asset-based lending, is currently primarily served by specialty lenders and has not yet become mainstream.

into two categories: K and A. Intangibles that help firms produce more are in K, and other intangibles that do not help firms produce more units of goods but impact prices are in A. I call the former production-based intangibles and the latter demand-shifter intangibles[10]. To give an example, intangibles such as brands[11] do not directly enter the production function in aiding firms to manufacture more units of widgets (thus not in K) but allow firms to charge higher prices or sell more units at the same price (thus in A). Other intangibles, such as customer relationships and business relationships, share the same feature.

Based on this framework, I go to the purchase price allocation data and categorize major categories of intangibles into production-based intangibles and demand-shifter intangibles. In Table 7, I list my classification. Kindly be aware that there exists a disparity between the economic meaning researchers attribute to specific intangible categories and the empirical measurement. My categorization is founded on empirical measurement, and I explain the definition of selected categories and my reasoning of classification below.

Production-based intangibles.

- General definition: Production intangibles directly contribute to the firm's production.
- Important categories:
  - Patent, software, technology, IP R&D: patents are legal protections granted for inventions. Software refers to computer programs and applications, including both off-the-shelf software and proprietary software developed by the company. Technology means the proprietary technology, process, or methodology developed, such as innovative manufacturing processes, research techniques, or proprietary algorithms. IP R&D is the in-process research and development.
  - Know-how, blueprints, license: know-how refers to the expertise, skills, and technical knowledge possessed by the acquired company's employees or management which includes trade secrets, best practices, and

[10] I do not take a stance on the form of the shift – can be parallel shifting or rotatory shifting (for some discussion in demand-shifter intangibles see Johnson and Myatt (2006)).

[11] Brands are valuable assets for firms. As of 2021, the combined worth of the top 100 brands in the US economy amounted to an astonishing $4.14 trillion (Bronnenberg et al. (2022)).

proprietary techniques. Blueprints are detailed technical drawings or plans used in the design and construction of products, machinery, or infrastructure. license, such as broadcast license, and operation license; these are materials that enable production.

  - Right of use and copyrighted material: the right of use represents the lessee's right to use a leased asset for the lease term. The underlying assets can be PP&E and intangible assets such as technology. Copyrighted material includes original works of authorship, such as literary works, artistic creations, music compositions, and software code. These are intangibles that can be used in production directly and help firms produce more products.
  - Organizational capital: business practices that facilitate production.[12]

Demand-shifter intangibles.

- General definition: Demand-shifter intangibles do not directly contribute to production but help firms sell more products at larger quantities or higher prices.
- Important categories:
  - Customer relationship, customer list: customer relationship is the established connections and interactions between the company and its customers. The relationship can include various aspects, such as the loyalty of customers and the potential for repeat business. The customer list contains details about the company's customers, such as contact information and purchasing history.
  - Brands, trademark, domain name: brands represent the overall perception and reputation of a company or its products/services in the marketplace. Trademarks distinguish a company's products or services from those of competitors with legal protection. Domain names are unique addresses that identify specific websites on the internet. They play a crucial role in establishing an online presence and facilitating

[12] As explained in the data section I do not capture this intangible very well empirically using PPA data.

customer access to a company's website. Domain names may reflect the company's brand name, product name, or key terms relevant to its business.

- Customer contract, backlog: Customer contracts represent formal agreements between the acquired company and its customers. These contracts outline the terms and conditions of the products or services to be provided, including pricing, duration, and any specific obligations or commitments. Customer contracts can be valuable assets because they often represent future revenue streams and provide visibility into the company's customer base. Backlog refers to the unfulfilled orders or contractual commitments that the acquired company has already secured but has not yet delivered or recognized as revenue.
- Business relationship: relationship with downstream and upstream firms, such as relationship with distributors, vendors, and suppliers.
- Data: In purchase price allocation (PPA), "data" typically refers to the value associated with data assets acquired as part of a business acquisition. Data assets can include various types of information collected and stored by the acquired company, most importantly customer data, sales data, and in some cases market research data, operational data, and proprietary datasets. This category is where the conceptual gap between current research and this empirical work is the largest. Some recent work on data economy (Begenau et al. (2018); Farboodi et al. (2019); Farboodi and Veldkamp (2023)) is extremely interesting. The essence of "data" economy is where firms gather information and essentially use data to reduce uncertainty is very interesting. From an empirical perspective, data is more similar to a customer list where a database contains information about valuable customer and their preferences. The more advanced analytical potential of data will be part of technology or organizational capital which is outside of my current study.
- Franchise agreement: a franchise agreement allows a franchisee to operate a business associated with the franchisor's trademark.
- Non-compete agreement: a non-compete agreement is a contractual arrangement between the buyer (acquirer) and the seller (target company)

that restricts the seller from engaging in competitive activities within a specified geographic area or industry sector for a certain period of time after the acquisition. Non-compete agreements do not impact the firms' production but protect the demand the firm faces.

Next, I conduct the same regression as in Table 4, but splitting intangibles into the aforementioned two categories to test if there is a differential effect on debt financing associated with production-based intangibles and demand-shifter intangibles. In Table 8 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. The results suggest that demand-shifter intangibles induce more debt than production capital intangibles. I use F-test to confirm that the difference in the two coefficients is statistically significant. I do acknowledge that this classification is a bold attempt. In the real world, the classification may not be as clear-cut as one would like. For my result, the most important types of demand-shifter intangibles are brand trademarks, customer lists, and customer relationships, and the most important types of production-based intangibles are patents, software, and technology.

In Figure 9, I show the regression results from selected categories from the production-based intangibles and demand-shifter intangibles. In general, demand-shifter intangibles are on the right side of production-based intangibles. Unfortunately, I cannot break technology-related into further details. Technology

Indeed, demand-shifter intangibles correlate with more debt financing than production-based intangibles.

6.2 Model for Intangibles and Debt Capacity

In this section, I provide a simple model to illustrate how demand-shifter intangibles and production-based intangibles have different implications for debt

usage. The key mechanism is that demand-shifter intangibles reduce the cash-flow volatility of firms, especially in market downturns.

The model has two time periods, $t = 0, 1$. There is a single firm with two production capital: tangible capital (k_T) and production-based intangible capital (k_N). Production-based 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 units of goods. I take the stock of intangible assets and tangible assets as exogenous. The innovative part of this model is to shed light on the heterogeneous characteristics of various types of intangibles which is a complicated hodgepodge of many assets.

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

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

The firm faces a demand curve in the form of

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

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-shifter 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 – a larger amount of customer relationship reduces the price impact of a large number of outputs when the market condition is tight. I model the demand curve this way is consistent with 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 debt usage to maximize initial equity value. For simplification purposes, here, I do not discount the $t = 1$ payment.

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

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.

In Figure 8 (a), the result shows as the value of the demand-shifter intangible increases, the optimal debt also increases. This result illustrates the possible channel that the 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 a higher optimal debt capacity. I empirically test the actual relationship between different types of intangibles and cash flow volatility. In Table 9, I show results from the regression analysis that confirm demand-shifter intangibles reduce cash flow volatility. One standard deviation increase in the demand-shifter intangibles (scaled by pre-acquisition assets) is associated with a reduction of 0.017 in the post-acquisition cash flow volatility, representing a decrease of 10% compared to the unconditional mean. In contrast, the impact of production-based intangibles on cash flow volatility is not statistically significant.

A prediction from this model is 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 firms with higher demand-shifter intangibles always have higher optimal debt in a given market environment, and this gap keeps diminishing as the market has less frequent negative shocks. I empirically test this prediction in Table 10. It confirms during bad times one more unit of demand-shifter intangibles correlates with \$0.68 of long-term debt. The coefficient is smaller in magnitude during good times – this number is \$0.53.

7 Enduring Impact

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

8 Robustness Checks

In this section, I conduct several robustness checks for my core empirical finding that intangibles can support debt to address potential remaining omitted variables issue and intangibles accounting challenges.

8.1 Confounding Investment in Tangible or Intangible Assets

An identification concern associated with my firm-year level regression framework is potentially, at the same time, the acquirer firms that acquire tangible or intangible assets also do more PP&E acquisition or R&D development on the side. Thus, the observed Δ intangibles or Δ tangibles from the M&A do not capture the full extent of the capital accumulation. Moreover, if any of these confounding developments on the side also correlate with more debt usage, then I potentially overestimate the effects. To give a concrete example, say the firms purchase intangible assets during the M&A and invest in more PP&E during the same time, and finance the investment using debt. The coefficient I observed from my regression design is potentially overestimated. In Figure 11 panel (a), I show the change in SG&A expense, and I do not find a significant concurrent pattern before or after the acquisition. In Figure 11 panel (b), I show the change in in-process R&D expense. The sign of the coefficient shows the firms reduce their own in-process R&D expense after the purchase of intangibles, but because of the large standard error associated with the estimates, I do not find a statistically significant concurrent pattern before or after the acquisition. Similarly, in Figure 11 panel (c), I also do not find a pattern before or after the acquisition in PP&E purchase.

8.2 Tobins' Q

In my baseline specifications, I control for total Q as suggested in Peters and Taylor (2017) which is a new Tobin'q proxy that accounts for intangible capital and they argue this proxy is a better proxy for the firm's investment opportunities. In Table 11, I re-run the baseline regression but use Tobin's Q. My main findings stay the same.

8.3 Initial Capital Structure of the Target

In my baseline specification, I consider the debt changes during 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. However, the situation is slightly tricky if the target firms already have 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. Fortunately, I have the balance-sheet data for some target firms. 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 12. My main findings stay the same.

8.4 Deal Structure and Taxation

The deal structure and taxation incentive in M&A is an important topic (Erickson (1996)). In my setting, if taxation consideration may be related to the valuation of assets, I should worry about biases in my results. An example may be, due to taxation reasons, the PPA valuation of intangibles (or tangibles) is manipulated – for example, purposefully allocating a lot of value into intangibles when in fact the target firm has a lot of tangible assets. Also, tangible assets support debt better than intangibles. Then, the positive coefficient that I observe for the intangible assets is an overestimation. I show my study is robust to this concern.

There are two types of tax treatment: tax-deferred transaction in which a seller does not recognize any gain or loss on its assets (i.e. "carryover basis"); taxable transaction in which a seller recognizes a gain or loss on the transaction (i.e. "stepped-up basis").

Carry-over basis. This means carrying over the seller's (i.e. target) original tax basis in the property. On a carry-over basis, the valuation work conducted during M&A does not impact the taxation of the acquirer at all. In accounting jargon, "the fair value adjustment in PPA are not taxable". Thus, the manipulation incentive of the value of intangibles for taxation purposes is the weakest.

A stepped-up tax basis means the tax basis is step-up to the full purchase price. Additionally, section 197 of the IRC, mandates straight-line 15-year amortization

for all intangible assets (including goodwill) acquired in a transaction. Thus, in this situation, the fair value valuation of intangible assets in PPA does impact taxation.

I infer the acquisition tax structure with its two determinants: primary considerations and acquisition type. In my sample, the dominant majority – 85% of the transactions are tax-deferred transactions and only 7.5% are taxable transactions, meaning the purchase price allocation impacts the taxation (for the remaining 7.5% of the sample I do not have enough information to infer the tax structure).

9 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.

10 Figures

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.

Note 2 — Preliminary Purchase Price Allocation

The pro forma purchase price allocation below has been developed based on preliminary estimates of fair value using the historical financial statements of Jos. A. Bank as of May 3, 2014.

Current assets	748,744(i)
Property, plant and equipment, net	170,916(ii)
Intangible and other assets	621,478(iii)
Current liabilities	(145,833)
Other non-current liabilities	(297,196)(iv)
Goodwill	722,199(v)
Total purchase price	$ 1,820,308

(i) Historical current assets was increased by approximately $7.5 million as a result of an increase of $46.0 million to reflect an adjustment of Jos. A. Bank's inventory to fair value and to conform to Men's Wearhouse's inventory methodology and the establishment of a $7.1 million income tax receivable. These increases were partially offset by the elimination of $1.9 million of Jos. A. Bank prepaid expenses, which the Company deemed did not meet the criteria for recognition as an asset for purchase price allocation purposes, the elimination of Jos. A. Bank's current deferred tax asset of $25.4 million and the recording of an $18.3 million deferred tax liability as a result of purchase price adjustments, which is included in current assets as the combined company has a net current deferred tax asset balance.

(ii) Historical property, plant and equipment, net was increased by approximately $19.9 million to reflect an adjustment to fair value.

(iii) Intangible and other assets were increased by approximately $621.2 million and consist of four separately identified assets. First, the Company identified the Jos. A. Bank tradename as an indefinite-lived intangible asset with a fair value of $539.1 million. Second, the Company identified a customer relationship intangible asset with a fair value of $53.0 million, which the Company expects to amortize over a useful life of 7 years. Third, the Company 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, the Company recognized an intangible asset related to the Jos. A. Bank franchise store agreements of $4.7 million, which the Company expects to amortize over 25 years. The allocation of the purchase price to acquired intangible assets is based on preliminary fair value estimates and is subject to final management analysis, with the assistance of third party valuation advisors.

(iv) Historical non-current liabilities were increased by approximately $245.9 million consisting of $272.3 million in deferred tax liabilities to be recorded as a result of the purchase price adjustments to fair value, primarily related to the recognized intangible assets. This amount was calculated using a tax rate of 38.8%, which approximates the Company's statutory rate. Additionally, non-current liabilities were increased by $14.1 million related to the recognition of an intangible liability for unfavorable Jos. A. Bank leases (as compared to prevailing market rates), which will be amortized over the expected remaining lease terms. These increases were offset by a decrease of $40.5 million to reflect the elimination of Jos. A. Bank's deferred rent balances as of May 3, 2014 as these amounts are not assigned any fair value during purchase price allocation.

(v) Goodwill was increased by $722.2 million to reflect the excess of the consideration paid to consummate the Acquisition over the fair value of the assets acquired.

(a) Purchase price allocation

Tradename	$539.1 million
Customer relationship	$53.0 million
Favorable leases	$24.4 million
Franchise store agreements	$4.7 million
Total Intangible assets	$621.2 million

(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.

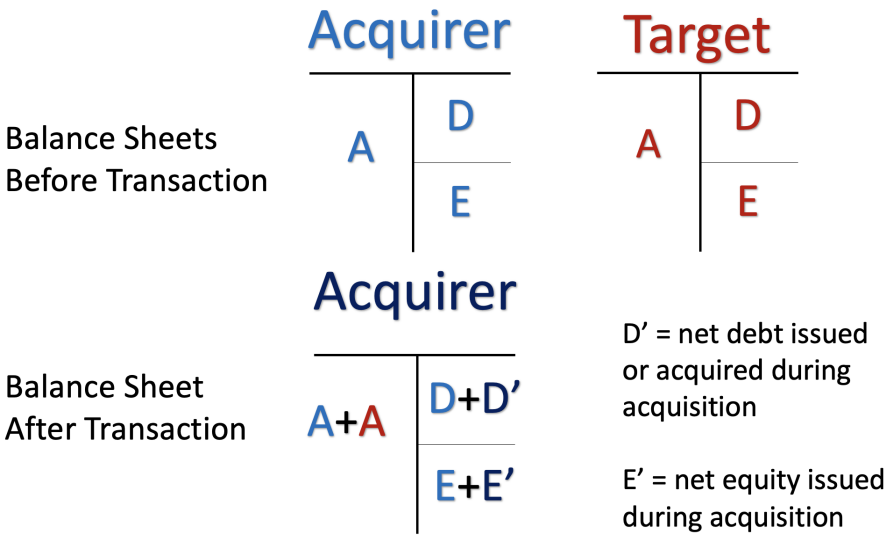
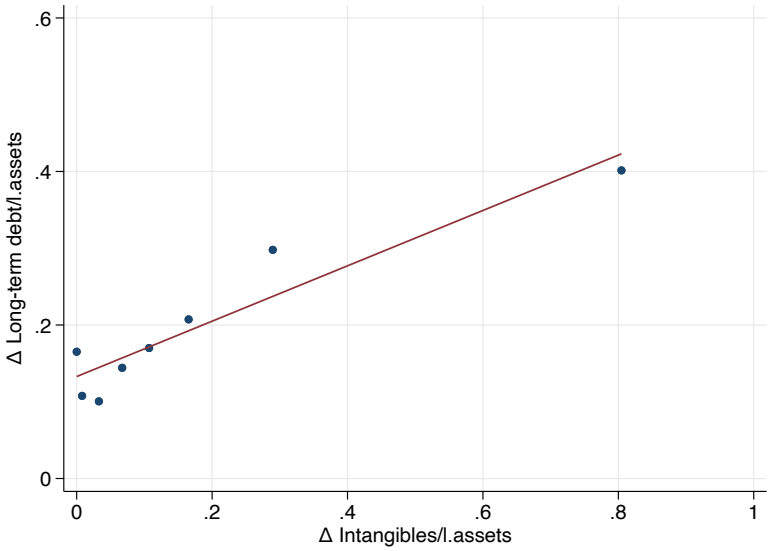
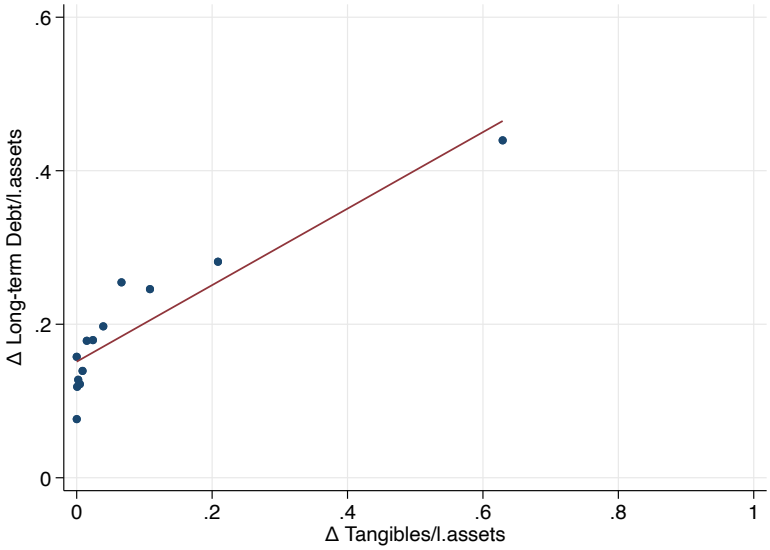


Figure 5: **Baseline Regressions in Binscatter Plots**



(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.

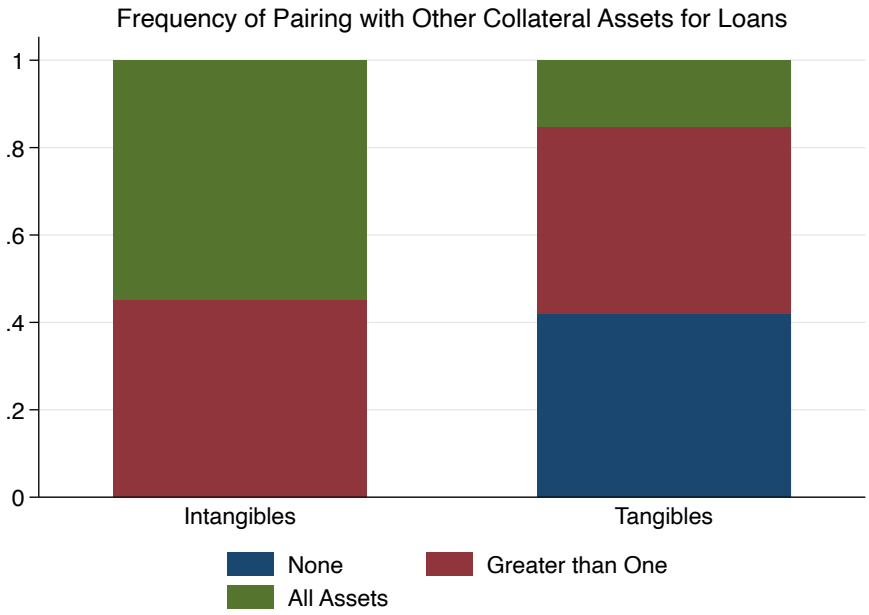
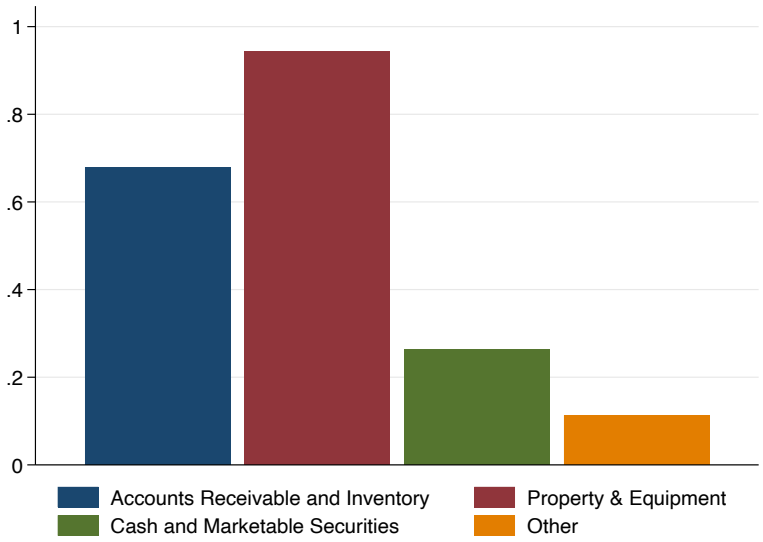
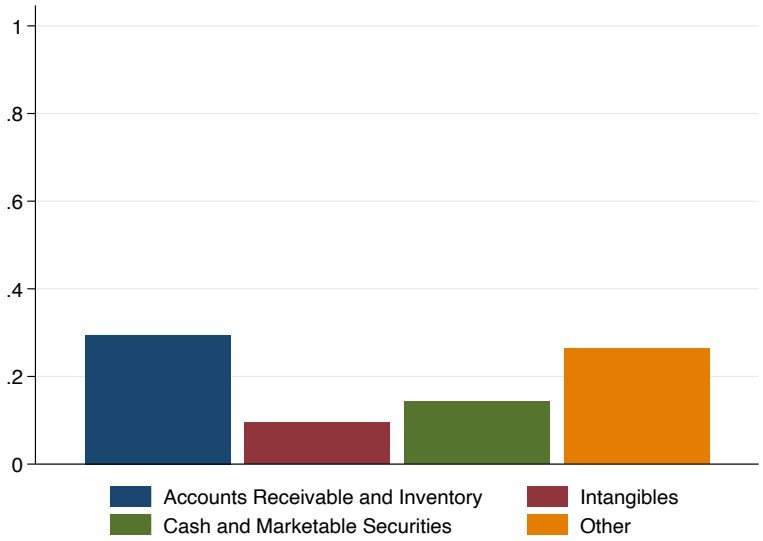


Figure 7: **Types of Other Assets Paired with Intangible and Tangible Assets for Loan Collateral** This chart plots the frequency of other types of assets paired with intangible assets (or tangible assets) for loans. The sample is new loan facilities or newly-amended loan agreements within one year after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

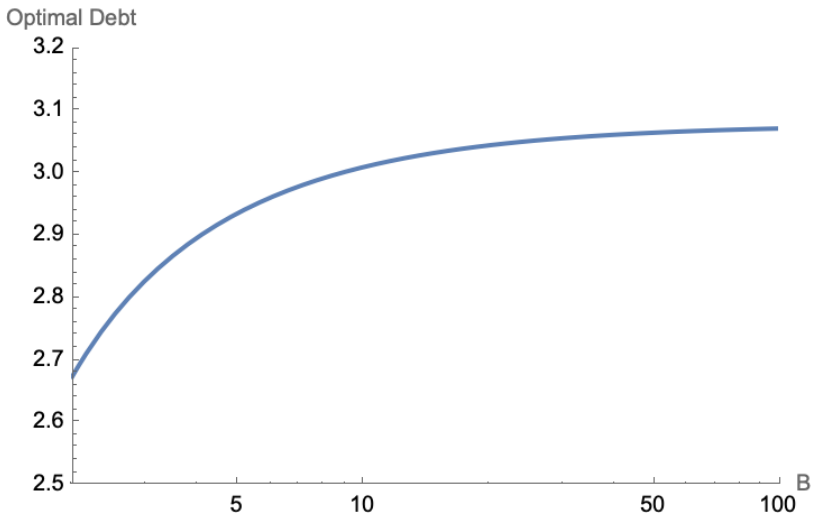


(a) Intangibles

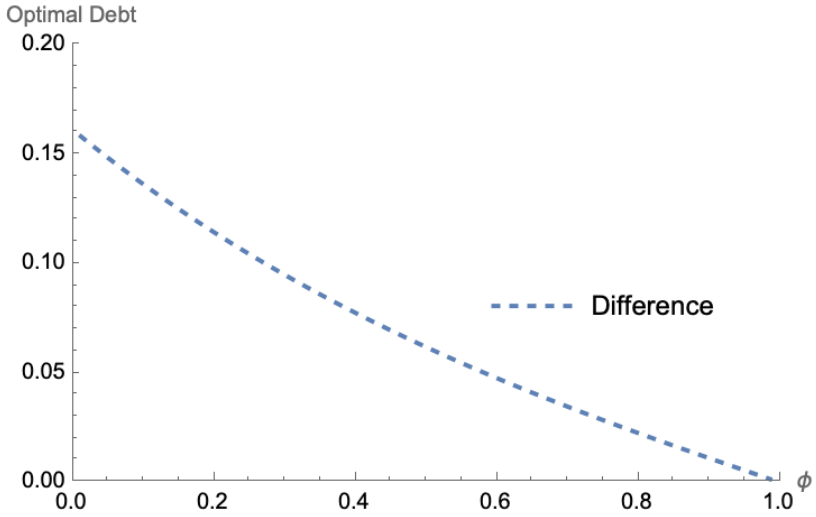


(b) Tangibles

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: **Debt Financing 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.

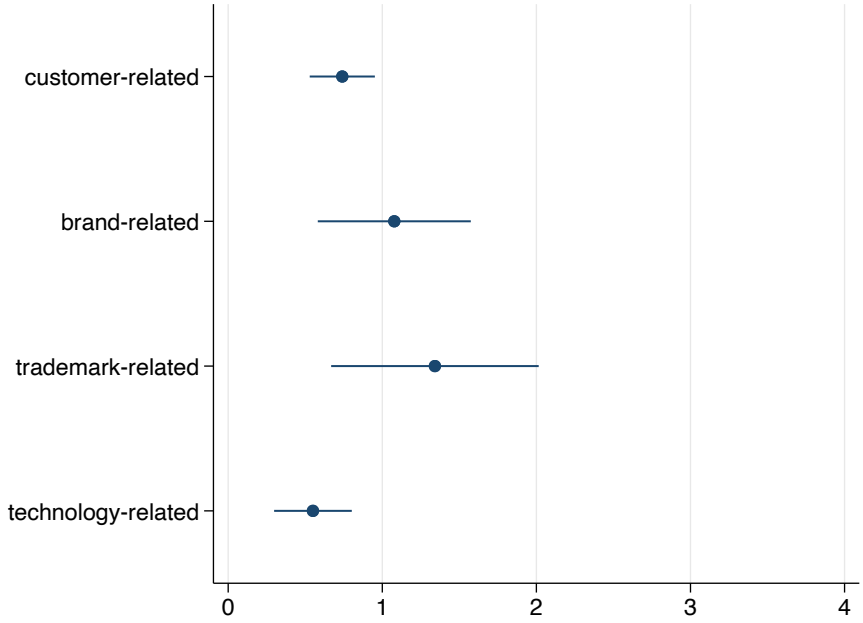


Figure 10: **Enduring Impact** This chart plots the regression coefficients from regressing 4-year lag and 5-year lead of the net long-term debt issuance on intangibles acquired during acquisition while controlling for all the controls and fixed-effects as in the baseline regression.

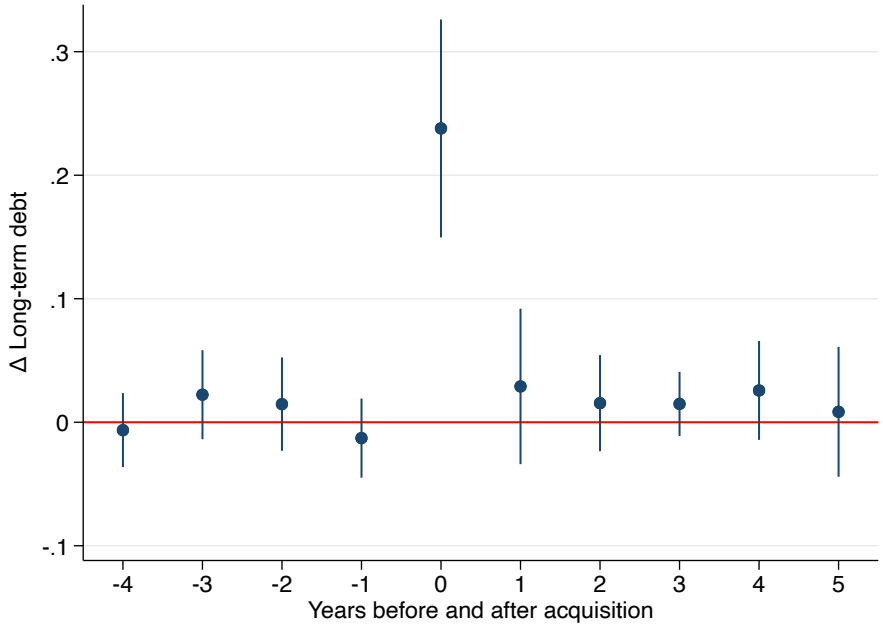
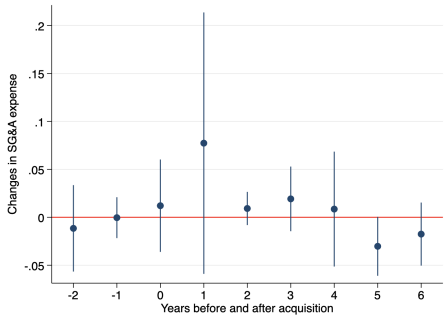
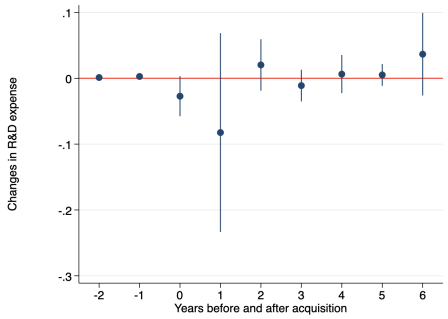


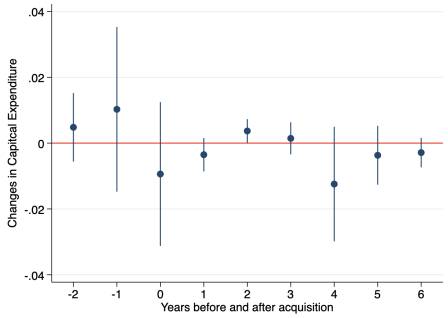
Figure 11: **Robustness Test for Confounding Investments**



(a) Change in SG&A expense scaled by lagged assets



(b) Change in in-process R&D expense scaled by lagged assets



(c) Change in PPENT expense scaled by lagged assets

11 Tables

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 C and see detailed information on the categorization of debt in Appendix B.

	p25	p50	p75	Mean	SD	N
Δ Long-term debt/l.assets	0.00	0.06	0.28	0.19	0.32	3800
Δ Asset-backed debt/l.assets	-0.00	0.01	0.16	0.11	0.24	2875
Δ Cash flow-backed debt/l.assets	0.00	0.00	0.18	0.13	0.30	2875
Δ Identifiable intangibles/l.assets	0.00	0.05	0.17	0.17	0.37	3831
Δ Tangibles/l.assets	0.00	0.01	0.06	0.09	0.24	3831
Δ Working capital/l.assets	0.00	0.00	0.05	0.05	0.13	3831
Deal size/l.assets	0.16	0.32	0.68	0.72	1.42	3831
Log assets	4.81	6.35	7.89	6.38	2.29	3889
Q	0.90	1.28	2.00	1.71	1.39	3306
Total q	0.55	0.96	1.70	1.65	2.63	3620
Credit-spread	0.03	0.03	0.05	0.04	0.02	3884
Book leverage	0.07	0.24	0.40	0.27	0.27	3877
Cash/l.assets	0.05	0.15	0.36	0.32	0.52	3830
EBITDA/l.assets	0.02	0.12	0.19	-0.01	0.58	3796
Net cash receipts/l.assets	0.03	0.11	0.17	0.04	0.34	3564
PPE/l.assets	0.06	0.15	0.38	0.31	0.38	3806
Cash from target/l.assets	0.00	0.00	0.01	0.03	0.08	3831
Pre-deal long-term debt to intangibles	0.01	0.12	0.59	1.68	7.46	2581
Pre-deal long-term debt to tangibles	0.10	0.61	2.71	6.89	24.53	2886

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 C and see detailed information on the categorization of debt in Appendix B.

	p25	p50	p75	Mean	SD	N
Δ Identifiable intangibles/l.assets	0.00	0.05	0.17	0.17	0.37	3831
Δ Intangibles (production-based)	0.00	0.00	0.06	0.09	0.25	3831
Δ Intangibles (demand-shifter)	0.00	0.00	0.07	0.07	0.15	3831
Customer-related intangibles	0.00	0.00	0.04	0.05	0.11	3831
Brand-related intangibles	0.00	0.00	0.01	0.02	0.05	3831
Trademark intangibles	0.00	0.00	0.00	0.01	0.03	3831
Patent intangibles	0.00	0.00	0.00	0.00	0.01	3831
Technology-related intangibles	0.00	0.00	0.02	0.03	0.09	3831
Business relation. intangibles	0.00	0.00	0.00	0.00	0.01	3831
Contract-related intangibles	0.00	0.00	0.00	0.02	0.10	3831
Human capital-related intangibles	0.00	0.00	0.00	0.00	0.01	3831
Goodwill intangibles	0.03	0.12	0.29	0.32	0.76	3831
Misc intangibles	0.00	0.00	0.00	0.00	0.01	3831

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

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

LHS Variable is Δ in Long-term Debt				
	(1)	(2)	(3)	(4)
Δ Intangibles	0.19***	0.17***	0.25***	0.24***
	(0.038)	(0.036)	(0.045)	(0.043)
Δ Tangibles	0.36***	0.33***	0.43***	0.43***
	(0.039)	(0.037)	(0.056)	(0.064)
Δ Working capital		0.24***	0.27***	0.27***
		(0.048)	(0.083)	(0.086)
Controls			X	X
Industry × year FE				X
Observations	3800	3800	2576	2530
R^2	0.127	0.135	0.228	0.312
F-stats: intan=tan	14	13.02	10.62	10.54
F-stats: p-val	.001	.001	.003	.003

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

This table presents the results of the regression analysis investigating the impact of intangibles on new debt 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 (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	Δ Bank debt				Δ Bond debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Intangibles	0.12***	0.093***	0.19***	0.18***	0.013	0.014	0.060***	0.058***
	(0.028)	(0.029)	(0.040)	(0.040)	(0.011)	(0.012)	(0.014)	(0.014)
Δ Tangibles	0.22***	0.19***	0.22***	0.22***	0.073***	0.075***	0.098***	0.095***
	(0.038)	(0.039)	(0.050)	(0.053)	(0.015)	(0.015)	(0.026)	(0.026)
Δ Working capital		0.23***	0.19	0.21		-0.015	0.019	0.027
		(0.064)	(0.13)	(0.13)		(0.024)	(0.030)	(0.031)
Controls			X	X			X	X
Industry × year FE				X				X
Observations	2875	2875	2042	2013	2875	2875	2042	2013
R^2	0.067	0.078	0.139	0.226	0.030	0.031	0.127	0.254
F-stat: intan=tan	4.75	5	.46	.49	9.08	9.19	1.68	1.47
F-stat: p-value	.04	.035	.507	.49	.006	.006	.209	.239

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

This table presents the results of the regression analysis investigating the impact of intangibles on new debt 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 B. Standard errors are reported in parentheses and are clustered at the industry and year level. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	Δ Cash flow-based Debt				Δ Asset-based Debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Intangibles	0.19***	0.17***	0.28***	0.25***	0.067***	0.040**	0.049*	0.050*
	(0.045)	(0.046)	(0.053)	(0.058)	(0.018)	(0.018)	(0.026)	(0.024)
Δ Tangibles	0.16***	0.14***	0.26***	0.23***	0.20***	0.17***	0.17***	0.20***
	(0.043)	(0.045)	(0.061)	(0.069)	(0.025)	(0.027)	(0.033)	(0.034)
Δ Working capital		0.13*	0.13	0.20*		0.26***	0.18**	0.14*
		(0.068)	(0.11)	(0.11)		(0.051)	(0.071)	(0.079)
Controls			X	X			X	X
Industry × year FE				X				X
Observations	2875	2875	2042	2013	2875	2875	2042	2013
R^2	0.075	0.078	0.155	0.237	0.055	0.073	0.100	0.186
F-stat: intan=tan	.61	.59	.09	.15	16.64	18.85	7.1	10.55
F-stat: p-value	.444	.452	.768	.699	0	0	.014	.004

Table 7: **Intangible Categorization**

The various intangible assets are categorized based on the framework presented in Section 6.1. 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-based	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 change in long-term debt, 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 (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

LHS Variable is Δ in Long-term Debt									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Intangibles (demand-shifter)	0.47***	0.56***	0.58***				0.45***	0.55***	0.57***
	(0.060)	(0.083)	(0.086)				(0.057)	(0.082)	(0.085)
Δ Intangibles (production-based)				0.13***	0.18***	0.17**	0.084*	0.17***	0.16**
				(0.044)	(0.058)	(0.061)	(0.046)	(0.057)	(0.057)
Δ Tangibles	0.35***	0.44***	0.44***	0.33***	0.44***	0.45***	0.34***	0.43***	0.43***
	(0.036)	(0.046)	(0.053)	(0.037)	(0.058)	(0.066)	(0.036)	(0.048)	(0.055)
Δ Working capital	0.22***	0.26***	0.28***	0.32***	0.36***	0.36***	0.20***	0.23***	0.24***
	(0.060)	(0.067)	(0.075)	(0.056)	(0.082)	(0.083)	(0.051)	(0.074)	(0.079)
Controls		X	X		X	X		X	X
Industry × year FE			X			X			X
Observations	3800	2576	2530	3800	2576	2530	3800	2576	2530
R^2	0.149	0.236	0.324	0.110	0.193	0.283	0.153	0.248	0.332
F-stat: ds-intan=pb-intan									14.14
F-stat: p-value									.001

Table 9: Regression Results on the Impact of Intangibles on Cash Flow Volatility by Type of Intangibles

This table presents the results of the regression analysis investigating the impact of intangibles on cash flow volatility by type of intangibles. Columns (1) through (4) present the outcome variable of cash flow volatility after the acquisition with different quantities of intangibles acquired. The post-deal cash flow volatility is measured as the standard deviation of income before extraordinary items scaled by lagged assets for 5 years after the acquisition ($ib/l.at$). The pre-deal cash flow volatility is measured as the standard deviation of income before extraordinary items scaled by lagged assets for 5 years before the acquisition ($ib/l.at$). Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

LHS Variable is post-acquisition cash flow vol.			
	(1)	(2)	(3)
Δ Intangibles (demand-shifter)	-0.013	-0.12**	-0.11*
	(0.065)	(0.053)	(0.059)
Δ Intangibles (production-based)	0.12**	0.077*	0.083
	(0.055)	(0.045)	(0.052)
Δ Tangibles	0.016	0.089	0.032
	(0.030)	(0.087)	(0.060)
Δ Working capital	-0.016	-0.010	-0.0053
	(0.067)	(0.074)	(0.083)
Cash flow vol. (pre)	0.17***	0.093**	0.066*
	(0.033)	(0.045)	(0.036)
Controls		X	X
Industry × year FE			X
Observations	2850	2112	2070
R^2	0.104	0.241	0.379

Table 10: Regression Results on the Impact of Demand-shifter Intangibles on Debt Financing during Bad or Good Times

This table presents the results of the regression analysis investigating the impact of intangibles on demand-shifter intangibles on debt financing during bad or good times. Significance levels are denoted by asterisks (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

LHS Variable is Δ Long-term Debt		
	Bad times	Good times
	(1)	(2)
Δ Intangibles (demand-shifter)	0.67***	0.51***
	(0.18)	(0.099)
Δ Intangibles (production-based)	0.12	0.21***
	(0.080)	(0.067)
Δ Tangibles	0.38***	0.44***
	(0.10)	(0.055)
Δ Working capital	0.096	0.23**
	(0.12)	(0.089)
Controls	X	X
Industry × year FE	X	X
Observations	838	1738
R^2	0.232	0.263

Table 11: **Regression Results on the Impact of Intangibles on Long-term Debt Robustness Check with Total Q**

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

LHS Variable is Δ in Long-term Debt				
	(1)	(2)	(3)	(4)
Δ Intangibles	0.19***	0.17***	0.25***	0.24***
	(0.038)	(0.036)	(0.042)	(0.040)
Δ Tangibles	0.36***	0.33***	0.42***	0.42***
	(0.039)	(0.037)	(0.053)	(0.060)
Δ Working capital		0.24***	0.26***	0.26***
		(0.048)	(0.085)	(0.088)
Controls			X	X
Industry × year FE				X
Observations	3800	3800	2588	2543
R^2	0.127	0.135	0.234	0.317
F-stats: intan=tan	14	13.02	10.7	10.41
F-stats: p-val	.001	.001	.003	.003

Table 12: **Regression Results on the Impact of Intangibles on Long-term Debt Robustness Check with Target Leverage Controls**

This table presents the results of the regression analysis results investigating the impact of intangibles on Long-term debt. Columns (1) through (4) present the outcome variable of net debt, 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 (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

LHS Variable is Δ in Long-term Debt				
	(1)	(2)	(3)	(4)
Δ Intangibles	0.19***	0.17***	0.28***	0.26***
	(0.038)	(0.036)	(0.056)	(0.059)
Δ Tangibles	0.36***	0.33***	0.42***	0.41***
	(0.039)	(0.037)	(0.091)	(0.10)
Δ Working capital		0.24***	0.27**	0.27*
		(0.048)	(0.13)	(0.14)
Controls			X	X
Industry × year FE				X
Observations	3800	3800	1361	1308
R^2	0.127	0.135	0.297	0.374
F-stats: intan=tan	14	13.02	1.85	1.76
F-stats: p-val	.001	.001	.186	.197

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Appendix

A Categories of Intangibles

Table A.1: **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

B 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.

C Variable definitions

Variable	Definition
Δ long-term debt issuance	(dltt-l.dltt))/lat
Spread	firm-level rating specific credit spread
Total Q	Peters and Taylor 17 from WRDS
Market-to-Book	mkval/ceq
Stock return	past 12 month cumulative return
Tobinś 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
Cash from target	cash from PPA/lat

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.[13] 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

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

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, 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.

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

$$\int_0^{\varepsilon_2} \left(\left(p^* + \frac{1}{B} q + \varepsilon \right) q - C \right) df\left(\varepsilon \mid \varepsilon < \varepsilon_2 \right) = p^* q + \frac{1}{B} q^2 - C + q \frac{\varepsilon_2^2}{2}$$

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:

$$\max_{F \geqslant 0} \{D(F) + \mathbb{E}[\max((1-\tau) p q - F + \tau F, 0)]\}$$

Start with the expectation term

$$\begin{aligned}
&\mathbb{E}[\max((1-\tau) p q - F + \tau F, 0)] \\
=&\mathbb{P}(z=0)\,\mathbb{E}[\max((1-\tau) p q - F + \tau F, 0) \mid z=0] + \mathbb{P}(z=1)\,\mathbb{E}[\max((1-\tau) p q - F + \tau F, 0) \mid z=1] \\
=&\mathbb{P}(z=0)\,\mathbb{E}[\max((1-\tau)(p^* + \varepsilon) q - F + \tau F, 0)] + \mathbb{P}(z=1)\,\mathbb{E}\left[\max\left((1-\tau)\left(p^* - \frac{1}{B} q + \varepsilon\right) q - F + \tau F, 0\right)\right] \\
=&\phi\left[\mathbb{P}(\varepsilon > \varepsilon_3) \int_{\varepsilon_3}^{1} ((1-\tau)(p^* + \varepsilon) q - F + \tau F)\, df(\varepsilon \mid \varepsilon > \varepsilon_3)\right] + (1-\phi)\left[\mathbb{P}(\varepsilon > \varepsilon_4) \int_{\varepsilon_4}^{1} \left((1-\tau)\left(p^* - \frac{1}{B} q + \varepsilon\right) q - F + \tau F\right) df(\varepsilon \mid \varepsilon \\
=&\phi\left[\mathbb{P}(\varepsilon > \varepsilon_3)\left((1-\tau) p^* q - F + \tau F + (1-\tau) q \int_{\varepsilon_3}^{1} \varepsilon\, df(\varepsilon \mid \varepsilon > \varepsilon_3)\right)\right] \\
&+ (1-\phi)\left[\mathbb{P}(\varepsilon > \varepsilon_4)\left((1-\tau)\left(p^* q - \frac{1}{B} q^2\right) - F + \tau F + (1-\tau) q \int_{\varepsilon_4}^{1} \varepsilon\, df(\varepsilon \mid \varepsilon > \varepsilon_4)\right)\right] \\
=&\phi\left[(1-\varepsilon_3)\left((1-\tau) p^* q - F + \tau F + (1-\tau) q \frac{1-\varepsilon_3^2}{2}\right)\right] + (1-\phi)\left[(1-\varepsilon_4)\left((1-\tau)\left(p^* q - \frac{1}{B} q^2\right) - F + \tau F + (1-\tau) q \frac{1-\varepsilon_4^2}{2}\right)\right]
\end{aligned}$$

Let ε_3 be the solution to the following equation$(1-\tau)(p^* + \varepsilon_3) q - F + \tau F = 0$

$$\begin{aligned}
(1-\tau)(p^* + \varepsilon_3) q &= F - \tau F \\
\varepsilon_3 &= \frac{F - \tau F - (1-\tau) p^* q}{(1-\tau) q} \\
\varepsilon_3 &= \frac{(1-\tau) F - (1-\tau) p^* q}{(1-\tau) q} \\
\varepsilon_3 &= \frac{F}{q} - p^*
\end{aligned}$$

Let ε_4 be the solution to the following equation: $(1-\tau)\left(p^* - \frac{1}{B} q + \varepsilon_4\right) q - F + \tau F = 0$

$$\begin{aligned}
(1-\tau)\left(p^* q - \frac{1}{B} q^2\right) + \varepsilon_4 (1-\tau) q - F + \tau F &= 0 \\
\varepsilon_4 (1-\tau) q &= F - \tau F - (1-\tau)\left(p^* q - \frac{1}{B} q^2\right) \\
\varepsilon_4 &= \frac{(1-\tau) F - (1-\tau)\left(p^* q - \frac{1}{B} q^2\right)}{(1-\tau) q} \\
\varepsilon_4 &= \frac{F}{q} - p^* + \frac{1}{B} q
\end{aligned}$$

Combine all the elements

$$\max_{F \geqslant 0} \{D(F) + \mathbb{E}[\max((1-\tau) p q - F + \tau F, 0)]\}$$

$$\max_{F \geqslant 0} \quad \phi \left[(1-\varepsilon_1) F + \varepsilon_1 \left(p^{\star} q + \frac{1}{2} q \varepsilon_1^2 - C \right) \right] + (1-\phi) \left[(1-\varepsilon_2) F + \varepsilon_2 \left(p^{*} q + \frac{1}{B} q^2 + \frac{1}{2} q \varepsilon_2^2 - C \right) \right]$$
$$+ \phi \left[(1-\varepsilon_3) \left((1-\tau) p^{*} q - F + \tau F + (1-\tau) q \frac{1-\varepsilon_3^2}{2} \right) \right] + (1-\phi) \left[(1-\varepsilon_4) \left((1-\tau) \left(p^{*} q - \frac{1}{B} q^2 \right) - F + \tau F + (1-\tau) q \frac{1-\varepsilon}{2} \right. \right.$$

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

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

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.