HEC Montréal

Diversification de l'entreprise et structure du capital : données probantes provenant des entreprises dérivées

par

William Gallego

Sciences de la gestion
(Spécialisation Finance)

Mémoire présenté en vue de l'obtention
du grade de maitrise ès sciences
(M. Sc.)

William Gallego
HEC Montréal
Directeur de recherche
Piotr Orłowski

Décembre, 2021

Diversification de l'entreprise et structure du capital : données probantes provenant des entreprises dérivées

William Juvenal Gallego Blandon [1]

Abstract

Cet article examine l'influence de la corrélation du rendement de l'actif (ARC) de l'entreprise sur les décisions relatives à la structure du capital de l'entreprise. La corrélation du rendement des actifs est définie comme la corrélation de Pearson entre le rendement sans effet de levier des actifs de firmes mères et filiales après un événement dérivé. À l'aide d'un échantillon de spin-offs sur une période de 21 ans, de 2000 à 2020, nous calculons l'ARC, puis testons sa relation avec l'effet de levier avant la scission. Nous utilisons les variables de structure du capital les plus pertinentes dans la littérature existante comme variables de contrôle dans nos modèles. Nos résultats montrent que l'ARC est négativement et fortement liée à l'effet de levier du marché, en accord avec notre hypothèse initiale basée sur la théorie du compromis. Les résultats suggèrent qu'à mesure que l'ARC augmente, les gestionnaires réduiront leur niveau d'endettement en fonction des valeurs de marché.

[1]HEC Montréal, Canada. Email: `william.gallego-blandon@hec.ca`.

Preprint submitted to HEC Montréal MSc Program Office *December 4, 2021*

Corporate Diversification and Capital Structure: Evidence from Spin-offs

William Juvenal Gallego Blandon [1]

JEL Classification Codes: G32; G34; C33

Abstract

This article examines the influence of the firm's asset return correlation (ARC) on corporate capital structure decisions. Asset return correlation is defined as the Pearson correlation between the unlevered return on assets from parent and subsidiary companies after a spinoff event. Using a sample of spin-offs across a period of 21 years, from 2000 to 2020, we calculate the ARC and then test its relationship with pre-spinoff leverage. We use the most relevant variables of capital structure in the existing literature as control variables in our models. Our findings show that ARC is negatively and strongly related to market leverage agreeing with our initial hypothesis based upon the tradeoff theory. The results suggest that as the ARC increases, managers would decrease their debt level based upon market values.

Keywords: Capital Structure, Asset Return Correlation, Panel Data Models.

[*]I would like to express my sincere gratitude to my thesis advisor, Professor Piotr Orłowski, for his patience, support, encouragement and excellent guidance during the process of writing this thesis.

[1]HEC Montréal, Canada. Email: william.gallego-blandon@hec.ca.

Contents

List of Tables

1. Introduction

Capital structure is a central topic in corporate finance. There are at least four relevant theories that help to understand how managers decide upon their capital structure and how they balance the company's debt to the equity required for the investment projects. On the one hand, the *tradeoff* theory argues that firms face a trade-off between the cost and the benefits of debt. The tax-deductible interest expenses encourage firms to utilize more debt. However, fixed debt obligations as well as the increasing costs of debt limit companies' debt capacity. The tradeoff theory links risk of default with levels of debt. Asset return correlation is associated with the firm's risk and the probability of default through the diversification effect. The greater the correlation between assets of a company, the greater the risk of default and the lower the debt capacity of the company. Our hypothesis is coherent with this theory and we believe that as our measure of correlation, as defined in section 3.2 increases, the firm's risk increases and the leverage ratio should decrease consequently.

On the other hand, the three theories, namely: the *pecking order*, the *agency cost* theory and the *market timing*, have their variables and the predictions on the impact to capital structure. For instance, tangibility and profitability appear in both, the tradeoff and the pecking order theories, however their predicted effects on capital structure go in opposite directions. On the one hand, for the tradeoff theory, higher tangibility and higher profitability both mean higher leverage since the former reduces the costs of distress and the latter lowers the probability of financial distress. On the other hand, for the pecking order theory, higher tangibility and higher profitability both mean lower leverage since the former reduces the information asymmetry issues whereas the latter increases the internal funds for the financing of projects, Frank and Goyal (2009). We will focus on the tradeoff theory as it associates an expected outcome for our measure of ARC as defined here.

Despite the fact that all these theories can explain some empirical findings, there is a general consensus in the literature that no single theory can explain the firms' behavior in choosing its debt allocation. The insufficiency of the main theories of capital structure is discussed extensively in Frank and Goyal (2009). Moreover, Rauh and Sufi (2012b) argue that two major problems arise when searching and measuring the impact of diverse variables on leverage. One problem is the leverage measure per se and firm's debt should be corrected for rent and lease expenses. The other problem is classifying firms based upon the Standard Industry Classification code (SIC). Instead, grouping firms by competitors or CIQ Classification in the same sector would be more appropriate. In sum, the challenge for researchers in the field is not only the measurement of leverage but also the measurement of its determinants. These, among other problems, leave the impact of some potentially influential variables unexplored.

The present study seeks an improvement in the empirical analysis framework that is used to determine firms' capital structure choices. Such an improvement is obtained through employing two innovative approaches in our analysis:

First, we introduce a measure of asset return correlation and control for asset return volatility to account for the firm's level of asset riskiness. We achieve this by limiting our sample to a set of spin-offs. Through the data available right after the spinoff event, we are able to build a proxy for two measures, asset return correlation and equity return correlation. When a company called "parent" spins off a company called "subsidiary", we suddenly have two different and independent entities from the same stem after the spinoff. For the rest of this study, "parent" refers to the company established before the spinoff event and "subsidiary" refers to the new company that begins trading right after the spinoff event.

Immediately after the spinoff, we observe the valuations of two assets (parent + subsidiary) rather than one. We assume that for some period after the spinoff, the correlation of the changes to these valuations is representative of what the assets correlation for the parent company should be if the spinoff had not taken place. From the changes in valuations, we are able to get the time series on both companies (assets) and then calculate the *equity return correlation* as the Pearson stock return correlation between both companies (assets) and the *asset return correlation* as the Pearson correlation between the unlevered

ROA values of parent and subsidiary firms.

Second, we use the traditional and proven determinants of capital structure as control variables in all our models based upon relevant empirical studies on the matter. In brief, we use the core factors found in Frank and Goyal (2009) plus volatility of asset returns, the core determinants of capital structure in Rauh and Sufi (2012b) and the two significant variables influencing CS found in Dittmar (2004). This approach provides a unique set of variables to be used as control variables when studying the impact of asset return correlation on market leverage.

The choice of asset return correlation as a new measure influencing leverage is based upon its relation to the diversification effect and subsequently to the firm's risk. The extent of correlation between a firm's asset valuations is important as it can impact the firm's financing decisions via three main channels:

I) Increasing debt capacity as a result of coinsurance effect:

The imperfect correlation of cash-flows implies a decline in the probability of default Bergh (1997). Coinsurance is the smoothing of variation in revenue and earnings streams achieved by acquiring companies that have negatively correlated revenue and earning cycles, Mansi and Reeb (2002) and Lubatkin and Chatterjee (1994).

II) Reducing cost of debt by mitigating the debt-holders' exposure at default:

Diversified assets can be more easily disposed and therefore provide more liquid collateral to the debt holders, Kochhar and Hitt (1998).

III) Decreasing debt capacity as a result of the business risk:

This issue mainly arises from the fact that more disperse business activities can in-turn increase the firm's monitoring costs and asymmetric information, Jensen (1986).

While the potential effect of asset return correlation on the firm's capital structure seems natural, such effect is not widely discussed in the literature. This likely originates from the fact that calculating the correlation between a firm assets valuations requires to have specific information on the firm's assets which is not readily available for most firms.

As previously described, spinoffs present the possibility of finding this information on the assumption that pre-spinoff, the parent company had 2 assets, each one represented by the parent and the newly created companies post-spinoff. After the spinoff, we are able to find the time series on daily stock return for the two independent entities. From the two time series, adjusted for leverage, one for parent and one for subsidiary, we manage to calculate what we call equity return correlation (ERC). We can also construct the asset return correlation measure by unlevering the return on assets from both companies and calculating the correlation between the two time series.

Using the values for ARC and ERC calculated above, we take two leading models of market leverage and book leverage in order to examine whether our measure of correlation explains leverage. The rest of the thesis is structured as follows: section 2 provides a review of the literature on capital structure, spin-offs and corporate diversification. Section 3 explains the data and provides a summary of their descriptive statistics. Section 4 describes and discusses the models employed. Section 5 presents and interprets the results. Finally, section 6 contains concluding remarks.

2. Literature review

This section provides an overview of previous work on four main themes: capital structure theories, core factors determining capital structure, empirical studies of spin-offs and capital structure and corporate diversification.

2.1. Theories of capital structure

The debate on corporate debt policy and its determinants was started by the seminal paper of Modigliani and Miller (1958). Under the assumptions proposed by the authors, the *tradeoff* theory argues that firms face a trade-off between the cost and the benefits of debt. While the tax-deductible interest expenses encourage firms to increase their leverage ratios, fixed debt obligations and the ever increasing costs of debt limit companies' debt capacity. In other words, managers must balance the benefits of taxes and other benefits of debt against the costs that come from financial distress, Mehrotra et al. (2005). This theory has an association to risk of default and risk of the company which relates directly to asset return correlation as previously defined. In fact, our hypothesis is that a negative relation of our measure of correlation with leverage measures should exist based upon this theory.

To account for the impact of managerial preferences on the choice of financing, Myers and Majluf (1984) developed the pecking order theory, which states that managers prefer internal over external financing. This happens due to the cost of information asymmetries between companies and investors. However, when external financing is considered, debt has priority over equity. In other words, managers will make use of internal funds whenever possible, Mehrotra et al. (2005). The influence of managerial behavior on firms financing decisions is further explored in the agency cost theory proposed by Jensen and Meckling (1976). According to the agency cost theory, the choice of debt is the outcome of a reconciliation between shareholders' preferences and managers' discretionary behaviours due to misaligned incentives. Finally, from a different view of the determinants of firms' behavior, market timing theory, proposed by Baker and Wurgler (2002), considers capital structure as the cumulative outcome of the efforts to explore market opportunities, without an optimal solution. The last three theories mentioned in this paragraph, although important in CS debates, do not bear predictive association with leverage and the measures of correlation defined here.

2.2. Determinants of capital structure

Numerous studies produce results on factors that are capable of explaining decisions in the capital structure choice. These many factors can also be explained through several different theories leading to a general consensus in the literature that no single theory can encompass the whole spectrum of firms' behavior in choosing their debt allocation. The insufficiency of the main theories of capital structure has been discussed extensively in Frank and Goyal (2009).

The authors identify six core factors that reliably explain market leverage: median industry leverage with positive (+) effect on leverage, market-to-book assets ratio with negative (–) effect on leverage, tangibility positive (+) effect, profits or return on assets negative (–) effect, size as log of assets positive (+) effect, and expected inflation positive (+) effect. If instead, book leverage is adopted, only three factors remain on top: median industry leverage with positive (+) effect, tangibility positive (+) effect and profits negative (–) effect. Although the authors try the variable *volatility of asset returns* in their regressions, they do not find it as a reliable and consistent determinant of capital structure. We use this measure as a control variable since the nature of our variable of interest might lead an omitted variable in our study.

Rauh and Sufi (2012b) take a different approach. They argue that measurement of leverage and its determinants pose a problem and propose a solution to improve the measurement of capital structure by explicitly accounting for leased capital. When considering the book leverage, the authors correct for capital leases as well as apply the same technique to improve the variables used as determinants of leverage. They identify five determinants with their respective sign denoting the relationship with book leverage: median industry leverage with leases positive (+) relation, owned tangibility with leases positive (+) relation, market-to-book assets with leases ratio negative (–) effect, size as natural logarithm of sales positive (+) relation and profitability with leases negative (–) relation.

2.3. Spin-offs and capital structure

Some researchers recognize that spinoff events provide some advantages when studying capital structure. Mehrotra et al. (2005) point out some unique characteristics of using spinoffs for the study: managers allocate a segment of a firm's assets to a new-born publicly traded company, shares of the new company are distributed proportionally in the form of a stock dividend to stockholders of the parent and most importantly, managers design the financial structures of the two companies by assigning portions of the existing debt between the parent and the spun-off unit. In sum, spinoffs reveal the conscious choices that managers make to assign different levels of debt depending on the business. The authors examine four potential determinants of capital structure based upon the tradeoff theory: operating income plus depreciation as a percentage of non-cash assets, the median standard deviations of the industry-matched companies, the ratio of fixed assets to total assets and tax status.

The results in Mehrotra et al. (2005) reveal that companies with higher ratios of property, plant, and equipment to total assets are allocated more debt. The authors also claim that differences in financial leverage are positively related to differences in profitability and negatively related to differences in the variability of industry operating income. These findings are in line with the traditional tradeoff theory of capital structure where profitability should be positively (+) related to leverage, concluding that managers determine a target capital structure that gives careful consideration to the ability to cover interest payments and the costs of financial distress.

Another author who studies the corporate capital structure through a sample of spinoffs is Dittmar (2004). Her paper examines the way capital structure of a subsidiary is determined by the firm following a spin off. In a spin-off, a subsidiary derived from a parent becomes a stand-alone entity. This fact provides special features considering that prior to the event the subsidiary is unable to issue equity and depends on the parent to finance its capital investments. This means that the subsidiary does not hold any debt nor manage its capital structure. This lack of history prevents variables like unexpected fluctuations of profits from pushing leverage below or above a target leverage ratio. The author examines eight variables as potential determinants of capital structure: size as natural logarithm of assets, R&D to sales and market to book as measures of growth, trichotomous tax variable, ROA, earnings volatility, collateral and median industry leverage.

The results in Dittmar (2004) indicate that the subsidiaries' leverage is negatively (−) related to growth as R&D intensity and positively related to its collateral (+) value. She also states that the difference between the subsidiaries and comparable firms' leverage ratios is positively related to profitability. Her findings conform with the tradeoff theory as more profitable firms with less risk of default will use more debt to finance its projects. The study of Dittmar (2004) adds two new control variables for the present study: R&D to sales and collateral.

In brief, notwithstanding that the hypothesis of the present study and that of Mehrotra et al. (2005) are both based upon the tradeoff theory, the study of Mehrotra et al. (2005) is focused on the differences between the leverage ratios of the two post-spinoff companies and the variables that determine these differences, whereas our study focuses on the influence of a correlation variable of the parent company pre-spinoff. Moreover, even though the study of Dittmar (2004) uses six of our control variables, the author applies these variables to the subsidiary and as mentioned before, our interest is on the parent's side.

2.4. Corporate diversification and capital structure

The purpose of this subsection is to explain the connection between diversification and firm risk reduction which is an important assumption in our study and the predictions that derive from the tradeoff theory. In an empirical study on the motivation of firms to merge, despite the potential detriment for stockholders, Amihud and Lev (1981) find that once two companies merge there is a reduced risk for the combined entity by virtue of the diversification effect. When multiple lines of business come together with imperfectly correlated returns, such effect appears, mitigating the firm's risk. The consequence of this reduction on the firm's risk is a lower default premium, Mansi and Reeb (2002). A spinoff event presents a situation where the conglomerate is already established pre-spinoff and as a consequence of the split we are able to measure the degree of diversification of the company through the calculation of asset return correlation. The higher the correlation, the lower the diversification effect and the higher the default premium. Consequently, the leverage ratio should fall. This way the negative relationship between asset return correlation and leverage ratio is established in light of the tradeoff theory. For our hypothesis to hold, we assume that the correlation measure does not change during the spinoff event, but in turn becomes measurable and stays constant at least for some time after the spin-off.

3. Data description

3.1. Data sources

The three main data sources for this study are Compustat, OptionMetrics and CRSP unless otherwise indicated.

The initial sample used for the purpose of this analysis consists of two subsets of spin-offs that span across a period of 24 years, from 1997 to 2020. The first subset of spin-offs, prepared by Professor Piotr Orłowski, contains 442 observations on parent and new company spinoffs, ranging from 1997 to 2017, for which security IDs and execution dates are provided. The second subset of spin-off events is from the lists on two websites: Zen of Investing [1] and Stock Spinoffs [2]. This subset has 285 spin-off observations ranging from 2009 to 2020 for which ticker and execution dates are provided.

The first step in making these subsets useful is to find the Cusip numbers from WRDS OptionMetrics. The reason is that we only have the Secid numbers for the companies and

[1] See: http://thezenofinvesting.com/recent-spinoffs/.
[2] See: https://www.stockspinoffs.com/recent-spinoffs/.

the link to the other databases, Compustat and CRSP, is the Cusip code. Unfortunately, not all companies in OptionMetrics have information on the matter, which leaves us with 661 observations out of 727 initial ones. After getting the Cusip codes and accounting for the overlap across the years 2009 to 2017, the sample reduces to 575 observations. In order to get the most out of our sample, we still need to obtain the Permanent Numbers or Permnos and the Global Company Key or Gvkeys for each observation in the sample. The Permnos are available in WRDS - Center for Research in Securities and Prices (CRSP). This process reduces our sample to 497 observations. Then, we search for the Gvkeys in the WRDS - COMPUSTAT database. This process again reduces the sample to 416 observations of parent and spun-off company with information on Secid, Ticker, Cusip, Permno, SIC and Gvkey.

3.2. Measure of correlation, control variables and definitions

The data in these variables correspond to values gathered for the parent company unless otherwise stated.

Let us first review our measures of correlation as the variables of interest in our study:

asset_ret_corr: ARC is the asset return correlation which is calculated as the Pearson correlation of the time-series of the unlevered return on assets of parent and subsidiary firms from the spin off event until the end of the year. Since this is the most important variable in the present study, we describe it in greater detail in section 3.3.

equity_ret_corr: ERC is the equity return correlation which is calculated as the Pearson correlation of the time-series of daily stock returns of parent and spun-off company from the spin off event for one year.

To account for the impact of other influencing variables besides ARC and ERC, we proceed to find data and calculate values on several control variables. Let us recall that we intend to find the relationship of two different types of correlation, asset return correlation and equity return correlation, and two different types of leverage: market leverage without leases and book leverage with leases. That said, the appropriate control variables when using market leverage without leases come from Frank and Goyal (2009). Consequently, we employ the six core factors, as control variables, proposed by the authors when studying the market leverage.

The six chosen factors for the market leverage without leases are: industry median leverage, tangibility, market to book ratio, return on assets, size as natural logarithm of assets and expected inflation. The definitions and abbreviations of these variables are as follows:

mklev: is the parent's firm market leverage without leases ratio, measured as total debt to market value of assets. The method we use to obtain this measure is in line with the theoretical framework employed by Frank and Goyal (2009).

imlev: is the median industry market leverage without leases as for the 3-digit industry SIC code.

tang: is the tangibility ratio as defined in Frank and Goyal (2009) which is the ratio of net property plant and equipment to total assets.

mktb: is the market to book ratio, this is one of the proxies for the firm's growth opportunities, obtained by dividing the market value of the company to its book value. Market to book ratio has proven to be a determining factor in explaining firms' financing decisions in several studies in the literature Dittmar (2004) and Frank and Goyal (2009).

roa: is the measure of profitability as return on assets (ROA). The measure is obtained by dividing operating income before depreciation to total assets.

size: is the measure of firm size using natural logarithm of total assets as in Frank and Goyal (2009) and deflated to 2010 real dollars.

exp_infl: is the yearly U.S expected inflation for years 2000 to 2020 from the FRED: Federal Reserve Bank of St. Louis website.

All the above mentioned variables, except expected inflation, are obtained from COMPUSTAT fundamentals database. The yearly expected inflation was obtained from the FRED: Federal Reserve Bank of St.Louis website [3]. The variable size is deflated to 2010 dollars with

[3] See: https://fred.stlouisfed.org/series/MICH.

data taken from the U.S. BUREAU OF LABOR STATISTICS website [4]. What we do for the deflators table is that we get the Consumer Price Index (CPI) from the calculator on the website and taking 2010 as the reference year so CPI for that year is 100. We then divide this number by the corresponding CPI for the year. As an example, for year 1997 the CPI is 73.59 then, the deflator for this year is $100/73.59 = 1.359$. We do the same for years 1997 to 2020 to generate the deflators table. The deflators table is not presented here.

For the book leverage, the most influential variables are the core determinants in Rauh and Sufi (2012b). The five core determinants are: industry median leverage, tangibility, market to book ratio, return on assets, size as natural logarithm of sales and all the variables are adjusted for leases as suggested in the paper. To avoid the complications associated with missing values, we remove all the spinoff observations for which data on daily stock returns or the control variables are missing. The definitions and abbreviations of these variables are as follows:

bklev: is the parent's firm book leverage ratio with leases, measured as total debt plus debt/capitalized lease obligations divided by book value of assets plus debt/capitalized lease obligations. This measure is in line with the theoretical framework employed by Rauh and Sufi (2012b).

imlev: is the median industry of book leverage with leases for the 3-digit industry SIC code.

tang: is tangibility ratio as defined in Rauh and Sufi (2012b) which is the ratio of net property plant and equipment to book value of assets plus debt/capitalized lease obligations.

mktb: is the market to book ratio, is one on of the proxies for firm growth opportunities, obtained by dividing market value of the company and book value of assets plus debt/capitalized lease obligations divided by book value of assets plus debt/capitalized lease obligations.

roa: is return on assets which is a measure for profitability of the company obtained by

[4]See: `https://www.bls.gov/data/inflation_calculator.htm`.

dividing operating income before depreciation plus rental expenses to book value of assets plus debt/capitalized lease obligations.

size: is the measure of firm size using natural logarithm of sales.

Common to the two measures of leverage used above, we introduce two more control variables. Research and development expenses and collateral have a significant impact in spinoffs' samples as shown by Dittmar (2004). These control variables are defined as follows:

coll: is collateral ratio defined as the ratio of gross property plant and equipment to total assets. The definition here defers somewhat from the definition in Dittmar (2004) and Frank and Goyal (2009) which would be the ratio of net property plant and equipment plus inventories to book value of assets. We did not use the original definition as Frank and Goyal (2009) has pointed out that tangibility and collateral would produce exactly the same outcomes rendering one or the other useless when used together.

rd_sale: is a proxy for the firm's growth opportunities, which according to Dittmar (2004), is obtained by dividing research and development expenses to the sales value.

Last, for our measure of correlation controlling for the volatility of asset returns is crucial since volatility determines riskiness as a measure of the firm's risk of default. That is why we ensure to include this control variable in our study. We calculate this variable as defined by Frank and Goyal (2009):

stock_vol: is the volatility of asset returns which according to Frank and Goyal (2009), is the annual volatility of asset returns that is obtained by the volatility of stock returns of parent company before the spinoff event.

For the purpose of this study, we have created four data sets combining market and book leverage with equity and asset return correlation as follows:

- Market leverage without leases and asset return correlation: 361 observations. Discussed in section 3.4
- Market leverage without leases and equity return correlation: 368 observations. Discussed in appendix A.1

- Book leverage with leases and equity return correlation: 342 observations. Discussed in appendix A.2
- Book leverage with leases and asset return correlation: 340 observations. Discussed in appendix A.3

The lack of data of some firm's specific information prevents the mentioned sets to be of equal sizes. For example, there are less missing values when calculating the market leverage without leases than when calculating book leverage with leases, basically for the correction of debt/capitalized lease obligations that the latter imposes to the data. Also, calculating the asset return correlation imposes an extra step compared to the equity return correlation calculation and this is why we observe less data available in the former variable. In sum, we get 368 observations of parent and spun-off unit for market leverage without leases and equity return correlation, 361 observations of parent and spun-off unit for market leverage without leases and asset return correlation, 342 observations of parent and spun-off unit for book leverage with leases and equity return correlation and 340 observations of parent and spun-off unit for book leverage with leases and asset return correlation.

3.3. Asset return correlation calculation

For the two data sets:

- Market leverage without leases and asset return correlation: 361 observations
- Book leverage with leases and asset return correlation: 340 observations

We need to calculate the *asset return correlation* (ARC). The variable is defined, in this study, as the Pearson correlation of the time-series of the unlevered return on assets ROA of parent and subsidiary firms from the spin off event until the end of the year.

To calculate the ARC variable, we need first to estimate the ROA of both parent and subsidiary companies. The problem is that ROA is not observable and we have to construct it from a formula that comes from Modigliani and Miller (1958) proposition II, as shown in equation 1:

$$\text{ROE} = \text{ROA} + (\text{ROA} - \text{ROD}) * \left(\frac{D}{E}\right) * (1 - \text{EFFTAX}) \tag{1}$$

Where:

ROE: Return on equity (stock return)

ROA: Return on assets

ROD: Return on debt

D/E: Debt to equity ratio

EFFTAX: Effective tax paid by the company

Isolating ROA, we get:

$$\text{ROA} = \frac{ROE + ROD * \left(\frac{D}{E}\right) * (1 - \text{EFFTAX})}{1 + \left(\frac{D}{E}\right) * (1 - \text{EFFTAX})} \tag{2}$$

To calculate the value of ROA, we need four more values as seen in equation (2) where ROE is observable as the *daily stock return* time-series and $\left(\frac{D}{E}\right)$ is observable as most firms in COMPUSTAT report their total debt D and equity E values. Calculating the other two variables, ROD and $EFFTAX$ becomes challenging because not all companies have this measures available in the database so we proceed as follows. The Warthon Research Database Services, WRDS (2021) has a newly instance called "wrds.wrdsapps.firm_ratio" or Firm_Ratio application which provides many useful company ratios ready to use for analysis. This application combines the power of CRSP and COMPUSTAT as sources of data and requires the Permno and Gvkey numbers to be useful. From the Firm_Ratio application, we find the four variables needed to calculate the ROA values. Regrettably, this database only has information for 283 observations on parent and spun-off companies out of the 361 observations in our sample. This fact would leave 78 companies useless which is a high loss considering the small sample.

To bring back the 78 firms for which data was not readily available, first, we search for the values to calculate ROE as the *daily stock return* time-series and $\left(\frac{D}{E}\right)$ as total debt D and equity E in COMPUSTAT fundamentals. Second, we create a proxy for $EFFTAX$ from the average or prevailing effective tax paid by companies in the same industry and in the same year as for each of the companies in our subset of 78 pairwise companies. Last, to create the proxy for ROD, we check for the credit rating of the firms in WRDS (2021) COMPUSTAT, we calculate an average ROD value grouping by letter rate and year. Some companies do not have a credit score so we assign the average value of the grouped CCC-, CCC, CCC+ ratings as ROD to these companies.

From this step we are able to create two time-series of ROA values, one for parent as ROA_{parent} and one for subsidiary $ROA_{spinoff}$.

The correlation is calculated from the Pearson correlation formula, equation (3):

$$\rho_{\text{ROAparent}-\text{ROAspin}} = \frac{COV(ROA_{parent}, ROA_{spinoff})}{\sigma_{ROAparent} * \sigma_{ROAspinoff}} \tag{3}$$

By the process described here and the benefits of the WRDS Firm_Ratio application, we are able to collect 361 observations for the combination market leverage without leases and asset return correlation and 340 observations for the combination book leverage with leases and asset return correlation sample. As mentioned in the previous section, section 3.2, the extra step in the ARC calculation as compared to the ERC calculation makes the former of smaller size.

The summary statistics for the data sets: market leverage without leases and asset return correlation is discussed in section 3.4. A detailed description of the summary statistics for book leverage with leases and equity return correlation is found in appendix A.2.

3.4. Description of the spinoffs

For constructing the proxy measure of asset return correlation and equity return correlation, we need to obtain the time-series of stock returns of the parent and the subsidiary. To obtain this measure, we gather the daily stock returns for parents and subsidiaries provided by OptionMetrics database from one month prior to the spin-offs' execution date until two years after the spin-off event took place. Although OptionMetrics and CRSP provide identical values for stock returns when data is available, we also notice that the availability of data in CRSP is more limited than that in OptionMetrics thus we prefer to use the latter data base. Considering missing values in obtaining the daily stock returns, we lose four observations for which data is not available in OptionMetrics, which again reduces our sample from 416 to 412 observations. To summarise, Table 1 presents, in a span of two years, the number of parent and spun-off companies for which data on stock returns is available and for which asset and equity return correlation calculations are possible.

Table 1: Data on parent and spun-off companies after the spin-off
and percent of survival after 2 years

Horizon in years	Pairwise availability of data	Percent of survival
1	412	99%
2	382	92%

This table shows an implying rate of survival since either the parent or the subsidiary ceased to exist in the database. We observe that at the end of the first year after the spinoffs, 99% or 412 out of 416 pairs of firms were active. In the second year, we still have 92% of surviving pairs of firms or 382 observations of parent and spun-off company. The numbers in Table 1 are somewhat far from those reported in Mehrotra et al. (2005). In year two, the authors reported a survival rate of 83% or 82 out 98 pairs of firms still active. We need to recall that Mehrotra et al. (2005) sample of spinoffs is collected from 1979 through 1997 and the authors do not mention any reason for this survival rate. The regression models in results: section 5.2 and appendix B.2 use the values in year 1 which is the data that comes right after the spinoff event. The data for models in robustness: section 5.3 and appendix B.3 come from year 2 or one period after the spinoff events.

After gathering and cleaning the data for the control variables for the set of *market leverage without leases and asset return correlation*, we are left with a final sample of 361 observations. In this set we find: the six core factors in Frank and Goyal (2009), the two variables as in Dittmar (2004), the volatility of asset returns and the asset return correlation measure. Asset return correlation is calculated as described in section 3.3.

The distribution of spin-offs per year is visualized on Table 2. This table details the number of spin-offs in each year for the 361 observations in the sample. As we can see, the sample observations are dispersed throughout the sample period. Since the composition of the sample comes as a natural process for the companies throughout the years, we do not suspect that this distribution drives our results.

Table 2: Sample Statistics for asset return correlation
Number of Spin-offs per Year

N	Year	Firms
1	2000	5
2	2001	22
3	2002	21
4	2003	12
5	2004	11
6	2005	10
7	2006	13
8	2007	15
9	2008	17
10	2009	9
11	2010	9
12	2011	16
13	2012	21
14	2013	25
15	2014	36
16	2015	40
17	2016	31
18	2017	19
19	2018	11
20	2019	13
21	2020	5
	Total	361

Another helpful indicator of diversification from the data is the firm's distribution in terms of the Standard Industrial Classification, SIC code. Table 3 details the number of observations where the parent's and subsidiary's SIC code differ.

Table 3: Percent of companies in a different industry: asset return correlation
SIC code comparison parent and subsidiary

Industry	Number of Observations	Percent of Observations
One-digit SIC code	145	40%
Two-digit SIC code	197	55%
Three-digit SIC code	238	66%
Four-digit SIC code	264	73%
Total number of firms	361	100%

This table shows that at the 4-digit SIC code 73% of spinoffs land in a different industry compared to their parents. The 3-digit code shows 66% of spinoff companies in a different industry than that of their parents. The 2-digit and 1-digit codes show a 55% and a 40% spinoffs in different industries than that of their parents. As shown, this table hints on how diversified the companies are pre-spinoff.

In the next table, we focus in the two data sets that actually produce significant results: market leverage without leases and asset return correlation with 361 observations and book leverage with leases and equity return correlation with 342 observations. After some scrutiny of the data and with the goal of preserving as many observations as possible, we winsorize R&D expenses and market to book ratio at 1% and 99% for extreme values. Table 4, presents the basic statistics of the data.

As for this table, we see that asset return correlation and equity return correlation range from negative (-0.769) to positive (1.00) values exhibiting a diverse sample of spinoffs. Table 4 shows the distribution of all the variables used in our models for market leverage without leases and asset return correlation in section 5.2 and the models for book leverage with leases and equity return correlation in appendix B.2.

More details for the data set of *book leverage with leases and equity return correlation* is found in appendix A.2.

Likewise, appendices A.1 and A.3 show the summary statistics for the data sets *market leverage without leases and equity return correlation* and *book leverage with leases and asset return correlation.*

Table 4: Summary Statistics: Data for market leverage and book leverage in parent firm
Core factors in Frank and Goyal (2009), Rauh and Sufi (2012b) and Dittmar (2004)

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Asset Return Correlation	361	0.210	0.268	−0.769	0.089	0.372	1.000
Equity Return Correlation	342	0.248	0.228	−0.769	0.127	0.394	1.000
Market Leverage without Leases	361	0.309	0.233	0.000	0.138	0.437	1.024
Collateral	361	0.423	0.391	0.000	0.118	0.629	2.133
Size: ln(Assets)	361	8.521	2.020	2.966	7.242	9.802	16.850
R&D Intensity	361	0.062	0.262	0	0	0.03	2
Tangibility	361	0.224	0.233	0.000	0.054	0.328	0.917
Market to Book ratio	361	1.319	0.900	0.167	0.748	1.568	5.191
Profitability	361	0.101	0.154	−0.680	0.053	0.142	1.451
Industry Lev (3-Digit)	361	0.233	0.174	0.002	0.084	0.365	0.788
Expected Inflation	361	0.029	0.004	0.024	0.026	0.032	0.041
Volatility of Asset Returns	361	0.027	0.026	0.003	0.015	0.031	0.345
Book Leverage with Leases	342	0.328	0.284	0.000	0.177	0.428	2.928
Size: ln(Sales)	342	7.912	2.050	−1.609	6.772	9.407	12.389
Tangibility leases corrected	342	0.234	0.241	0.000	0.056	0.336	0.917
Mktb with leases	342	1.693	1.064	0.566	1.076	1.933	12.007
Profitability leases corrected	342	0.117	0.152	−0.534	0.058	0.160	1.404

We will finish this section with a correlation matrix between the explanatory variables. This will provide us with a better understanding for any potential collinearity problem among them. Table 5 shows the values for each pair of explanatory variables in the sample of 361 firm observations of this section.

Table 5: Correlation matrix of explanatory variables: sample of 361 spinoff observations

	ARC	coll	size	rd_sale	tang	mktb	roa	imlev	exp_infl	stock_vol
ARC	1.00	0.07	0.14	0.07	0.09	-0.01	0.07	-0.08	0.08	-0.01
coll	0.07	1.00	0.01	-0.17	0.87	-0.09	0.23	0.23	0.06	-0.03
size	0.14	0.01	1.00	-0.23	0.06	-0.19	0.03	0.09	-0.03	-0.13
rd_sale	0.07	-0.17	-0.23	1.00	-0.16	0.27	-0.32	-0.25	0.00	0.10
tang	0.09	0.87	0.06	-0.16	1.00	-0.10	0.18	0.29	0.05	-0.04
mktb	-0.01	-0.09	-0.19	0.27	-0.10	1.00	0.39	-0.23	-0.11	-0.09
roa	0.07	0.23	0.03	-0.32	0.18	0.39	1.00	-0.01	0.07	-0.12
imlev	-0.08	0.23	0.09	-0.25	0.29	-0.23	-0.01	1.00	0.10	0.03
exp_infl	0.08	0.06	-0.03	0.00	0.05	-0.11	0.07	0.10	1.00	0.07
stock_vol	-0.01	-0.03	-0.13	0.10	-0.04	-0.09	-0.12	0.03	0.07	1.00

As we observe from Table 5, tangibility and collateral exhibit an 87% Pearson correlation value and are the only pair of variables that show a measure this high. The rest of the variables do not have a relevant correlation value between them. To avoid collinearity problems with the variables mentioned, we will set collateral aside and will continue to use only tangibility alongside with the other variables described here as explanatory variables for the rest of the paper.

3.5. Data for the industry

In this section, we want to set a baseline with the companies that did not spin off in the same industry and in the same period as those in our sample of spinoffs. This benchmark is important, first of all, because we want to have an updated look at how the traditional determinants of capital structure have evolved over time. Second, it is important to compare how different are the results from our spinoff samples from values of the general population. To this aim, we gather data on companies that did not spin off in the same industry and in the same period of our spinoffs, from 2000 to 2020, and then apply the same models used for the models in our samples together with the traditional determinants of CS.

3.5.1. Data for industry and market leverage without leases

For the Frank and Goyal (2009) market leverage without leases variables plus Dittmar (2004) variables, we gathered 10,573 companies that represent the 49 industries as for the 2-Digit SIC code. The winsorizing technique was used for extreme values on market leverage without leases, market to book, return on assets, and R&D intensity. The summary statistics for this model is shown in Table 6.

Table 6: Summary Statistics: market leverage without leases for Companies that did not spin off and Frank and Goyal (2009) Core factors plus Dittmar (2004) variables for years 2000-2020

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Market Leverage without Leases	10,573	0.241	0.266	0.000	0.010	0.393	0.965
Tangibility	10,573	0.266	0.287	0.000	0.037	0.448	1.000
Market to Book ratio	10,573	2.136	2.119	0.149	0.802	2.562	8.637
Profitability	10,573	−0.186	0.858	−6.095	−0.163	0.136	0.408
R&D Intensity	10,573	0.700	1.855	0	0	0.2	8
Size: ln(Assets)	10,573	5.885	3.061	−6.849	3.853	7.842	16.636
Expected Inflation	10,573	0.028	0.004	0.024	0.025	0.031	0.041
Industry Lev (3-Digit)	10,573	0.167	0.176	0.000	0.022	0.267	0.781

3.5.2. Data for industry and book leverage with leases

For the Rauh and Sufi (2012b) book leverage variables with leases, we gathered 12,169 companies that represent the 49 industries as for the 2-Digit SIC code. The winsorizing technique was used for extreme values on book leverage, market to book ratio, size, return on assets, and R&D intensity. All variables were winsorized to the 1 and 99% except R&D intensity and market to book which were winsorized to the 1% and 95%. The summary statistics for the models in the Rauh and Sufi (2012b) core determinants plus Dittmar (2004) variables industry section are shown in Table 7.

Table 7: Summary Statistics: Book Leverage for Companies that did not spin off and
Rauh and Sufi (2012b) Core Determinants plus Dittmar (2004) variables for years 2000-2020

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Book Leverage	12,169	0.367	0.495	0.000	0.049	0.499	3.711
Tangibility	12,169	0.230	0.283	0.000	0.008	0.381	1.000
Market to Book ratio	12,169	2.193	1.872	0.476	1.049	2.449	8.019
Size: ln(Sales)	12,169	4.909	3.004	−3.297	3.074	6.857	11.310
Profitability	12,169	−0.123	0.702	−5.079	−0.054	0.134	0.424
R&D Intensity	12,169	0.431	1.166	0	0	0.2	5
Industry Lev (3-Digit)	12,169	0.235	0.170	0.005	0.079	0.399	0.748

4. Methodology

4.1. Model for market leverage without leases

To investigate the impact of equity return correlation on market leverage without leases we estimate model in equation (4). We have our variable of interest and eight control variables as explained in section 3.2. All variables here refer to parent company except asset return correlation which is calculated as explained in section 3.3.

$$\begin{aligned} parent\_mklev_s = \alpha + \beta_1 * asset\_ret\_corr_{s,t+1} + \gamma_2 * imlev_{s,t+1} + \gamma_3 * tang_{s,t+1} \\ + \gamma_4 * mktb_{s,t+1} + \gamma_5 * roa_{s,t+1} + \gamma_6 * size_{s,t+1} + \gamma_7 * exp\_infl_{s,t+1} \\ + \gamma_8 * rd\_sale_{s,t+1} + \gamma_9 * stock\_vol_{s,t} + \mu_i + \varepsilon_{i,t+1} \end{aligned} \tag{4}$$

Where:

α**:** is a constant

μ**:** is the unobservable firm level fixed effects

ε**:** is the error term

The rest of the variables are as defined in section 3.2.

4.2. Model for book leverage ratio with leases

To investigate the impact of equity return correlation on book leverage with leases we estimate the model in equation 5. We use our variable of interest and seven control variables as explained in section 3.2. The variables are adjusted for debt/capitalized lease obligations as described in the Rauh and Sufi (2012a) appendix for Rauh and Sufi (2012b). All variables here refer to parent company except equity return correlation which is calculated as explained in section 3.2.

$$\begin{aligned} parent\_bklev_s = \alpha + \beta_1 * equity\_ret\_corr_{s,t+1} + \gamma_2 * imlev_{s,t+1} + \gamma_3 * tang_{s,t+1} \\ +\gamma_4 * mktb_{s,t+1} + \gamma_5 * roa_{s,t+1} + \gamma_6 * size_{s,t+1} \\ +\gamma_7 * rd\_sale_{s,t+1} + \gamma_8 * stock\_vol_{s,t} + \mu_i + \varepsilon_{i,t+1} \end{aligned} \tag{5}$$

The regressions for asset return correlation and equity return correlation are carried out in a similar way using the models presented in equations (4) and (5). The asset return correlation variable is calculated according to equation (3) and is used for market leverage without leases ratio and book leverage ratio with leases as for the indications given in Frank and Goyal (2009) and Rauh and Sufi (2012b) respectively.

5. Results

As discussed in section 4, we use two different types of leverage measures as depending on the leverage definition, we need a different calculation method for the control variables. For instance, the measure of tangibility appears in both models of section 4 but in equation (5) the measure of tangibility has been corrected to account for debt/capitalized lease obligations. This way, we are consistent with the measure used for leverage and the control variables proposed as calculated in Frank and Goyal (2009) and Rauh and Sufi (2012b), respectively.

For all the regression models in this section, we employ equations (4) and (5). The variables of interest (ARC and ERC) and the control variables are those described in section 4. We apply time (year) and industry (2-Digit SIC) fixed effects in the regressions and robust standard errors for the regression models performed in this section following the method suggested by Petersen (2009) using time (year) effect and industry (2-Digit SIC) effect in coherence with the R 'Sandwich' package (2021) and the vcovPL function (Clustered Covariance Matrix Estimation for Panel Data) as in Zeileis et al. (2021).

The two models that produce significant results for our variables of interest are:

- Market leverage without leases and asset return correlation: 361 observations
- Book leverage with leases and equity return correlation: 342 observations

As stated in section 3.5, we first require to set a baseline for the industry measure of market leverage and the control variables, so we have an updated measure of the magnitude and sign of the coefficients for the traditional core determinants of capital structure, all this applied to the industries and periods to match those of the spinoff samples.

5.1. Reference models for industry and market leverage without leases

Table 8 presents the benchmark for the market leverage without leases ratio and the reliable control variables found by Frank and Goyal (2009) and Dittmar (2004) variables for years 2000-2020. This table contains two models, on 10,573 observations, that validates the relevance of the control variables during the same period and for the same industries as our sample of spin-offs.

Model 1 in Table 8 shows that industry median leverage, tangibility, market to book ratio, profitability and company size, five out of six core factors, are significant at 1% level to explain the variation on market leverage without leases measure. All variables maintain the sign as expected in the literature. The adjusted R^2 tells us that 31.9% of market leverage without leases variation is explained by these five variables. Expected inflation is not relevant at any of the traditional confidence levels. The coefficient magnitudes in this model fall closely within the range of values set by the original study of Frank and Goyal (2009). For example, industry median leverage coefficient ranges from 0.466 to 0.715 in Frank and Goyal (2009) while the value for this variable is 0.582 for our benchmark. Tangibility ranges from -0.006 to 0.134 and our value is 0.077. Table V in Frank and Goyal (2009) show the values for the coefficients for years 1950 to 2003. The values for all years in the table are: industry median leverage 0.684 against our measure of 0.582, tangibility 0.092 vs 0.077, market to book -0.024 vs -0.032, profitability -0.120 vs -0.056 and size 0.011 vs 0.008.

Model 2 incorporates the R&D intensity variable as in Dittmar (2004). The newly introduced variable is negative and significant at 1% level. The adjusted R^2 increases to 32.4% showing that R&D variable adds explanatory power to the model. In sum, industry median leverage, tangibility, market to book, profitability, and size remain significant and preserve the signs of the original Frank and Goyal (2009) work leaving expected inflation out of the group. As for the variables in Dittmar (2004), R&D intensity is significant and also preserves the expected negative relationship with leverage.

Table 8: Regression models on market leverage without leases for companies that did not spin off for years 2000 to 2020 and Frank and Goyal (2009) core factors plus Dittmar (2004) variables

	Dependent variable: Market Leverage without Leases	
	Model 1	Model 2
Industry Lev (3-Digit)	0.582***	0.563***
	(0.027)	(0.031)
Tangibility	0.077***	0.071***
	(0.013)	(0.013)
Market to Book ratio	-0.032***	-0.031***
	(0.002)	(0.002)
Profitability	-0.056***	-0.062***
	(0.002)	(0.003)
Size: ln(Assets)	0.008***	0.008***
	(0.001)	(0.001)
Expected Inflation	0.969	1.099
	(1.116)	(1.218)
R&D Intensity		-0.010***
		(0.001)
Constant	0.105**	0.112**
	(0.041)	(0.048)
Observations	10,573	10,573
R^2	0.320	0.324
Adjusted R^2	0.319	0.324
Residual Std. Error	0.219 (df = 10566)	0.219 (df = 10565)
F Statistic	827.842*** (df = 6; 10566)	723.711*** (df = 7; 10565)
Note:		*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

Let us summarize our benchmark coefficients with the expected values according to the the literature in Table V of Frank and Goyal (2009), and Table 5 in Dittmar (2004). Table 9 shows the comparison, magnitudes and sign of coefficients.

Table 9: Summary of model 2 vs expected values from literature: Frank and Goyal (2009) and Dittmar (2004)

Variable	New Benchmark	Literature expected value	In range?	Equal sign
Constant	0.112	0.039	Yes	Yes
Industry Lev (3-Digit)	0.563	0.684	Yes	Yes
Tangibility	0.071	0.092	Yes	Yes
Market to book ratio	-0.031	-0.024	Yes	Yes
Profitability	-0.062	-0.120	Yes	Yes
Size: ln(Assets)	0.008	0.011	Yes	Yes
Expected Inflation	1.099	1.328	Yes	Yes
R&D Intensity	-0.010	-0.13	NA	Yes

In brief, this section provides an updated version of the seven most reliable variables in explaining capital structure in the works of Frank and Goyal (2009) and Dittmar (2004). Table 9 shows that the magnitudes and signs for our benchmark coefficients for market leverage are in line with the literature and that the core determinants of capital structure hold remarkably well for the most recent data in the industries in our sample that did not spin off.

It is important to note that although we will introduce *volatility of asset returns* as a new and necessary variable for the models in the next section, we are not using it here since Frank and Goyal (2009) did not find this variable to be reliable. The reason why we use *volatility of asset returns* as a control variable in the sample of spinoffs is that our variable of interest is *asset return correlation* and as such, omitting this control variable would certainly cause endogeneity problems.

5.2. Market leverage without leases and asset return correlation regressions

Table 10 presents the most important models in our study. It shows the results of the regression models of market leverage without leases on asset return correlation. The models show three different specifications of control variables and asset return correlation. Model

1 presents the regression of market leverage without leases on the seven core factors in Frank and Goyal (2009), and Dittmar (2004). The results show that only tangibility is not significant at any relevant confidence level. Profitability is positive and significant at the 10% level. Expected inflation is negative and significant at the 5% level. The rest of the variables in the model are significant at the 1% level. With respect to the benchmark in model 2, Table 8, we see that profitability, expected inflation, and R&D intensity have different coefficient signs. The adjusted R^2 is 32.1%.

Model 2 adds the variable volatility of asset returns to model 1. We judge this control variable to be related to our variable of interest (ARC), meaning that omitting it in our analysis could cause serious endogeneity problems leading the results to be biased. The coefficient for this variable is positive and significant at the 1% level. The remaining variables maintain their signs and significance with respect to model 1 except that R&D intensity decreases its significance to the 5% level. The adjusted R^2 slightly increases to 32.2% indicating a tiny improvement in explanatory power.

Model 3 introduces our variable of interest: asset return correlation. The coefficient has a value of -0.031 with significance at the 1% level, meaning an agreement with our initial hypothesis in light of the tradeoff theory. Under this results we can say that, holding everything else constant, an increase of one percent (1%) or 0.01 in asset return correlation would lead market leverage to fall by 0.00031 units. The other control variables carry on with their significance and signs as compared to model 2. The adjusted R^2 improvement is not visible and remains at 32.2%.

In sum, model 3 in Table 10 shows a negative and significant relation between asset return correlation and market leverage without leases which agrees with the tradeoff theory of capital structure in support of our initial hypothesis. As for the results in the model, all other things equal, the higher the correlation, the lower the market leverage without leases which in practical terms means that managers would use less debt as the firm's asset return correlation increases.

Table 10: Regression models on market leverage without leases for sample companies for Frank and Goyal (2009) core factors plus Dittmar (2004) variables and asset return correlation

	Dependent variable: Market Leverage without Leases		
	Model 1	Model 2	Model 3
Asset Return Correlation			-0.031***
			(0.006)
Industry Lev (3-Digit)	0.531***	0.528***	0.523***
	(0.025)	(0.026)	(0.026)
Tangibility	-0.020	-0.018	-0.014
	(0.028)	(0.028)	(0.027)
Market to Book ratio	-0.097***	-0.096***	-0.096***
	(0.006)	(0.007)	(0.007)
Profitability	0.153*	0.156*	0.162**
	(0.078)	(0.081)	(0.079)
Size: ln(Assets)	0.012***	0.013***	0.013***
	(0.002)	(0.002)	(0.002)
Expected Inflation	-5.431**	-5.600**	-5.455**
	(2.480)	(2.636)	(2.585)
R&D Intensity	0.063***	0.059**	0.063***
	(0.023)	(0.024)	(0.024)
Volatility of Asset Returns		0.481***	0.485***
		(0.135)	(0.128)
Constant	0.356***	0.339***	0.336***
	(0.100)	(0.100)	(0.099)
Observations	361	361	361
R^2	0.335	0.337	0.339
Adjusted R^2	0.321	0.322	0.322
Residual Std. Error	0.192 (df = 353)	0.192 (df = 352)	0.192 (df = 351)
F Statistic	25.355*** (df = 7; 353)	22.406*** (df = 8; 352)	19.965*** (df = 9; 351)
Note:			*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

Let us compare model 1 in Table 10 with model 2 in Table 8 for the benchmark. Here, we are comparing the coefficients of the seven control variables used in the previous section with the coefficients obtained for the same variables applied to our sample of spinoffs. We want to check for magnitudes and signs of the coefficients. To this goal, we carry out a Z-test to verify whether the coefficients are statistically different using equation (9) from appendix B.2. Table 11 summarizes the results.

Table 11: Comparing the coefficients of model 1, Table 10 with model 3, Table 8 in industry benchmark

Variables	Equal sign	Z_values	Critical	Sign_diff @5%	CI Overlap
Constant	Yes	-2.20	1.96	Stat Different	Overlap
Industry Lev (3-Digit)	Yes	0.80	1.96	Not Stat Different	Overlap
Tangibility	Yes	2.91	1.96	Stat Different	Overlap
Market to book ratio	Yes	9.75	1.96	Stat Different	No overlap
Profitability	No	-2.74	1.96	Stat Different	No overlap
Size: ln(Assets)	Yes	-1.61	1.96	Not Stat Different	Overlap
Expected Inflation	No	2.36	1.96	Stat Different	Overlap
R&D Intensity	No	-3.21	1.96	Stat Different	No overlap

We see that most of the coefficients are statistically different in magnitude and that even three of the variables are different in sign. Only industry median leverage and size are not statistically different for the benchmark and the coefficients for our market leverage sample. It comes to no surprise that industry median leverage for the benchmark and our sample are similar in all respects: magnitude, sign, and confidence intervals. This variable stands out as the most reliable factor of capital structure by most authors in the literature. Size is also similar in magnitude, not statistically different and CIs overlap. Since the industry benchmark used here excludes all the companies in the sample, we can conclude that the spinoffs will behave differently from those companies that do not spin off.

5.3. Market leverage without leases and asset return correlation robustness check

In this section, we want to check how the relation between ARC and market leverage holds one year after the spinoff event. We carry on with the same models as in the previous section moving every variable calculation one year ahead following equation (4). The results for the regression models for market leverage without leases and asset return correlation plus the variables of control are shown in Table 12.

We see in model 3, Table 12 that one year later after the spinoff event, three control variables and our variable of interest remain significant at the 1% level. Industry median leverage, size, and market to book ratio also keep their signs. Asset return correlation is negative and holds a strong relationship with market leverage without leases one year later. This goes in line with our initial hypothesis that according to the tradeoff theory, as the asset return correlation increases, the value of market leverage without leases should decrease. To conclude, from the analysis in this section, our findings suggest robustness as one year later the strong relationship between ARC and market leverage without leases still holds.

Table 12: Regression models on market leverage without leases for sample companies for Frank and Goyal (2009) core factors plus Dittmar (2004) variables and asset return correlation: every variable calculation is done one year later with respect to Table 10

	Dependent variable: Market Leverage without Leases		
	Model 1	Model 2	Model 3
Asset Return Correlation			-0.134***
			(0.030)
Industry Lev (3-Digit)	0.546***	0.537***	0.527***
	(0.054)	(0.059)	(0.052)
Tangibility	0.007	0.005	0.005
	(0.035)	(0.032)	(0.030)
Market to Book ratio	-0.065***	-0.064***	-0.066***
	(0.008)	(0.008)	(0.008)
Profitability	-0.149**	-0.122**	-0.130**
	(0.066)	(0.060)	(0.061)
Size: ln(Assets)	0.014**	0.016***	0.019***
	(0.007)	(0.005)	(0.006)
Expected Inflation	-3.086	-3.230	-1.681
	(2.394)	(2.742)	(3.044)
R&D Intensity	-0.056**	-0.062**	-0.052**
	(0.024)	(0.025)	(0.026)
Volatility of Asset Returns		1.482*	1.402*
		(0.821)	(0.810)
Constant	0.264*	0.214	0.186
	(0.151)	(0.134)	(0.140)
Observations	329	329	329
R^2	0.303	0.310	0.330
Adjusted R^2	0.288	0.293	0.311
Residual Std. Error	0.217 (df = 321)	0.216 (df = 320)	0.214 (df = 319)
F Statistic	19.976*** (df = 7; 321)	18.008*** (df = 8; 320)	17.443*** (df = 9; 319)
Note:			*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

5.4. Weaknesses and caveats: limits of the analysis

Although we find a significant relationship between our measure of interest, asset return correlation, and market leverage without leases we need to recall that in this calculation we make some strong assumptions that need to hold for the study to be relevant. The first assumption is that the post-spinoff valuations and their return dynamics are the same had there been no spinoff and then they would have not been observed. We believe that this assumption is not far from reality under an efficient market hypothesis.

The second assumption is that correlation as stated here does not change during the spinoff event, but in turn becomes measurable and stays constant at least for some time after the spinoff. This is a bold assumption as we are again trusting the efficiency of the market. In the aggregate, we see that for at least one more period after the spinoff event, our variable of interest continues to be significant as in the previous period. The robustness check in section 5.3 validates this assumption.

A third assumption is that our calculated value for asset return correlation keeps the same sign as if we could observe the real internal asset correlation pre-spinoff. We need to recall that an intermediate step before obtaining the value for ARC is the calculation of ROA through equation (2) which is a theoretical formula. Through the results presented here, we observe the consistency and validity of the formulas in equations (1) and (2). We believe that as for the coherence of the intermediate and final steps, our calculated proxy for ARC captures the sign as well as the magnitudes for our variable of interest.

We understand that endogeneity may arise due to the omission of explanatory variables in the regression, which would result in the error term being correlated with the explanatory variables, thereby violating a basic assumption behind ordinary least squares (OLS) regression analysis. It may also be caused by simultaneity, Roberts and Whited (2013). For the scope of this paper, we do not have instruments to address this concern.

We have carefully chosen the control variables as described in section 3.2 for our models in section 5.2 since we are aware that endogeneity is a problem. Omitted variables lead to endogeneity problems and biased coefficients. We try to minimize these problems through the incorporation of the most reliable variables found in the works of Frank and Goyal (2009) and Dittmar (2004). Also, as mentioned earlier, we include the control variable *volatility of asset returns* for its relation with our variable of interest, ARC.

One last problem related to endogeneity is the selection of spin-offs as a unit of study. We have effectively set a baseline model of coefficients for those companies that do not spinoff in section 5.1 and showed that the companies in our sample of spinoffs simply possess different characteristics and should produce different magnitudes and signs for the coefficients compared to companies that do not spin off. In sum, the results and the analysis presented in this study only holds, and is conditional on companies that do spin off.

It is also important to address the construction of the correlation measure in this section. Throughout this study, we use the Pearson correlation measure, equation (6) as the measure for correlation instead of the correlation derived from the *variance of a sum*, equation (7):

$$\rho_{\text{ROAparent}-\text{ROAspin}} = \frac{COV(ROA_{parent}, ROA_{spinoff})}{\sigma_{ROAparent} * \sigma_{ROAspinoff}} \tag{6}$$

$$\rho_{\text{ROAparent}-\text{ROAspin}} = \frac{VAR(ROA_{prespinoff}) - VAR(ROA_{parent}) - VAR(ROA_{spinoff})}{2 * \sigma_{ROAparent} * \sigma_{ROAspinoff}} \tag{7}$$

The use of the former equation is supported in the fact that although both measures account for the correlation of the time-series post-spinoff, the Pearson correlation sets boundaries to the possible values in the calculation. The estimate of correlation through equation (7) becomes noisy as things change over time and there is no reason for this measure to fall within the boundaries minus one and one [-1, 1]. Following the reasoning in Frank and Goyal (2009), we consider that the measure of correlation in this study is forward-looking as it is derived from the interactions in the stock market as opposed to the book value measure which accounts mostly for past events.

In appendix B, we present the models and results for book leverage with leases and equity return correlation similar to the models and processes found in this section. It is interesting to note that we find a significant and positive relation between book leverage with leases and equity return correlation but we present these results as a reference only. We are aware that calculating the measure of correlation this way leads to misinterpretations since it depends on the capital structures on both parent and spun-off company.

6. Conclusion

Throughout the years, capital structure decisions have captivated the interest of numerous researchers, and yet the field remains inconclusive. Asset return correlation is a measure that captures a firm's diversification level, and consequently the riskiness of the firm. Motivated by the topic as well as the availability of information on corporate events like spinoffs, the present study is an effort to test whether asset return correlation (ARC) has any impact on two traditional measures of market and book leverage. Using a sample of 416 spinoffs from 2000 to 2020 we are able to estimate a proxy for the measure of asset return correlation. The lack of data on some firm's specific information creates data sets with differing number of observations. After setting up the control variables by the existing literature, we perform the regression models for market leverage without leases and asset return correlation. The results show that ARC is negative and significantly related to market leverage without leases. This finding corroborates our initial hypothesis in light of the tradeoff theory. As for the results in Table 10, asset return correlation seems to fit well as a proxy to capture the corporate diversification effect, meaning that pre-spinoff, companies with higher correlation have a lower level of market leverage. In practical terms, when managers see a high value for asset return correlation, they will be inclined to less debt in their companies.

For our proxy measure of correlation, asset return correlation, we make some strong assumptions as described in section 5.4. One of the assumptions is that correlation must represent the company's correlation pre-spinoff. Moreover, correlation should not change during the spinoff and should stay constant and measurable for a period after. In view of the results, we can argue that this is the general case for most firms. Another limitation is endogeneity. In virtue of this limitation we include the most reliable determinants of capital structure as control variables in our models and we do not go further to find other variables to decrease the problem.

The present study contributes to the field of corporate finance and specifically within the capital structure domain in that we examine an unexplored variable of correlation as a potential determinant of CS yielding positive results. We also revisit the core determinants of capital structure to the specific industries and the period where the spinoff sample belongs to. This is equally important since we are able to compare the results in the sample of spinoffs to the case where companies do not spin off implying that when companies experience such event, they will behave differently concerning their capital structures.

In view of the results, we have found a new variable that influence the firm capital structure when that measure is available as in the case of spinoffs. Specifically, we have shown that asset return correlation has a strong relationship with market leverage without leases and since the strong relation holds up to two periods after, we are confident that the case could be generalized to samples of the same type.

References

Amihud, Y. and Lev, B. (1981). Risk reduction as a managerial motive for conglomerate mergers. *The Bell Journal of Economics*, 12(2):605–617.

Baker, M. and Wurgler, J. (2002). Market timing and capital structure. *The journal of finance*, 57(1):1–32.

Bergh, D. D. (1997). Predicting divestiture of unrelated acquisitions: an integrative model of ex ante conditions. *Strategic Management Journal*, 18(9):715–731.

Clogg, C. C., Petkova, E., and Haritou, A. (1995). Statistical methods for comparing regression coefficients between models. *American Journal of Sociology*, 100(5):1261–1293.

Dittmar, A. (2004). Capital structure in corporate spin-offs. *The Journal of Business*, 77(1):9–43.

Frank, M. Z. and Goyal, V. K. (2009). Capital structure decisions: which factors are reliably important? *Financial management*, 38(1):1–37.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American economic review*, 76(2):323–329.

Jensen, M. C. and Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, 3(4):305–360.

Kochhar, R. and Hitt, M. (1998). Linking corporate strategy to capital structure: diversification strategy, type and source of financing. *Strategic Management Journal*, 19(6):601–610.

Lubatkin, M. and Chatterjee, S. (1994). Extending modern portfolio theory into the domain of corporate diversification: Does it apply? *The Academy of Management Journal*, 37(1):109–136.

Mansi, S. A. and Reeb, D. M. (2002). Corporate diversification: What gets discounted? *The Journal of Finance*, 57(5):2167–2183.

Mehrotra, V., Mikkelson, W., and Partch, M. (2005). Do managers have capital structure targets? evidence from corporate spinoffs. *Journal of Applied Corporate Finance*, 17(1):18–25.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American economic review*, 48(3):261–297.

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

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies*, 22(1):435–480.

Rauh, J. D. and Sufi, A. (2012a). *Online Appendix for: Explaining Corporate Capital Structure: Product Markets, Leases, and Asset Similarity* . https://amirsufi.net/data-and-appendices/csproduct_rauhsufi_20100628_appendix.pdf [Accessed: 15.07-2021].

Rauh, J. D. and Sufi, A. (2012b). Explaining corporate capital structure: Product markets, leases, and asset similarity. *Review of Finance*, 16(1):115–155.

Roberts, M. R. and Whited, T. (2013). Chapter 7 - endogeneity in empirical corporate finance. *Handbook of the Economics of Finance*, 2(part A):493–572.

WRDS (2021). *Wharton Research Data Services*. https://wrds-www.wharton.upenn.edu/login/ [Accessed: 15.07-2021].

Zeileis, A., Lumley, T., Graham, N., and Koell, S. (2021). *Robust Covariance Matrix Estimators.* https://cran.r-project.org/web/packages/sandwich/sandwich.pdf [Accessed: 15.07-2021].

Appendix A Book and market leverage data

A.1 Market leverage without leases and equity return correlation data

After gathering and cleaning the data for the control variables for the set of *market leverage without leases and equity return correlation*, we are left with a final sample of 368 observations. In this set we find: the six core factors in Frank and Goyal (2009), one of the variables in Dittmar (2004), the volatility of asset returns and the equity return correlation. Equity return correlation is calculated as the Pearson correlation of the time-series of stock returns of parent and subsidiary firms after the spinoff event through equation (8).

$$\rho_{\text{StockRetParent,StockRetSpin}} = \frac{COV(StockRet_{parent}, StockRet_{spinoff})}{\sigma_{StockRetParent} * \sigma_{StockRetSpinoff}} \tag{8}$$

The distribution of spinoffs per year is visualized on Table 13. This table details the number of spin-offs in each year for the 368 observations in the sample. As we can see, the sample observations are dispersed throughout the sample period. Since the composition of the sample comes as a natural process of the companies throughout the years, we do not suspect that this distribution drives our results.

Another helpful indicator of diversification from the data is the firm's distribution in terms of the Standard Industrial Classification, SIC code. Table 14 details the number of observations where the parent's and subsidiary's SIC code differs.

This table shows that at the 4-digit SIC code 73% of spinoffs land in a different industry than that of their parents. The 3-digit code shows 66% of spinoff companies are in a different industry than that of their parents. The 2-digit and 1-digit codes show a 54% and a 40% spinoffs in different industries than that of their parents. As shown, this table hints on how diversified the companies are pre-spinoff.

After some scrutiny of the data and with the goal of preserving as many observations as possible, we winsorize R&D expenses and market to book ratio at 1% and 99% for extreme values. Table 15 presents the basic statistics of the data.

Table 13: Sample Statistics
Number of Spin-offs per Year

N	Year	Firms
1	2000	5
2	2001	22
3	2002	21
4	2003	12
5	2004	11
6	2005	10
7	2006	11
8	2007	15
9	2008	17
10	2009	8
11	2010	9
12	2011	17
13	2012	22
14	2013	23
15	2014	35
16	2015	38
17	2016	32
18	2017	20
19	2018	15
20	2019	14
21	2020	11
	Total	368

Table 14: Percent of Companies in a Different Industry
SIC code comparison Parent and Subsidiary

Industry	Number of Observations	Percent of Observations
One-digit SIC code	149	40%
Two-digit SIC code	199	54%
Three-digit SIC code	242	66%
Four-digit SIC code	267	73%
Total number of firms	368	100%

Table 15: Summary Statistics: Data for market leverage and equity return correlation in parent firm
Frank and Goyal (2009) core Factors plus Dittmar (2004) variables

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Equity Return Correlation	368	0.252	0.239	−0.769	0.127	0.389	1.000
Market Leverage without Leases	368	0.303	0.227	0.000	0.140	0.434	1.008
Size: ln(Assets)	368	8.481	2.026	3.486	7.169	9.787	16.850
R&D Intensity	368	0.061	0.252	0	0	0.03	2
Tangibility	368	0.233	0.240	0.000	0.056	0.336	0.917
Market to Book ratio	368	1.343	0.955	0.167	0.745	1.615	5.759
Profitability	368	0.100	0.155	−0.860	0.053	0.144	1.451
Industry Lev (3-Digit)	368	0.232	0.184	0.000	0.076	0.363	0.781
Expected Inflation	368	0.029	0.004	0.024	0.026	0.031	0.041
Volatility of Asset Returns	368	0.026	0.025	0.003	0.015	0.031	0.345

As for this table, we see that equity return correlation ranges from negative (-0.769) to positive (1.00) values also hinting on a well diversified sample of spinoffs. Table 15 shows the distribution of all the variables used in our market leverage without leases and equity return correlation models.

A similar process is done for the set *book leverage with leases and equity return correlation.* This set is composed of 342 observations of parent and spun-off company. The summary statistics tables, can be seen in appendix A.2. Likewise, appendix A.3 shows the summary statistics for the data set *book leverage with leases and asset return correlation.*

A.2 Book leverage ratio with leases and equity return correlation data

This appendix shows the summary statistics for the *book leverage with leases and equity return correlation* data. A similar process to the one described in appendix A.1 is done to obtain the data on book leverage ratio with leases and equity return correlation. We see a smaller sample of 342 parent and spun-off company observations since there is less data available for the core determinants in Rauh and Sufi (2012b) than for those in Frank and Goyal (2009). All the variables are adjusted to reflect the debt/capitalized lease obligations as described in section 4. Table 16 shows the summary statistics of equity return correlation and all the variables of control. R&D Expenses is winsorized to the 1% and 99%.

Table 16: Summary Statistics: Data for book leverage and equity return correlation in parent firm
Rauh and Sufi (2012b) core Determinants plus Dittmar (2004) variables

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Equity Return Correlation	342	0.248	0.228	−0.769	0.127	0.394	1.000
Book Leverage with Leases	342	0.328	0.284	0.000	0.177	0.428	2.928
Tangibility	342	0.234	0.241	0.000	0.056	0.336	0.917
Market to Book ratio	342	1.693	1.064	0.566	1.076	1.933	12.007
Size: ln(Sales)	342	7.912	2.050	−1.609	6.772	9.407	12.389
Profitability	342	0.117	0.152	−0.534	0.058	0.160	1.404
R&D Intensity	342	0.066	0.282	0	0	0.03	2
Industry Lev (3-Digit)	342	0.266	0.153	0.005	0.141	0.385	0.748
Volatility of Asset Returns	342	0.026	0.025	0.003	0.014	0.030	0.345

A.3 Book leverage with leases and asset return correlation data

This appendix shows the summary statistics for the *book leverage with leases and asset return correlation* data. Since the lease adjustment in Rauh and Sufi (2012b) variables poses a new hurdle for the data, we lose 2 observations respect to previous section, appendix A.2. Table 17 shows the summary statistics for the variables of interest. R&D expenses is winsorized to the 1% and 99%.

Table 17: Summary Statistics: Data for book leverage and asset return correlation in parent firm
Rauh and Sufi (2012b) core Determinants plus Dittmar (2004) variables

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Asset Return Correlation	340	0.208	0.270	−0.769	0.086	0.374	1.000
Book Leverage with Leases	340	0.332	0.287	0.000	0.172	0.442	2.928
Tangibility	340	0.229	0.234	0.000	0.056	0.331	0.917
Market to Book ratio	340	1.661	0.892	0.688	1.079	1.893	5.531
Size: ln(Sales)	340	7.915	2.030	−1.609	6.813	9.404	12.389
Profitability	340	0.118	0.152	−0.534	0.059	0.161	1.404
R&D Intensity	340	0.068	0.294	0	0	0.03	2
Industry Lev (3-Digit)	340	0.263	0.152	0.005	0.140	0.381	0.748
Volatility of Asset Returns	340	0.026	0.025	0.003	0.014	0.030	0.345

Appendix B Results for book leverage with leases and equity return correlation with significant results for the variables of interest

B.1 Reference models for industry and book leverage with leases

In this section, we set the baseline for the book leverage ratio and the core determinants illustrated in Rauh and Sufi (2012b). Table 18 contains the reference regression models for the book leverage with leases and the reliable control variables found by Rauh and Sufi (2012b) for years 2000-2020. The variables in this table are calculated and adjusted for leases where it is pertinent as described in section 4.2 following the appendix Rauh and Sufi (2012a) for the Rauh and Sufi (2012b) paper. The table is composed of three models, on 12,169 observations and the variables coincide in the same period and for the same industries as our sample of spin-offs.

Model 1 in Table 18 shows that all variables, industry median 3-digit leverage, tangibility, market to book ratio, size as natural logarithm of sales, and profitability are significant at the 1% level. It is worth noting that all these variables except market to book ratio maintain the signs of the Rauh and Sufi (2012b) paper. The adjusted R^2 shows that 32.9% of book leverage with leases variation is explained by these five variables.

Model 2 introduces the R&D intensity variable. This results in R&D intensity being negative and significant, as expected, at the 1% level. The other variables keep their signs as in Model 1 and are all significant at the 1% level. The adjusted R^2 increases to 34.5%, which shows a notorious explanatory power improvement by the addition of R&D intensity. In brief, four of the variables in Rauh and Sufi (2012b) show significance at the 1% level but tangibility and market to book ratio have opposite signs as compared to the literature. R&D intensity as in Dittmar (2004) is significant at the 1% level and it maintains the expected sign as in the original regressions from the cited researcher.

Table 18: Regression Models on book leverage with leases for companies that did not spin off for years 2000 to 2020 and Rauh and Sufi (2012b) core factors plus Dittmar (2004) variables

	Dependent variable: Book Leverage with Leases	
	Model 1	Model 2
Industry Lev (3-Digit)	0.994***	0.898***
	(0.021)	(0.019)
Tangibility	0.073***	0.052***
	(0.011)	(0.011)
Market to Book ratio	0.050***	0.050***
	(0.002)	(0.002)
Size: ln(Sales)	0.014***	0.005***
	(0.001)	(0.002)
Profitability	-0.337***	-0.356***
	(0.023)	(0.025)
R&D Intensity		-0.065***
		(0.005)
Constant	-0.100***	-0.007
	(0.008)	(0.021)
Observations	12,169	12,169
R^2	0.329	0.345
Adjusted R^2	0.329	0.345
Residual Std. Error	0.406 (df = 12163)	0.401 (df = 12162)
F Statistic	1,195.406*** (df = 5; 12163)	1,069.773*** (df = 6; 12162)
Note:		*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

Let us summarize the findings for our control variables in model 2, the coefficients, robust standard errors, and their confidence intervals at the 99% level. Table 19 shows the results.

Table 19: Summary of model 3 in table 18, confidence interval and robust standard errors

Variable	Coefficient	Robust Standard Errors	CI lower 99%	CI upper 99%
Constant	-0.01	0.02	-0.06	0.04
Industry Lev (3-Digit)	0.90	0.02	0.85	0.94
Tangibility	0.05	0.01	0.03	0.08
Market to book ratio	0.05	0.00	0.05	0.05
Size: ln(Sales)	0.01	0.00	0.00	0.01
Profitability	-0.36	0.02	-0.41	-0.30
R&D Intensity	-0.07	0.00	-0.08	-0.05

B.2 Book leverage with leases and equity return correlation regressions

The models in Table 20 correspond to regressions of book leverage with leases on equity return correlation, and six more control variables as described in section 4.2. The variable of interest is equity return correlation instead of asset return correlation for this case. As shown in model 1, all the variables, except for R&D intensity, are significant. Tangibility is negative and significant at the 5% level. Market to book ratio is positive and is significant at the 10% level. Size is negative and significant with an opposite sign as compared to the literature. The adjusted R^2 is 34%, and goes in line as compared to the adjusted R^2 in the benchmark Table 18 which highest value was 35.2%.

Model 2, by the addition of volatility of asset returns, actually deteriorates our results from model 1 as for the adjusted R^2 to 33.8%. The rest of variables bear similar outcomes as compared to model 1. Model 3 introduces our variable of interest: equity return correlation. ERC is positive and significant at the 1% level. Industry median leverage and tangibility keep their signs from previous models. Market to book ratio remains positive and significant at the 10% level. Size and profitability are significant but exhibit different signs as compared to the literature. R&D intensity is positive and not significant throughout the models. The adjusted R^2 improves to 34.5%.

Table 20: Regression models on book leverage with leases for sample companies for Rauh and Sufi (2012b) core factors plus Dittmar (2004) variables and equity return correlation

	Dependent variable: Book Leverage with Leases			
	Model 1	Model 2	Model 3	Model 4
Equity Return Correlation			0.121***	0.117***
			(0.045)	(0.038)
Industry Lev (3-Digit)	0.583***	0.583***	0.588***	0.602***
	(0.025)	(0.026)	(0.022)	(0.033)
Tangibility	-0.122**	-0.122**	-0.143***	-0.145***
	(0.048)	(0.048)	(0.041)	(0.035)
Market to Book ratio	0.069*	0.069*	0.069*	0.065***
	(0.036)	(0.037)	(0.036)	(0.025)
Size: ln(Sales)	-0.015***	-0.015***	-0.018***	-0.016***
	(0.005)	(0.005)	(0.005)	(0.002)
Profitability	0.662***	0.662***	0.646***	0.682***
	(0.223)	(0.222)	(0.218)	(0.134)
R&D Intensity	-0.016	-0.016	-0.034	
	(0.091)	(0.091)	(0.091)	
Volatility of Asset Returns		-0.012	-0.044	
		(0.186)	(0.191)	
Constant	0.130***	0.131***	0.125***	0.110***
	(0.020)	(0.020)	(0.018)	(0.037)
Observations	342	342	342	342
R^2	0.351	0.351	0.360	0.359
Adjusted R^2	0.340	0.338	0.345	0.348
Residual Std. Error	0.231 (df = 335)	0.231 (df = 334)	0.230 (df = 333)	0.229 (df = 335)
F Statistic	30.215*** (df = 6; 335)	25.821*** (df = 7; 334)	23.415*** (df = 8; 333)	31.323*** (df = 6; 335)
Note:				*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

Model 4 takes out volatility of asset returns and R&D intensity from model 3. All the remaining variables in model 4 turn to be significant at the 1% level. Compared to our benchmark in Table 18, we find that industry median keeps the same sign, tangibility has an opposite sign, market to book ratio keep the same sign. Size and profitability exhibit different signs whereas R&D intensity is not even significant in Table 20 as it is in Table 18. The adjusted R^2 goes up to 34.8%.

We see in model 4 that equity return correlation (ERC) has a positive and strong relationship with book leverage with leases measure. The relationship just found is contrary to the predictions of the tradeoff theory. We should be careful about the conclusions of the findings since basically three out of five control variables display opposite signs as compared to our benchmark. Tangibility, size and profitability have opposite signs in model 4 of Table 20 as compared to model 2 in Table 18. Only industry median leverage and market to book ratio keep the sign in both models. Under this conditions, it is reasonable to think that the correction for debt/capitalized leases to the book leverage ratio is pushing the coefficients to the opposite direction in our sample. The variable of interest, ERC, is not alien to the trend here, as according to the tradeoff theory, should exhibit a negative relationship.

To understand the relationship between ERC and book leverage with leases better, we further explore the magnitude and confidence intervals (CI) of the coefficients in the benchmark and model where the variable of interest is. With this goal in mind, let us compare model 1 in Table 20 with the benchmark set in section B.1 for model 2. The values for the coefficients, robust standard deviations, and confidence interval are shown in Table 21.

Table 21: Summary of model 1 in table 20, confidence interval and robust standard errors

	Coefficient	Robust Standard Errors	CI lower 99%	CI upper 99%
Constant	0.13	0.02	0.08	0.18
Industry Lev (3-Digit)	0.58	0.03	0.52	0.64
Tangibility	-0.12	0.05	-0.23	-0.01
Market to book ratio	0.07	0.04	-0.02	0.15
Size: ln(Sales)	-0.02	0.00	-0.03	-0.00
Profitability	0.66	0.22	0.14	1.18
R&D Intensity	-0.02	0.09	-0.23	0.19

First we check whether the coefficients are statistically different using a Z-test, equation (9) as explained in Clogg et al. (1995):

$$z = \frac{\beta_{bench} - \beta_{model}}{\sqrt{(SE\beta_{bench})^2 + (SE\beta_{model})^2}} \tag{9}$$

Where:

z: is the calculated z score

β_{bench}: is the coefficient from the benchmark

β_{model}: is the coefficient from model of interest

$SE\beta_{bench}$: is the robust standard error from the benchmark coefficient

$SE\beta_{model}$: is the robust standard error from the model of interest coefficient

Using the values in Tables 19 and 21, we obtain the results in Table 22:

Table 22: Comparing coefficients of Equity Return Correlation and Industry Benchmark

	Variables	Z_values	Critical	Sign_diff @5%	CI Overlap
1	Intercept	-4.69	1.96	Stat Different	No overlap
2	Industry Lev (3-Digit)	9.96	1.96	Stat Different	No overlap
3	Tangibility	3.50	1.96	Stat Different	No overlap
4	Market to book ratio	-0.51	1.96	Not Stat Different	Overlap
5	Size: ln(Sales)	4.03	1.96	Stat Different	No overlap
6	Profitability	-4.54	1.96	Stat Different	No overlap
7	R&D Intensity	-0.54	1.96	Not Stat Different	Overlap

We see that most of the coefficients are statistically different in magnitude and sign as for the Z-test results and the CI overlap. Since the industry benchmark used here excludes all the companies in the sample, we can conclude that spinoffs in the sample will behave differently from those companies that do not spin off.

In brief, Table 20 has revealed some interesting results as all variables from the Rauh and Sufi (2012b) are significant except R&D from Dittmar (2004). The positive relation between ERC and book leverage with leases means that, all other things equal, the greater the correlation, the less diversified the firm is, and the greater the book leverage. In this scenario, managers with less diversified firms as measured by the ERC, should make more use of debt.

B.3 Book leverage with leases and equity return correlation robustness check

In this section, we want to check how well our variable of interest continuous to be significant a period later. The results for the regression models for book leverage with leases and equity return correlation plus the variables of control are shown in Table 23.

Model 3 reveals that one year later after the spinoff event, the relationship between the book leverage with leases and equity return correlation still holds. This means that ERC in model 4 Table 20 has some predicted power over the book leverage measure once we control for the variables in the model.

Table 23: Regression models on market leverage without leases for sample companies for Rauh and Sufi (2012b) core factors plus Dittmar (2004) variables and equity return correlation one year later

	Dependent variable: Book Leverage with Leases		
	Model 1	Model 2	Model 3
Equity Return Correlation			0.116**
			(0.056)
Industry Lev (3-Digit)	0.594***	0.604***	0.589***
	(0.026)	(0.027)	(0.026)
Tangibility	-0.097***	-0.102***	-0.103***
	(0.026)	(0.023)	(0.027)
Market to Book ratio	0.054***	0.056***	0.055***
	(0.013)	(0.013)	(0.012)
Size: ln(Sales)	-0.016***	-0.013**	-0.017***
	(0.006)	(0.005)	(0.007)
Profitability	0.690***	0.698***	0.702***
	(0.075)	(0.075)	(0.074)
Volatility of Asset Returns	-0.068**	-0.068**	-0.076**
	(0.032)	(0.031)	(0.032)
R&D Intensity		1.013***	0.826***
		(0.375)	(0.301)
Constant	0.153***	0.105**	0.105***
	(0.047)	(0.043)	(0.039)
Observations	300	300	300
R^2	0.260	0.263	0.268
Adjusted R^2	0.245	0.245	0.248
Residual Std. Error	0.233 (df = 293)	0.233 (df = 292)	0.233 (df = 291)
F Statistic	17.186*** (df = 6; 293)	14.868*** (df = 7; 292)	13.340*** (df = 8; 291)
Note:			*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

Appendix C Market and book leverage regressions with no significant results for the variables of interest

Two sets of data in our study do not produce any significance for our variables of interest:

- Market leverage without leases and equity return correlation: 368 observations
- Book leverage with leases and asset return correlation: 340 observations

We show these regressions here as a reference only.

C.1 Book leverage with leases and asset return correlation regressions

Table 24 shows the results for the regression models for book leverage with leases, asset return correlation and control variables:

Table 24: Regression models on book leverage with leases for sample companies for Rauh and Sufi (2012b) core factors plus Dittmar (2004) variables and asset return correlation

	Dependent variable: Book Leverage with Leases		
	Model 1	Model 2	Model 3
Asset Return Correlation			0.013
			(0.014)
Industry Lev (3-Digit)	0.576***	0.571***	0.573***
	(0.020)	(0.021)	(0.022)
Tangibility	-0.193***	-0.193***	-0.194***
	(0.029)	(0.029)	(0.030)
Market to Book ratio	0.011	0.010	0.010
	(0.029)	(0.029)	(0.029)
Size: ln(Sales)	-0.016**	-0.017***	-0.017***
	(0.006)	(0.006)	(0.006)
Profitability	0.962***	0.961***	0.958***
	(0.169)	(0.168)	(0.168)
R&D Intensity	0.079	0.080	0.077
	(0.070)	(0.069)	(0.069)
Volatility of Asset Returns		-0.260	-0.261
		(0.173)	(0.170)
Constant	0.215***	0.229***	0.228***
	(0.039)	(0.039)	(0.038)
Observations	340	340	340
R^2	0.309	0.309	0.309
Adjusted R^2	0.296	0.295	0.293
Residual Std. Error	0.240 (df = 333)	0.241 (df = 332)	0.241 (df = 331)
F Statistic	24.801*** (df = 6; 333)	21.242*** (df = 7; 332)	18.543*** (df = 8; 331)
Note:			*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)

C.2 Market leverage without leases and equity return correlation regressions

Table 25 shows the results for the regression models for market leverage without leases, equity return correlation and control variables:

Table 25: Regression models on market leverage without leases for sample companies for Frank and Goyal (2009) core factors plus Dittmar (2004) variables and equity return correlation

	Dependent variable: Market Leverage without Leases		
	Model 1	Model 2	Model 3
Equity Return Correlation			0.029
			(0.023)
Industry Lev (3-Digit)	0.293***	0.289***	0.291***
	(0.069)	(0.069)	(0.070)
Tangibility	0.084**	0.084**	0.080**
	(0.036)	(0.034)	(0.032)
Market to Book ratio	-0.073***	-0.071***	-0.071***
	(0.010)	(0.010)	(0.010)
Profitability	-0.00003	0.016	0.011
	(0.081)	(0.082)	(0.083)
Size: ln(Assets)	0.011***	0.013***	0.012***
	(0.004)	(0.003)	(0.004)
Expected Inflation	-3.292	-3.762	-3.891
	(2.255)	(2.632)	(2.628)
R&D Intensity	-0.018	-0.024	-0.027
	(0.033)	(0.033)	(0.034)
Volatility of Asset Returns		0.985***	0.942***
		(0.168)	(0.147)
Constant	0.320***	0.288**	0.291**
	(0.113)	(0.117)	(0.117)
Observations	368	368	368
R^2	0.247	0.258	0.259
Adjusted R^2	0.232	0.241	0.240
Residual Std. Error	0.199 (df = 360)	0.198 (df = 359)	0.198 (df = 358)
F Statistic	16.858*** (df = 7; 360)	15.577*** (df = 8; 359)	13.868*** (df = 9; 358)
Note:			*p<0.1; **p<0.05; ***p<0.01

Coefficients are estimated via OLS. Time (year) and industry (2-Digit SIC) fixed effects are used in the regressions and robust standard errors are clustered by year and industry using the Clustered Covariance Matrix Estimation for Panel Data function in Zeileis et al. (2021) and the method in Petersen (2009)