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Do financial synergies explain corporate spin-offs?

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DO FINANCIAL SYNERGIES EXPLAIN CORPORATE SPIN-OFFS?

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ABSTRACT

This paper investigates the role of financial synergies as precursors of spin-offs. Our sample includes 106 parent firms that spun-off a subsidiary during the period 1983-2015. The results highlight that negative financial synergies do not have a statistically significant impact on the spin-off likelihood. Correlation among firms, however, significantly influences the choice to spin-off a subsidiary. While the results are insignificant, the trend shows that when present, negative financial synergies can increase the probability of spinning-off a subsidiary up to four percent. Correlation among firms significantly affects the probability: an increase of one quartile can impact the spin-off likelihood up to fifteen percent. In addition, this paper touches upon the relationship between financial synergies and total leverage. Looking at the relation between financial synergies and leverage, parent and target firms with negative financial synergies increased their joint leverage more than parent and target firms with positive financial synergies. Nevertheless, the low number of data points in our sample impacts the statistical significance of this trend. While in this current sample financial synergies seem not to have any material impact, these results are promising for further research.

Keywords: Financial synergies; Spin-off; Restructuring

JEL classifications: G30, G34, G39

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With this final work we can mark the end of our Master of Science at BI - Norwegian Business School. These two years have been a tremendous experience that we will always cherish. We are looking forward to put our knowledge learnt into action. Life is a classroom where more things are awaiting to be discovered and learnt.

Finally, we would like to thank our families for the continuos never-ending support they gave us throughout these two years.

Lars Andreas Haugen & Damiano Maggi

Contents

1. Introduction

Spin-offs are among the most important decisions a management team will ever face. Does remaining merged still provide additional benefits or is being independent better? Synergies and the additional benefits of having two independent firms are among the most used justification for spin-offs, both from researchers and managers. While empirical literature has deeply investigated the role of operational synergies, financial synergies have received less attention. In a Modigliani and Miller world, financial synergies do not exist as capital structure is irrelevant. In the real world, however, capital structure matters and reaching an optimum can create financial synergies. When taxes, bankruptcy costs, informational asymmetries, and agency cost are introduced the resulting financial synergies may influence the scope of a firm. Positive financial synergies favor mergers between two independent firms, while negative financial synergies favor the separation of two merged firms. Hence, when negative financial synergies are present, the firms are better off being separate. In this paper we want to examine whether financial synergies, specifically negative financial synergies, are a precursor of spin-offs as discussed by Leland (2007). According to Leland, financial synergies are a tool to optimize the capital structure and alter the scope of a company (merging vs. separating). As a result, our leading research question is: do financial synergies explain corporate spin-offs?

An interesting topic

If financial synergies influence the decision to alter the scope of the firm, then early recognition of those can provide additional insights in the comprehension of corporate divestitures. While M&A transactions have been deeply researched, the lack of substantial data on spin-offs made the latter less examined. As a result, additional studies on spin-offs can provide further interesting knowledge to the empirical research. Previous research addressed the importance of economies of scale, economies of scope, and the market power, without deeply investigating the role of financial synergies. Leland (2007) hypothesizes the key role of financial synergies in explaining the use of structured finance and corporate spin-offs. The presence of negative financial synergies (for two firms merged together) implies that their

combined current scope and capital structure are not optimal. The separation into two independent companies would result in a higher total value for the two separate firms. As a result, we believe that understanding whether financial synergies are drivers of spin-offs is an interesting and worthwhile topic to be investigated.

When financial synergies are negative and the total net benefits to leverage (defined as the difference between tax savings and default costs) for the two separate firms are higher than the gains from leverage for the merged firm, the two firms should separate and increase their combined leverage. Consequently, this thesis will additionally investigate whether this concept holds in our sample of firms. Understanding the relationship between financial synergies and leverage is an additional interesting topic to be researched.

This study differs from previous empirical works due to the particular sample chosen for the study. The sample of firms includes parent companies that were public before and after the spin-off, as well as target companies that became, or already were, public companies. As a result, we hope that this specific sample of firms and the idea of financial synergies as drivers of spin-off will make this study interesting. While the results show that financial synergies do not have an impact on the spin-off likelihood, the presence of negative financial synergies increases the probability of spin-off a subsidiary. Concluding, this study aims to contributing to the body of research on spin-offs. The remaining uncertainty surrounding the relationship between financial synergies and spin-off likelihood should be addressed by future studies, thus testing the validity of our answers.

Structure of this paper

The rest of this paper is organized as follows: Chapter II will present you a wide background on corporate spin-offs and the empirical work done so far. Chapter III will introduce the main theory relative to financial synergies resulting from an optimal capital structure. Chapter IV will illustrate our empirical design of the study and will discuss in depth the tools required to test our hypotheses. Chapter V will illustrate the data collection process, and summary statistics will be presented. Chapter VI will present the estimation outputs for the two main hypothesis tested in this paper. Chapter VII will discuss the estimation output and provide a rationale for those results. Finally, Chapter VII will present the conclusions and implications for future empirical work.

2. Background and literature review

2.1 What is a spin-off?

A spin-off is one type of corporate divestiture available to the management of a firm. Divesting through a spin-off involves a trade-off between positive and negative consequences which the managers need to carefully ponder. A first, and simple, definition of a spin-off is:

> *A corporate spin-off is the separation of a business unit, or subsidiary, from its parent company.*

A more formal definition of corporate spin-offs is given by the U.S. Securities and Exchange Commission:

> *In a "spin-off," a parent company distributes shares of a subsidiary to the parent company's shareholders so that the subsidiary becomes a separate, independent company. The shares are usually distributed on a pro rata basis.*

A corporate divestiture involves a parent firm disposing of its asset, separating part of its activities from the rest of the firm. Sell-off, Spin-off, and Equity carve-out are different types of corporate restructurings available to the management of the parent company. Spin-offs differ from sell-offs and equity carve-outs for a simple underlying idea. While sell-offs and equity carve-outs generate wealth to the parent firm - e.g. additional cash inflows -, spin-offs do not create additional wealth. As outlined in the definition, the shares of the subsidiary firm are given to the existing shareholders of the parent firm - or partially retained by the parent itself - without raising additional cash. Hence, while not creating additional wealth (e.g. cash inflows) a spin-off remains a technique to enhance firm values for both the subsidiary and the parent company.

2.2 Empirical Research on spin-offs

2.2.1 Spin-offs in the literature

Before introducing the theory relative to financial synergies as a possible driver of spin-offs, this study wants to present the reader an extensive background, and appropriate studies, on the empirical research conducted on spin-offs up-to-date. Empirical studies have been mainly focusing on this set of drivers as precursors of a spin-off of a subsidiary:

- Corporate focus;
- Wealth transfer from bond-holders;
- Reduction of negative synergies;
- Information asymmetries;
- Clientele effects;
- Increased probability of a takeover;

Corporate focus *Spin-offs can create value due to an increased corporate focus after the corporate divestiture of unrelated divisions*. Empirical research investigated whether spin-offs can actually increase the value of the two separate firms. Daley, Mehrotra, and Sivakumar (1997) observed positive returns when the parent company and the spun-off company have different two-digit SIC industry codes (signaling a higher corporate focus). They found substantial improvements for the parents (increased Return On Assets) when the spin-off was driven by focus-increasing actions. Desai and Jain (1999) found that these corporate focus driven spin-offs are associated with, among others, higher announcement-day returns and improved operating performance. Berger and Ofek (1999) analyzed the possible causes of corporate refocusing programs. Three possible explanations to corporate refocusing have been discussed. First, as observed by Subrahmanyam and Titman (1999) as well, refocus programs are triggered by the decrease in benefits of having an internal capital market [see also Ahn and Denis (2004)]. The expansion and increased liquidity in external capital markets, such as stock markets, resulted in a decreased benefit

of having unrelated sources of cash-flows for conglomerate firm. A second explanation involves the change in the competitive and regulatory conditions during the period of 1980s. A third, and final explanation, involves agency conflicts between managers and owners. Refocus by the parent firm is the result of corporate control events that modify the firm's governance. Berger and Ofek (1999) found that refocus programs are driven by reductions in agency conflicts, and that corporate control events often trigger the refocus program. Furthermore, firms that refocused exhibit an average positive CAR around 7.3 %. As a result, firms that refocused were able to reduce agency conflicts and increased firm's value.

Wealth transfer from bond-holders *Spin-offs increase shareholders' wealth while reducing firm's debt-holders by reducing the total assets of a firm*. Galai and Masulis (1976) studied whether an increase in cash flows' volatility leads to a reduced payoff for debt-holders. Empirical results confirm this intuition: an increase in volatility decreases debt-holders' claims and increases the expected value for shareholders. Hence a spin-off can increase the volatility of the firms, reducing debt-holders' claims and increasing the expected payoff for shareholders. MacMinn and Brockett (1995) argued that spin-offs transfer away from debt-holders parts of the parent's assets reducing, as a result, the debt-holders expected payoff. Hence, the separation of activities has an impact on the ability of debt-holders to claim those assets transferred to the spun-off company.

Reduction of negative synergies *Separating two different divisions may create value through the reduction of any existing negative synergies between the parent company and its subsidiary*. Gertner, Powers, and Scharstein (2002) found that the subsidiary's investment decisions became more sensitive after the spin-off was executed. Seoungpil and Denis (2004) documented that, before the spin-off was carried out, parent firms invest less in high-growth divisions and are traded at discount compared to peers. After the spin-off is executed, the parent firm diversification discount is eliminated and investments for the high-growth division have increased.

Information asymmetries *Having too many divisions under the same parent can create information asymmetries between outside investors and inside investors.* The consolidation and aggregation of financial data across divisions increases the in-

formation asymmetries for outside investors. Information asymmetries as a driver for corporate divestiture has been investigated by Krishnaswami and Subramaniam (1999). They found that spin-offs are more common for firms with a higher degree of information asymmetries between the two groups of investors (outsiders vs. insiders). As a result, the mitigation of information asymmetries increases the firm value both for the parent and the subsidiary firm.

Clientele effects *A spin-off creates the possibility for shareholders to only hold the stock of the subsidiary firm instead of the stock of the merged firm*. As some spun-off companies become public, the market gains the ability to only hold the stock of the subsidiary. Before the spin-off, an investor who wants to invest in the subsidiary is forced to acquire and hold the stock of the merged firm. Vijh (1994) analyzing a sample of 113 spin-offs (from 1964 to 1990) found that there was an average excess return of 3.0% (on ex-date) associated with spin-offs. According to Vijh, the return is mainly driven by the possibility for investors to hold the two different stocks (parent stocks and spun-off). Hence, the availability of two separate stocks, which are not combined into one "merged" share any longer, attracts different type of investors.

Increased probability of a takeover *A spin-off creates the possibility for the division to become a target of a takeover*. As parent and subsidiary become two independent companies, outside investors will have the possibility to acquire the subsidiary without the need of negotiating with the management of the parent firm. Cusatis, Miles, and Woolridge (1993) investigated the creation of value steaming from 146 tax-free spin-offs during the period 1965-1988 using parent, target, and combined parent-target stock returns. Their results show that the spin-off is a low-cost method of transferring control of the subsidiary to bidders that will create more value. Hence, spin-offs allowed subsidiaries to become targets for takeovers compared to similar merged firms.

As corporate divestitures increase the value of both the parent firm and the new subsidiary, scholars have tried to quantify the increase in wealth for shareholders from corporate divestitures. A brief overview includes the following articles. Hite and Owers (1983) demonstrated that excess returns exist without explaining the sources of those returns. Vijh (1994) found that there is a 3.00% excess-return ex dates. Schipper and Smith (1983) report a two-day excess-return of 2.84%, while

Miles and Rosenfeld (1983) found an average 3.4% return associated with a corporate spin-offs.

2.2.2 Financial synergies and spin-offs

Leland (2007) hypothesizes that the separation of two merged firms can be driven by financial synergies. If negative financial synergies are present, the additional benefits of having a merged structure vanishes and separating the two activities is more beneficial. As the two companies will be independent, this will allow each firm to have separate optimal capital structures and scopes. In addition, if net benefits to leverage for the separate firms are higher than when the two companies merged, this would result in a greater combined leverage for the two separate firms. This relationship can be expressed as: $LV(A) + LV(B) > LV(AB)$ where LV(A) is the leverage of entity A, LV(B) is the leverage of entity B, and LV(AB) is the leverage of the two entities together. As there are gains from leverage, having two separate optimal capital structures will result in a higher total value for the two independent firms than the total value when the two companies are merged together. While Lewellen (1971) assumes that financial synergies are always *positive* when two firms merge together, Leland's arguments provide a rationale for *negative* financial synergies and their implications in the separations of activities.

3. Theory

3.1 Synergies: basic foundations

Prior to illustrate the theory regarding financial synergies as a spin-off driver, let us give a general definition for a synergy:

> A synergy is the increase in value created by the combined operations of two different firms (i.e. Firm A and Firm B).

We can express this concept in the following formula:

$$V(AB) > V(A) + V(B)$$

Where V(AB) is equal to the value of the two firms combined together, V(A) stands for the value of firm A alone , and V(B) is the value of firm B alone.
As a result, the *synergy* between two firms can be expressed as the following:

$$S = V(AB) - [V(A) + V(B)]$$

The idea should be clear: Two companies are synergistic when their total value when they are merged is greater than the total value when they are two independent companies. Most empirical studies principally focused on the reduction of negative operational synergies, economies of scale, economies of scope, and market power as drivers of spin-offs, few studies investigated the role of financial synergies as precursors of spin-offs. In the literature (see Lewellen (1971)), financial synergies were identified as those synergies that reduce the cost of capital or widen the scope (increasing diversification) of the parent firm. While Lewellen (1971) argues that financial synergies are always positive, Leland (2007), with his model of capital structure, illustrates the possibility of financial synergies being negative. What is more, according to Leland, negative financial synergies may be a determinant for the divestiture of a subsidiary by parent companies.

3.2 Financial synergies and optimal capital structure

In order to express financial synergies, a model for a firm's capital structure is required. During the years, scholars have developed different capital structure theories and discussed their implications. Here in this section we will highlight two main capital structures, both of which we believe are relevant both for our study: Modigliani and Miller (1958) and Leland (2007) capital structure theories.

3.2.1 Modigliani and Miller 1958 capital structure

In 1958, Modigliani and Miller elaborated a model of capital structure which resulted in two of the most important propositions in modern finance. While these two propositions are, nevertheless, still valuable, they are not a good representation of the real world. The reason is that two authors made a series of strong assumptions that do not hold in reality: (i) Frictionless market; (ii) Competitive markets; (iii) Homogeneous information; (iv) No taxes; (v) Firm's cash flows are not dependent on its finance policy. According to the theory, as the capital structure does not influence the firm's value, financial synergies do not exist. However, when taxes and bankruptcy costs are taken into account, capital structure and financial synergies matter. As a result, in order to accommodate these factors a more realistic capital structure model is required such as: Leland (2007).

3.2.2 Leland 2007 capital structure

Leland's 2007 capital structure relies on the two-period models elaborated by DeAngelo and Masulis (1980) and Kale, Noe, and Ramirez (1991). This model distinguishes between two types of cash flows: (i) Activity cash flows; (ii) Corporate cash flows. Activity cash flows are those cash flows resulting from the firm's day-to-day activities. Corporate cash flows are influenced by the boundaries of the firm and, thus, reflect the limited liability of the firm. In this model a more realistic assumption regarding the interest payments is made: interest expenses are tax deductible. Although better and more genuine, this creates an endogeneity problem. On one hand, interest expenses are a function of debt, on the other hand, debt depends on interest expenses. Leland, in his base case scenario, uses numerical techniques to find the optimal debt leverage and debt value, hence resolving this endogeneity .

I. Cash Flows, Taxes and Limited Liability

The following paragraphs rely on the Leland (2007) paper. Consider two periods in a risk-neutral environment *t={0,T}* where T represents the last period in this time span. r_t is defined as the risk-free interest rate for the period *{0, T}*, and X is the future *operational* cash flow at time *t=T*. As noted by Scott (1977) and Sarig (1985), and Leland, the *operational* cash flow might be non-positive. The risk neutral environment where the model applies, implies that X_0, the value of the *operational* cash flow at time *t=0*, can be expressed as:

$$X_0 = \frac{1}{(1+r_T)} \int_{-\infty}^{\infty} X dF(X), \tag{3.1}$$

where F(X) represents the *cumulative* probability distribution of the *operational* cash flow at time t=T. Limited liability permits equityholders to let the firm go bankrupt when cash flows are negative. As a result, the value of a limited-liability firm (pre-tax) is:

$$H_0 = \frac{1}{(1+r_T)} \int_{0}^{\infty} X dF(X), \tag{3.2}$$

while the value (pre-tax) of the limited liability is:

$$L_0 = H_0 - X_0 \tag{3.3}$$

substituting eq. 3.1 and eq. 3.3 we obtain:

$$-\frac{1}{(1+r_T)} \int_{-\infty}^{0} X dF(X) \geq 0. \tag{3.4}$$

Note: $L_0 = 0$ occurs when the probability of non-positive future cash flows is zero.

Now, consider a firm that has no debt and where its equity holders enjoy limited liability. τ represents the tax rate at which the cash flows are taxed. Inserting (1-τ) in eq. 3.2 yields the after-tax value of this firm:

$$\begin{aligned} H_0 &= \frac{1}{(1+r_T)} \int_{0}^{\infty} (1-\tau) X dF(X) \\ &= (1-\tau) H_0. \end{aligned} \tag{3.5}$$

Finally, $T_0(0)$ equals to the amount of taxes (present value) paid by the equity-financed firm.

$$T_0(0) = \tau H_0 \tag{3.6}$$

II. Debt, Tax Shield, and Firm Default

Relying on Merton (1974), Leland (2007) expresses the debt of a firm as a zero-coupon bond issued at $t = 0$ with the principal (*P*) due at time *T*. Following the notation, let $D_0(P)$ represent the *market* value of the firm's debt at time t=0. The interest expense is expressed as

$$I(P) = P - D_0(P). \tag{3.7}$$

Recalling the more realistic assumption made by Leland (interest expenses are tax deductible), taxable income is represented by the difference between operational cash flows and interest payments (X - I(P)). X^{BE} is defined as the zero-tax level of cash flow ("break-even point"). Applying this definition and substituting eq. 3.7 into I(P) yields:

$$X^{BE} = I(P) = P - D_0(P) \tag{3.8}$$

Following the paper, Leland assumes that taxes have a "zero loss offset": No tax refunds are paid when $X < X^{BE}$. The present value of future tax payments of a firm with debt equals to the value of the zero-coupon bond (*P* = Debt principal) is:

$$T_0(P) = \frac{\tau}{(1 + r_t)} \int_{X^{BE}}^{\infty} (X - X^{BE}) dF(X). \tag{3.9}$$

Following Merton (1974) the value of the equity can be seen as a call option with strike price equals to the zero-coupon bond issued by the firm. Note that equity is the residual value after deducting the repayment of the principal and the taxes. It has a lower bound equal to zero and an unlimited upper bound. Therefore, *E* (Equity) can be expressed as:

$$E = Max[X - \tau Max[X - X^{BE}, 0] - P, 0]. \tag{3.10}$$

Let's define default at time *t* as the negative Equity (*E*) for this limited liability firm. Insolvency by the firm occurs when the cash flow generated by operations (X) is less than the cash flow needed to the debt repayment (X^D). As a result, we can

express X^D as:

$$X^D = P + \tau Max[X^D - X^{BE}, 0]. \tag{3.11}$$

Leland (2007) proves by contradiction that $X^D \geq X^{BE}$ - hence: $X^D \leq X^{BE}$ - using this relationship: $X^D = P$. Hence, recalling eq. 3.8, $X^{BE} = P - D_0 < P = X^D$, hence $X^{BE} < X^D$ results in a contradiction. Concluding, X^D has to be greater or equal than X^{BE}. Following eq. 3.11 we have:

$$X^D = P + \tau(X^D - X^{BE}) \tag{3.12}$$

which implies (substituting eq. 3.8)

$$X^D = P + \frac{\tau}{(1-\tau)} D_0. \tag{3.13}$$

Given eq. 3.8 and eq. 3.13, $D_O(P)$ can now be determined. If at time $t = T$ the firm is solvent $(X \geq X^D)$ the debtholders will receive back the principal (*P*). If, on the other hand, $(X \leq X^D)$ the firm is defaulting on its obligations. The discounted value of debt is therefore:

$$D_0(P) = \frac{P\int_{X^D}^{\infty} dF(X) + (1-\delta)\int_0^{X^D} X dF(X) - \tau\int_{X^{BE}}^{X^D}(X - X^{BE})dF(X)}{(1+r_T)} \tag{3.14}$$

It is important to note that in eq. 3.14 X^{BE} and X^D are functions of $D_0(P)$ (see eq. 3.8 and eq. 3.13) The equity value can now be expressed as a call option with strike price equal to the debt level (shareholders will receive a positive cash flow whenever $X \geq X^{BE}$). Thus, when $X^D \geq X^{BE}$, the equity value can be expressed as:

$$E_0(P) = \frac{1}{(1+r_T)}\left(\int_{X^D}^{\infty}(X-P)dF(X) - \tau\int_{X^D}^{\infty}(X - X^{BE})dF(X)\right). \tag{3.15}$$

At $t = 0$, the value of the leveraged firm is equal to the sum of the debt value and the equity value:

$$V_0(P) = D_0(P) + E_0(P) \tag{3.16}$$

where $D_0(P)$ and $E_0(P)$ satisfy their respective equations. The optimal level of debt, which maximizes the firm value, determines the optimal capital structure of the firm.

Gains from leverage

Increasing debt creates gains for an unlevered firm. These additional benefits can be expressed as the difference between the value of the leveraged firm and the original unlevered value ($V_{0L} - V_{0U}$). As a result, gains from leverage - or net benefits to leverage - are the present value of the difference between tax savings (due to interest expenses) and default costs. Therefore, V_{OL} can be expressed as:

$$V_{OL} = V_{0U} + \Theta_0(P) - \Lambda_0(P), \tag{3.17}$$

where Θ represents the tax savings, Λ represents the bankruptcy (default) costs. Θ is the difference between the tax levels of the unlevered firm and levered firm. Therefore,

$$\begin{aligned} \Theta_0(P) &= T_{0U} - T_{0L} \\ &= \tau H_0 - \frac{\tau}{(1+r_T)} \int_{X^{BE}}^{\infty} (X - X^{BE}) dF(X). \end{aligned} \tag{3.18}$$

Using eq. 3.6 and eq. 3.9, the present value of the default costs, $\Lambda_0(P)$, can be expressed as:

$$\Lambda_0(P) = \frac{\delta}{(1+r_T)} \left(\int_0^{X^D} X df(X) \right), \tag{3.19}$$

using eq. 3.13, where δ represents the fraction of cash flows lost because the firm is defaulting. V_{0U} is firm's value when is unlevered, hence the maximization problem turns out to choose the appropriate level debt (P) that optimizes the difference between Θ and Λ. As a result, as long as the tax savings are more than the default costs, leverage will bring additional benefits.

3.2.3 Estimating financial synergies

Financial synergies

Following Leland (2007), a formulation for financial synergies can now be outlined. Now let's suppose the managers needs to decide whether to merge two firms A and B and choose to jointly leverage these two merged firms or keep them separate and independently leverage the two companies. Following Leland (2007), financial synergies resulting from a corporate divestiture or merger - Δ - are the difference between the firm value of the merged firm and the total value of the two separate

firms:

$$\Delta \equiv v_{0M}^{*} - v_{0A}^{*} - v_{0B}^{*}, \tag{3.20}$$

note that $v_{0i}^{*} \equiv v_{0i}(P_i^{*})$, P_i^{*} is the debt that optimizes the firm value ($i = [A, B, M]$). A *positive* Δ implies that the two firms should merge or, if merged, they should keep their merged structure. On the other hand, a *negative* Δ indicates that the two firms should separate to increase their values if they are merged or, if they are already independent, they should not engage in a merger.

The three main components of financial synergies

Δ, recalling eq. 3.17 and eq. 3.20, can be decomposed into its three main components, namely:

- Change in the unlevered firm resulting from the merger: $\Delta V_0 \equiv V_{0M} - V_{0A} - V_{0B}$;
- Change in the tax savings: $\Delta\Theta \equiv \Theta_{0M} - \Theta_{0A} - \Theta_{0B}$;
- Change in default costs: $\Delta\Lambda \equiv \Lambda_{0M} - \Lambda_{0A} - \Lambda_{0B}$.

and this relationship can be expressed as,

$$\Delta = \Delta V_0 + \Delta\Theta - \Delta\Lambda \tag{3.21}$$

Leland (2007) notes that the merger or divestiture can influence ΔV_0 as we will see now. Assuming that the marginal tax rate - τ - is equal for all firms, ΔV_0 can be expressed as (using eq. 3.3 and $X_{0M} = X_{0A} + X_{0B}$),

$$\begin{aligned} \Delta V_0 =& (1-\tau)(H_{0M} - H_{0A} - H_{0B}) \\ =& (1-\tau)\left((X_{0M} - X_{0A} - X_{0B}) + (L_{0M} - L_{0A} - L_{0B})\right) \\ =& (1-\tau)(L_{0M} - L_{0A} - L_{0B}) \end{aligned} \tag{3.22}$$

where *LL* is equal to: $LL \equiv (1 - tax)(L_{0M} - L_{0A} - L_{0B})$. Hence, ΔV_0 - or the LL term - is the difference between the total after-tax value of the limited liability for the merged firm and the the total after-tax value of the two limited liability values for the two separate firms. The LL term is never positive as Scott (1977), Sarig (1985) and Leland (2007) outlined. In addition, the LL effect is strictly less than zero when the expected value of cash flows is less than zero and the correlation between cash

flows of firms is not perfect. Finally, we can rewrite eq. 3.21 using eq. 3.22 and defining ($LE \equiv \Delta\Theta - \Delta\Lambda$):

$$\Delta = LL + LE \tag{3.23}$$

As the *LL effect* is always negative, the final sign of financial synergies depends on the *LE effect*. When the gains from leverage for the two separate firms are higher than when they are merged together, the LE effect is negative. As the LE effect becomes negative the two firm should separate their activities and increase their leverage accordingly.

3.3 Challenges with empirical applications

The model developed by Leland (2007) is mainly based on operational cash flow, resulting in a challenge for the empirical application. Firstly, it is difficult to separate accounting figures (reported in financials databases) and the financial values needed for the empirical application (e.g. operational cash flows and corporate cash flows). Additionally, the number of possible observations is limited, both for company financials as well as cash flows values. This would result in a challenging estimation of the cash flows' volatility and the correlation between firms.

To overcome this problem, and calculate a measure for business risk and correlation between companies activities, this study will employ asset returns volatility and the resulting correlation as a proxy. Asset volatility can be a good proxy of the riskiness of the firm given it includes both the risks faced by bond-holders and shareholders. As noted by Levine and Wu (2016), asset volatility can be estimated using the equity-to-value ratio and the firm's equity volatility (cfr. Welch (2004) and Frank and Goyal (2006)). Firm's asset volatility, which depends on the resulting volatilities of debt and equity, can be decomposed as:

$$\sigma^2 = \left(\frac{E}{D+E}\right)^2 \cdot \sigma_E^2 + \left(\frac{D}{D+E}\right)^2 \cdot \sigma_D^2 + 2 \cdot \frac{E \cdot D}{(D+E)^2} \cdot Cov(E, D) \tag{3.24}$$

where E is the equity values and D are the debt values. Yet, the estimation of σ_D is challenging given the infrequent trading for the company's debt as well as different type of debt (e.g. bonds, bank loans). In this study, the simple unlevering approach is

used, and σ_D will be assumed to be zero (e.g. Correia, Kang, and Richardson (2015)). As a result, the last two terms of the equation above will be equal to zero. As Levin and Wu (2016) note, the estimated relationship between the simple estimate of asset volatility and leverage must be treated with caution. This approach does not take into account the riskiness of debt, hence as leverage increases the bias in the measurement increases, leading to a spurious correlation between asset volatility and leverage. To reduce the high-leverage bias, the estimation of the asset volatility will use the following relationship $\sigma^2 = \frac{E}{E+D} \cdot \sigma_E^2$ where E is the market equity value and D is the sum of short term debt and half of the long term debt. As a result, employing this scaling would reduce the bias associated with high-leverage with our estimation of asset volatility. While other more accurate methods to estimate asset volatility exist, the simple unlevered approach can still provide good results. Correlation is recovered using the methodology outlined by Levine and Wu (2016). The authors define ρ as the correlation between the two firms unobserved asset returns. Levine and Wu (2016), following Merton (1974), recall that the a firm equity value is equal to the value of a call option on the underlying asset value of the firm. Hence, the correlation estimated using equity returns can be a good proxy for the correlation between two firms activities. The reason is that if measured over a short period of time the firm's equity and asset values are perfectly correlated. Correlation is used, and included in our study, as we want to test proposition 4 from Leland (2007). According to this proposition, a merger will be undesirable - and divestiture will be preferred - when two firms have different volatilities and are positively correlated.

Financial synergies are intrinsically difficult to estimate with precision. Leland (2007) does not provide a functional form to estimate the "*LL* effect"(see eq. 3.22). Hence, the lack of a model specification for the LL effect results in a less accurate estimation of financial synergies. To overcome the estimation challenge for financial synergies, this paper will use net benefits to leverage - the LE effect - as proxy. The Net Benefits to Leverage (NBL) are defined as $NBL = TS - DC$, where TS are Tax Savings and DC are the Default Costs. The model estimates from Korteweg (2010) will be used to recover estimates for net benefits to leverage. Finally, this study will assume that parent companies are at their optimal capital structure the year before the spin-off, managers are rational and have perfect foresight, and the correlation matrix is constant.

3.4 Testable Hypotheses

In this study, two hypotheses are being tested. Hypothesis I is our leading question that this paper is trying to answer. On the other hand, hypothesis II touches upon and investigates the relationship between financial synergies and leverage. As a result, this paper will devote more space to answer our leading question, hence hypothesis I. Nevertheless, further studies could better investigate the implications of hypothesis II.

Hypothesis I

Financial synergies (Δ) are a precursor of a spin-off.

This hypothesis tests whether financial synergies have an impact on the decision to spin-off a subsidiary as Leland (2007) discussed. If parent and target firms have negative financial synergies, they should separate to reach their optimal capital structure and scope. The null hypothesis (H_0) is that financial synergies are not precursor of a spin-off.

Hypothesis II

The percentage change in leverage for firms with negative financial synergies and negative LE effect should be greater than the percentage change in leverage for firms with positive financial synergies.

This hypothesis tests whether parent and target firms that have negative financial synergies and a negative LE effect, on average, increase their total pro-forma leverage (i.e. the leverage constructed using consolidated financial items) after the spin-off. If the LE effect is negative then the total gains from leverage for the separate firms are higher than the gains from leverage when the two firms are merged. Hence, we expect to find that parent and target firms with negative financial synergies - with the resulting LE term negative - will have a higher percentage change in total leverage than those parents and targets with positive financial synergies. The null hypothesis (H_0) is that the leverage percentage change for firms with negative financial synergies is lower than the leverage percentage change for firms with positive financial synergies.

4. Empirical design of the study

4.1 Statistical tools

A spin-off is a dichotomous choice (stay merged (0) vs. spin-off (1)) and to understand what could influence this decision a binary outcome model needs to be used. A Ordinary Least Squares estimation could produce fitted values outside the interval [0,1] making those values useless for our analysis. To overcome this problem and answering our leading question, this study will employ a binary outcome regression model. These kind of models (non-linear models) impose the restriction on the outcome of the dependent variable (y) to be $0 \leq y \leq 1$. Logit, probit and log-log models are the three main models that can be used. The main difference among the three models lies in the choice of the underlying distributional functions. The logit model employs the cumulative distribution function of the *logistic* distribution. The probit model employs the *standard normal* cumulative distribution function, while the third model employs the *logarithm* cumulative distribution function. The logit and the probit model are the most suitable to use for this study, given their distributions are symmetric around zero. As the probit model relies on the standard normal cumulative distribution function, we think this model is suitable for this study. The probit and logit coefficients are estimated using a Maximum-Likelihood Estimation technique ($\hat{\beta}$ is obtained by maximizing the log-likelihood function). While probit or logit models are the best choice for this study, the interpretations of the resulting coefficients are not straightforward as in a classic linear regression. The reason is that the increase in probability depends on both the values of the other regressors and the starting value of the regressor currently examined. To solve this hurdle, we will estimate the change in probability resulting from a quartile increase holding all the other regressors at their median. As a result, this would enhance our understanding of the impact - hence the marginal effect - of an independent variable on the spin-off likelihood. Finally, given the equivalence of the two models, the logit model will additionally be used in various robustness checks (see 6.1.1).

The dependent variable for our analysis is the choice that the parent has to spin-off its subsidiary or stay merged:

$$Spin - Off = \begin{cases} 1, & \text{if Parent spin-off the subsidiary} \\ 0, & \text{if Parent does not spin-off the subsidiary.} \end{cases} \tag{4.25}$$

The probability of a spin-off, according to the probit model, is: $\Phi(x'\beta) = \int_{-\infty}^{x'\beta} \phi(z)dz$, where x is the vector containing the independent variables, β contains the estimated coefficients from the probit model and ϕ is the standard normal cumulative distribution. Finally, the methodology employed in this study is similar to the one outlined by Berger and Ofek (1999), where the two authors investigated the causes of refocusing.

In addition to our leading question of this study, we will investigate the average percentage change in leverage - before and after the divestiture - for those firms that have undergone a spin-off. We want to test whether the average percentage change in leverage for firms with negative financial synergies (and a negative LE term) is greater than the average percentage change in leverage when two firms exhibit positive financial synergies. This test can be expressed as:

$$\mathbb{E}[\Delta Leverage|FS < 0] \geq \mathbb{E}[\Delta Leverage|FS \geq 0]$$

As a result, after estimating the proxy values for financial synergy, the average percentage changes in leverage for the two groups (firms with negative vs. firms with positive financial synergies) will be calculated. The percentage change in leverage is defined as the difference between the pro-forma leverage (sum of the debt of the parent and target after the spin-off, scaled by their assets) and the previous leverage of the merged firm (total debt scaled by the total asset). We will specifically test whether firms with total negative financial synergies have increased their total leverage more than firms with positive financial synergies. The statistical tools we will employ are two: A t-test of the average percentage change in leverage, and a two sample t-test. The first test will examine whether the average change in leverage for the two groups of firms (those with negative financial synergies vs. those with positive financial synergies) is statistically significant. The second test will examine whether the average percentage change in leverage is the same across these two groups (H_0: $\mathbb{E}[\Delta Leverage|FS < 0] = \mathbb{E}[\Delta Leverage|FS \geq 0]$).

4.2 Hypothesis I

4.2.1 Baseline specification

We will now present our baseline regression specification. This study will focus on understanding whether the presence of negative financial synergies influences the choice of divesting a subsidiary through a spin-off by the parent company. The baseline regression will use two specifications for financial synergies. The first specification is an indicator for *negative* financial synergies to understand whether the mere presence of negative financial synergies have an impact. This indicator can be seen as a "treatment" administered to parent companies. The second indicator is the estimated values for financial synergies. The baseline regression, when one of the two variables for financial synergies is included, is:

$$SPINOFF_{i,t} = f(LEV_{i,t-1}, ROA_{i,t-1}, LN(TA)_{i,t-1}, CORR_i, \\ CRISIS_{i,t}, GROWTH_{i,t-1}, FS_{i,t-1}) \tag{4.26}$$

where FS stands for the indicator for *negative* financial synergies or the estimated values for financial synergies. Note that the indicator and the estimated values are not simultaneously included in the baseline regression.

4.2.2 Control variables

Table 4.1 shows the expected sign and the rationale to include each control variable used in the first part of this study. The additional independent variables included in this study are leverage, ROA, LN (TA), and sales growth as in Berger and Ofek (1999).

Leverage is constructed as firm i's end-of-year total debt over end-of-year asset value. To test the robustness of the model a second measure of leverage has been defined as firm i's end-of-year total debt net of end-of-year asset value net of cash and short term investments. The first measure of leverage will be referred as Leverage 1 and will be used in the baseline regression. While Leverage 2 refers to the second leverage measure. This variable controls for the amount of debt compared to its asset.

Table 4.1: **Control Variables - Probit Regression**

Variable	Description	Expected Coefficient Sign
Leverage	We expect that parent company will have less incentives to spin-off when they have a high level of leverage. A high leveraged company would prefer a sell-off as a divestiture mechanism raising additional cash to lower leverage.	-
ROA	ROA controls for the profitability of the parent firm. We expect that the more profitable the parent is the less incentives it has to spin-off the subsidiary.	-
LN (TA)	The natural logarithm of end-of-year parent's asset has been used to control the size of the firms. As a result we will expect that larger parent will be less likely to spin-off their subsidiary.	-
Correlation	Correlation controls for the degree of dependence among firms. We expect a higher level of correlation, given different firms' volatility, decreases the benefit of internal diversification and, hence, increases the likelihood of a spin-off.	+
Crisis	If spin-offs are a way to increase the total firms value and to reach the firm's optimal value, rational managers will not spin-off companies during period of crisis.	-
Sales growth	Parent firms that experienced a growth in sales are less likely to spin-off given that they experienced an increase in sales	-
DFS	Negative financial synergies, as Leland (2007) noted should give incentives to parents to spin-off.	+
FS	Negative financial synergies, as Leland (2007) noted, should give incentives to parents to spin-off.	-

ROA, Return on Assets, is constructed as the firm i's end-of-year t-1 EBITD over the end-of-year total assets at t-2, as in Berger and Ofek (1999). An additional specification of ROA, is constructed as the firm i's end-of-year t-1 EBITD over the average of end-of-year total assets at t-1 and t-2. The first measure of ROA will be used in the baseline regression and will be referred as ROA 1. ROA 2 refers to the second ROA measure. ROA is included to control for the profitability of firms.

LN (TA) is constructed as firm i's natural logarithm of the end-of-year total assets. This variable controls for the firm size. This study takes the logarithm value of firm assets to reduce the impact of outliers and currency effects.

Correlation is recovered using 12 months of equity returns both for the parent and the target firm. As Levine and Wu (2016) considered, when returns are calculated over a short time intervals, the correlation between equity returns is a good approximation for the correlation between asset returns (activities). In order to recover overlapping equity returns for both the target and the parent company, a one year after the spin-off estimation window is used. This is due to the impossibility

to observe stock prices for the majority of spun-off companies before the spin-off is executed. It is assumed that the estimated correlation between firms' asset returns after the spin-off is constant. Correlation is included to control for the extent of how companies are related to each other and test proposition 4 from Leland (2007).

Crisis is a dummy variable that takes value equal to one when a the economy is in a downturn. Data on business cycles by NBER has been used to recover periods of economic downturn (defined using the NBER guidelines). This variable controls for potential effects of an economic downturn on the decision to spin-off a subsidiary.

Sales growth is constructed as the annual rate of change in sales from year t-2 to year t-1. This variable controls for the increase in sales and expansion of the parent company's sales.

FS is the proxy for financial synergies, as discussed in chapter 3, recovered using the estimation parameters by Korteweg (2010). The required variables for the model have been constructed following Korteweg. The model estimates net benefits to leverage defined as $TS_i - DC_i$, where TS is Tax Savings and DC is Default Costs. To calculate the LE effect (proxy for our financial synergies) we require: $LE = \Delta TS - \Delta DC$, hence, $LE = (TS_{t-1,M} - (TS_{t-1,A} + TS_{t-1,B}) - (DC_{t-1,M} - (DC_{t-1,A} + DC_{t-1,B})$. Using the available estimation ($NBL_i = TS_i - DC_i$), the LE effect can be rewritten as: $LE = NBL_{t-1,M} - (NBL_{t-1,A} + NBL_{t-1,B})$. This variable controls for financial synergies.

DFS is a dummy variable that takes value one when financial synergies are less than zero. Financial synergies are recovered as described above. DFS is an indicator variable that signals the presence of *negative* financial synergies, and can be seen as a "treatment" administered to parent companies. FS and DFS are not simultaneously included in any of the regressions.

Leverage, ROA, LN (TA), Correlation, FS, and Sales growth are continuous independent variables, while, DFS and Crisis are discrete variables equal to one when the conditions are fulfilled. All the independent regressors are estimated at the year before the spin-off event.

4.3 Hypothesis II

We will now present the empirical design for Hypothesis II. Using the financial data in our possession, we will calculate the total leverage before and after the spin-off for the parent and the target firms. Leverage - in this hypothesis - is defined as the total debt (short term debt plus long term debt) over the assets value. As the two firms are consolidated before the spin-off, no adjustments are required. However, after the spin-off the total leverage will be calculated as the pro-forma leverage of the two combined entities. As we were not able to estimate financial synergies for all the 106 firms in our initial sample, this hypothesis will examine the percentage change in leverage for those 71 firms with estimates for financial synergies. The percentage change in leverage is defined as the ratio of the total leverage after the spin-off over the total leverage prior the spin-off multiplied by 100. After we estimated the change in total leverage, we will separate the firms into two groups. The first group contains those firms with negative financial synergies; the second group contains those firms with positive financial synergies. As a result, the first group contains all firms with negative financial synergies and their estimated changes in leverage. Vice versa, the second group contains all firms with positive financial synergies and their estimated changes in leverage.

As a result, we will test - employing a t-test - whether the average changes in leverage for the two groups are statistically significant (where H_0: $\Delta Leverage$ = 0). The procedure is straightforward: we will firstly test whether the average change in leverage for the first group is statistically significant and then we will proceed with the second group. To understand whether these average changes for the two groups are equal, a two-sample t-test will be used. This specific t-test checks whether the averages for the samples are equal or they are different (H_0: $\mathbb{E}[\Delta Leverage|FS < 0] = \mathbb{E}[\Delta Leverage|FS \geq 0]$).

If this hypothesis is correct, we should observe that firms that have overall negative financial synergies - and the LE term is negative - should increase their combined leverage more than firms with positive proxy values. Finally, if the results of this hypothesis will not be statistically significant it will, nevertheless, shows that a trend could exist and further studies should better investigate this relationship.

5. Data and summary statistics

5.1 Data

The data relative to spin-off events have been obtained from Thomson Reuters SDC Platinum database. The time span chosen covers the period 1983-2015. The database returned approximately 4,396 spin-off events available. In order to obtain reliable and available financial data, the sample has been further refined. The following filters were applied: (i) The parent company is a public firm; (ii) The spun-off firm is a public firm. This further filtering resulted in 420 spin-off events where both the firms were classified as public (SDC code: "P").

The sample, however, contained spin-off events that are not of interest for this study. From the 420 firms we selected those events where the parent company spun-off a business unit, or a subsidiary. We defined a company as subsidiary when the parent firm owns more than 50 % of the voting rights and the two companies are treated on a consolidated base. Our final sample, therefore, contains 106 spin-off events that have occurred between 1983-2015. Spin-offs occurred in 2016 were discarded as all the set of information needed is not available. Table A.1 in the appendix contains the frequency of spin-offs relative to the time period of this study. Table A.2 in the appendix contains all the spin-off companies that have been used in this study. Each spin-off event has been investigated to understand whether it was appropriate for our study. In addition, each parent and target have been checked for any change after the spin-off event (e.g. change of the corporation's name, acquisition of the parent by other companies). Next, companies found on SDC Platinum were matched on Compustat using their corresponding CUSIP, or ISIN, code. This enabled us to collect end-of-year financials data. Missing company financial values have been collected through Datastream. Firms without any data available in Compustat or Datastream have been discarded.

Our study compares the sample of spin-off firms to a sample of control firms that did not divest through a spin-off. In order to ensure a meaningful comparison, and to limit the number of possible control companies, a matched sample is employed. The control companies financials have been obtained through Compustat and Compus-

tat global during the 1983-2015 time span. The pool of control companies include those firms who have similar firm size (expressed as the natural log of assets), operated in the same industry at the time of the spin-off (4-digits SIC codes have been used to match every firm), and have similar leverage measures. This yielded a final sample of 117 control parent and target firms. Target control firms are companies that are the most similar to the spun-off target in our initial sample. The reason to include target control companies is that we needed to create a similar couple of companies as those that divested through a spun-off. Our samples include only parent and target firms that were public - or became public in case of a spun-off company - after the spin-off and were listed on regulated stock exchanges. The reason is that to estimate the correlation measure, equity returns are required. Equity returns have been calculated using the share prices obtained through Datastream.

5.2 Summary statistics

The sample of firms used in this study contains 56 parent companies that spun-off a subsidiary in their same industry (where industry has been defined using the two-digit SIC code). The remaining 50 parent companies have spun-off subsidiaries that were not classified in the same industry after the divestiture by the parent company. In our sample, spin-offs were more frequent during the period 1998-2001 and the period 2005-2008 (see Table A.1). From this initial screening, spin-offs seem to be more common during periods preceding a crisis, when investors are usually optimist as noted by Powers (2001).

Table 5.1 presents the comparative statistics between the “treated” sample (those companies that experienced a spin-off) and its matched counterpart. For most of the variables, treated and control firms are similar without notable differences. With respect to the matching variables (firm size and leverage) the deviations between the treated and control parents are on average within 8%. Parent companies that have spun-off a subsidiary seem to have performed worse in terms of magnitude of operating costs (the natural logarithm is used to remove the effects of wide-ranging values) and return on assets in the year prior the spin-off. The only variable where the two samples seem to differ is in their parent firm’s magnitude of operating costs. Concluding, looking at these comparative statistics, it is reliable to use the matched sample as it has similar values for leverage, size, and profitability with respect to

Table 5.1: **Comparative statistics of treated and control companies**

This table shows the differences between spin-off companies and control companies for variables that have been used for matching firms. ROA cannot be calculated for target companies due to insufficient data for the majority of the spun-off companies. *, **, *** respectively indicates that the difference in means is significant at 10%, 5%, and 1%.

	Parent Firms			Target Firms		
Variable	Spin-off Parent	Control Parent	Difference	Spin-off Target	Control Target	Difference
LN(TA)	8.295	7.671	0.624	6.754	6.700	0.054
Leverage	0.249	0.269	-0.020	0.252	0.265	-0.013
ROA	0.122	0.126	-0.004	-	-	-
LN(Op. Costs)	7.139	6.794	0.346**	5.898	5.852	0.046

our initial sample of 106 parent and target companies.

Table 5.2 shows the summary statistics for parent companies in our samples. Target companies' summary statistics are reported in the appendix (Table A.3). For all the variables in Table 5.2 the gap between the median and mean values, on average, is not excessive. On average, firm size is equal to 7.696 and the leverage ratio equals to 0.27. Operating costs, as noted previously, are higher for "treated" parent firms (7.358 vs. 6.700). In addition, the average correlation between parent and subsidiaries is 0.163. However, when looked separately, treated parent companies have a higher correlation with subsidiaries compared to the control sample. The average value for ROA is around 0.12. When cash is deducted from total debt and total assets the leverage measure decreases on average by 15%. Return on assets is not significantly different when a different specification (see 4.2.2) is used. The ratio between the subsidiary assets and the parent assets is on average around 30%. Financial synergies have been estimated as the difference between the net benefits to leverage for the consolidated firm and the sum of the net benefits to leverage for the two pro-forma separated firms. The average proxy value for the financial synergies is around 0.488. Note that the FS is only a proxy measure and further study should aim to a more accurate estimation of financial synergies. The lack of specific financial data for some companies (e.g. Property, plant, and equipment values, sales turnover) have influenced the ability to calculate net benefits to leverage for all the firms in our initial sample of 106 parent companies. Univariate tests suggest that parent companies that spun-off a subsidiary have higher costs and are more correlated with their target.

Table 5.2: **Summary Statistics Parent Companies**

This table reports the summary statistics for the control variables used in our estimation models. The statistics are computed at the year before the spin-off was effective. The Correlation measure (ρ) is obtained through stock prices and it acts as proxy for asset correlation. Leverage, and ROA measures have been computed as in the control variables exhibit in chapter 4.

Panel A: Summary Statistics for the entire sample of parent companies						
	Obs.	Mean	Std. Deviation	Lower Quartile	Median	Upper Quartile
LN (TA)	223	7.969	2.425	6.485	8.170	9.441
Leverage1	223	0.268	0.186	0.121	0.255	0.394
Leverage2	223	0.229	0.195	0.033	0.211	0.363
Correlation	223	0.163	0.162	0.042	0.142	0.268
ROA1	223	0.122	0.083	0.065	0.108	0.168
ROA2	223	0.109	0.099	0.067	0.104	0.157
LN (Op. Costs)	223	7.017	2.440	5.346	7.343	8.602
Growth	223	0.694	5.131	0.000	0.102	0.266
FS	142	0.488	4.381	-0.008	0.300	0.866
Panel B: Summary Statistics for the parent companies (Spin-off)						
LN (TA)	106	8.295	2.196	7.068	8.504	9.661
Leverage1	106	0.249	0.172	0.108	0.247	0.351
Leverage2	106	0.207	0.184	0.002	0.191	0.336
Correlation	106	0.216	0.164	0.095	0.197	0.315
ROA1	106	0.122	0.078	0.065	0.116	0.164
ROA2	106	0.113	0.097	0.060	0.107	0.152
Growth	106	0.452	1.022	0.011	0.123	0.836
LN (Op. Costs)	106	7.358	2.225	6.069	7.689	8.776
FS	71	0.384	3.112	-0.026	0.299	0.905
Panel C: Summary Statistics for the parent companies (Controls)						
LN (TA)	117	7.671	2.590	5.812	7.729	9.106
Leverage1	117	0.269	0.187	0.142	0.259	0.392
Leverage2	117	0.232	0.193	0.061	0.209	0.354
Correlation	117	0.116	0.145	0.014	0.081	0.199
ROA1	117	0.126	0.088	0.068	0.114	0.172
ROA2	117	0.112	0.103	0.064	0.110	0.167
Growth	117	1.000	7.358	0.000	0.086	0.244
LN (Op. Costs)	117	6.700	2.597	4.872	7.109	8.470
FS	71	0.342	7.133	-0.006	0.299	0.842

In order to understand how these variables interact and determine the choice of a parent company to spin-off a subsidiary, a multivariate analysis is required. Given the lack of data useful to estimate financial synergies for specific companies our baseline regression will be estimated using two samples: the matched sample and the full sample. The matched sample contains all the treated and control parent companies that we have been able to estimate proxy values for financial synergies. The full sample includes all the 106 parent and target companies with relative controls. The full sample serves as a sensitivity analysis. Comparing the estimated coefficients for independent variables in the two samples, with relative change in probability, enhance the understanding how the economic significance of a specific independent variable varies. The correlation matrix between the independent variables used in our baseline regression (see Chapter 4, eq. 4.26) is estimated (Table 5.3). As in a regular linear regression, non-linear models such as probit and logit can produce biased results when multicollinearity is present. Table 5.3 shows that multicollinearity seems not to be a concern in any of the sample used (matched vs. full sample) or when different variables for financial synergies are used.

Table 5.3: **Correlation Matrix - Baseline Regression**

This table reports the correlation among the regressors in the baseline specification.

Panel A: Matched sample using the indicator for *negative* financial synergies							
	Leverage	ROA	Correlation	DFS	LN (TA)	Sales Growth	Crisis
Leverage	1.0000						
ROA	0.1395	1.0000					
Correlation	-0.0305	0.1479	1.0000				
DFS	0.0534	0.0413	0.1559	1.0000			
LN (TA)	0.2580	0.1822	0.3347	0.0101	1.0000		
Growth	0.0765	-0.1291	0.0547	0.1523	-0.1756	1.000	
Crisis	-0.0946	0.0646	0.0945	-0.1178	0.0744	-0.0772	1.0000
Panel B: Matched sample using the estimated values for financial synergies							
	Leverage	ROA	Correlation	FS	LN (TA)	Sales Growth	Crisis
Leverage	1.0000						
ROA	0.1675	1.0000					
Correlation	-0.0342	0.1110	1.0000				
FS	-0.0881	-0.1708	-0.1224	1.0000			
LN (TA)	0.2371	0.1625	0.2979	-0.0483	1.0000		
Growth	0.0814	-0.1616	0.0510	-0.0432	-0.1903	1.000	
Crisis	-0.1449	0.1022	0.0743	-0.0793	0.0362	-0.0737	1.0000
	Panel C: Full sample						
	Leverage	ROA	Correlation	LN (TA)	Sales growth	Crisis	
Leverage	1.0000						
ROA	0.1054	1.0000					
Correlation	-0.1143	0.0715	1.0000				
LN (TA)	-0.0006	-0.0064	0.3732	1.0000			
Sales growth	0.0428	-0.0756	0.0478	-0.1251	1.0000		
Crisis	-0.0920	0.0846	0.0517	0.0483	-0.0401	1.0000	

6. Results

6.1 Hypothesis I - Estimation output

Financial synergies are not significant precursors of spin-offs as Table 6.1 and Table 6.2 highlight. This result is robust across the two different specification for financial synergies, the indicator for negative financial synergies and the estimated continuous values. The additional regressors included, with the exception of the correlation measure, are not statistically significant precursors of a spin-off. Correlation between the two companies is the only significant result at a the .01 level as the results show. In addition to the reported coefficient estimates, Table 6.1 and Table 6.2 report the economic importance of the regressors in the spin-off decision. The economic significance is calculated as the increase in probability of the spin-off for a change of one quartile - or from 0 to 1 in case of a dummy variable - for each continuous independent variable holding all the regressors at their median values. As a sensitivity test of the matched sample we present the coefficient estimates that use the full sample of 106 “treated” firms with relative controls. The independent variables in panel B of Table 6.1 exclude the two specifications of financial synergies as we were not able to estimate proxy values for all the firms present in our full sample. In addition, using the full sample to estimate our baseline model would test the effects of the variables used to match firms on the likelihood of spin-off. After the baseline regression is estimated, variance inflated factors are determined to check whether multicollinearity is present in any of the regression (Tables A.4 - A.6). The results show that multicollinearity is not a serious concern for our estimates. Finally, the variance-covariance matrix is reported in Table A.7 in the appendix. To understand whether our baseline regression is overall significant the model p-values are reported. Looking at p-values we can reject the null hypothesis and conclude that the models are overall significant. Looking at the change in probability, the economic significance of financial synergies depends on how the variable is specified (4% vs. 1%). Among all regressors, correlation has the highest significant impact - on average 15% - on the spin-off likelihood. These first results show that financial synergies are not significant precursor of spin-offs while correlation among firm has

Table 6.1: **Baseline regression estimation output I**

This table reports the output of the probit model. Panel A contains all the spin-off parents with relative controls. DFS refers to the indicator for *negative* financial synergies. The total number of treated firms is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. Panel B contains the full sample of treated parents (spin-off) and control companies. Financial synergies variables are omitted to enable the estimation of the full sample. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. When all the covariates are at their median values, the probabilities of a spin-off are 45.358 % for the matched sample and 41.625 % for the full sample. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
	Panel A: Matched Sample		**Panel B: Full Sample**	
Leverage	-0.444 (-0.570)	1.971%	-0.399 (-0.810)	2.137%
ROA	-2.272 (-1.550)	4.873%	-0.444 (-0.410)	0.840%
Correlation	3.249*** (4.030)	15.422 %	2.603*** (4.31)	12.908 %
DFS	0.112 (0.440)	4.389 %	- -	-
LN (TA)	0.064 (1.000)	3.479 %	-0.010 (-0.260)	0.819 %
Sales growth	-0.051 (-0.470)	0.224 %	-0.065 (-0.680)	0.264 %
Crisis	-0.247 (-1.070)	-9.829 %	-0.134 (-0.740)	-5.286 %
Constant	-0.656 (-1.260)		-0.208 (-0.570)	
N (Spin-off)	71		N (Spin-off)	106
N (Control)	71		N (Control)	109
Model p-value	0.0007		Model p-value	0.0004
Pseudo R^2	0.139		Pseudo R^2	0.082

a significant impact on the spin-off likelihood in this specific sample.

6.1.1 Robustness checks

To check whether the previous results are sensible to the variables included or the model chosen, our model is estimated according to new criteria. In the first robustness check we estimate the baseline regressions using a logit model to investigate whether the change in probability and the significance of the results are robust using a different underlying distribution for the dependent variable. The second robustness check employes a leverage measure which deducts cash and short term investments. The third check includes asset volatility and investigates whether it influences the previous estimates. Finally, to rule out any model-specific results, all the robustness checks report the coefficient estimates resulting from a probit and logit model.

Table 6.2: **Baseline regression estimation output II**

This table reports the output of the probit model. The total number of treated firms is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. FS is the independent variable associated with the estimated continuous values for financial synergies. The full sample is omitted and is only reported in Table 6.1. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. When all the covariates are at their median values, the probability of a spin-off is 44.139 %. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

Variable	Coefficient estimate	Change in probability
Leverage	-0.540 (-0.670)	2.471 %
ROA	-2.743 (-1.450)	5.520 %
Correlation	2.792*** (3.540)	13.725 %
FS	-0.122 (-1.280)	1.027 %
LN (TA)	0.044 (0.670)	2.404 %
Sales growth	-0.083 (-0.650)	0.366 %
Crisis	-0.184 (-0.790)	-7.332 %
Constant	-0.311 (-0.550)	-
N (Spin-off)	71	
N (Control)	71	
Model p-value	0.0012	
Pseudo R^2	0.125	

From all the estimation outputs, it can be observed that the coefficient for the correlation measure is, on average, around 3 for the probit model and 5 for the logit model. Correlation among firms remains significant at the .01 level throughout all the robustness checks and have approximately the same economic significance. Nevertheless, the two independent variable specifications for financial synergies remain insignificant throughout all the estimation outputs. Despite the insignificance of the results (possibly driven by the low number of data points), when negative financial synergies are present the parent has a higher probability to spin-off the subsidiary as the theory would predict. Finally, the remaining independent variables stay insignificant throughout all the robustness checks. Chapter 7 will interpret and further discuss the results for hypothesis I.

Table 6.3: **Estimation Output - Hypothesis II**

This table reports the output test of means for hypothesis II. The percentage change in debt is defined as the difference between the pro-forma leverage (sum of the debt of the parent and target after the spin-off, scaled by their assets) and the previous leverage of the merged firm (total debt scaled by the total asset). The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

FS	Average Debt Change	Median Debt Change
Negative FS	5.840%	5.137%
	(0.680)	
Positive FS	0.463%	0.573 %
	(0.080)	
N (Spin-off)	71	

6.2 Hypothesis II - Estimation output

When a merged firm exhibits negative financial synergies (with total net benefits to leverage for the separate companies higher than those of the merged firm), the parent company has more incentives to change its current capital structure and spin off the subsidiary. This separation of activities would allow firms to increase their combined leverage. Looking at table 6.3 it can be seen that for those parent companies that exhibited a negative proxy value related to financial synergies the average percentage change in leverage is around 5.84%. On the other hand, the percentage change in leverage for firms with positive proxy value for financial synergies is approximately zero. From these results, it seems that when negative proxy values for financial synergies are present, parent and subsidiary firms increased their combined leverage more than firms with positive proxy values. Despite the statistical insignificance of the results, it could be noted that a positive trend between negative financial synergies and change in leverage exists. To test whether the average percentage change in leverage is the same for the two groups, a two sample t-test is performed. The t-test value is around 0.509 with a corresponding p-value of 0.613. As a result, we cannot reject the null hypothesis that the two sample averages are different (H_0: $\mathbb{E}[\Delta Leverage_{FS^-}] = \mathbb{E}[\Delta Leverage_{FS^+}]$). The insignificant results may be driven, once more, by the low number of observations (71 in total) and the high variability of the data in our sample. While statistically insignificant, these estimates confirm the idea that after the spin-off companies with negative proxy values for financial synergies increase their aggregate leverage more than firms with positive proxy values. Chapter 7 will interpret and further discuss these results.

7. Interpretation and discussion

Hypothesis I

The estimation outputs of the baseline regression, and additional robust tests, show that financial synergies are not precursors of spin-offs in this specific sample. In spite of these results, it can be observed that a prime candidate as determinant for spin-offs is the degree of how firms are correlated. Finally, additional independent variables are not significant precursors of spin-offs in this study sample.

Financial synergies seem not to have any significant impact on corporate decisions to spin-off a subsidiary. On the other hand, the baseline regressions - with subsequent robustness checks - show that when negative financial synergies are present they can increase the probability of a firm to spin-off a subsidiary. Negative financial synergies implies firms having incentives to separate their activities in order to reach a higher total firm value. If firms are better off separate, with different optimal capital structures, then the spin-off has to be a value enhancing technique of divestitures. The economic significance of negative financial synergies varies between 1% and 4% depending on the specification of the variable. Despite the statistical insignificance, a positive relation between negative financial synergies and the spin-off likelihood seems to exist. The statistical insignificance of these results may have been influenced by a number of factors. For one, financial synergies are not observable for us: the lack of a function for the LL effect limits the correct estimation of financial synergies. Another factor is the proxy chosen: net benefits to leverage. The estimated values have been calculated using the parameters from Korteweg (2010) which may impact the results. Future research could investigate whether these results hold with different proxies. Finally, the low number of data points increase the sample standard error, hence impacting the true economic significance of financial synergies. In spite of the lack of significance, this study's first results are encouraging regarding negative financial synergies as a driver of corporate divestiture. The positive sign associated with the indicator for *negative* financial synergies, and vice versa, the negative coefficient associated with financial synergies (in their continuous value) are promising for further empirical research.

The robust result from this study is the overall significance of correlation among

firms. In the finance literature, studies focused whether having uncorrelated lines of businesses creates additional benefits for the parent company. Hann, Ogneva, and Ozbas (2013) shows that firms with less correlated lines of business have a lower cost of capital, in accordance with a coinsurance effect among firms. Leland (2007) discusses how a merger will be undesirable when firms have different volatilities and high correlation. As a result, it should be observed that firms that exhibit a high correlation among their activities, or asset returns, have lower incentives to stay together, or even merge. Looking at the estimation output, it can be observed that as the correlation increases, and the two firms have different volatilities, the probability of spin-off increases. The economic significance of correlation varies between 12% and 16% across estimation outputs. This result is consistent with the view of spin-offs as a value-enhancing mechanism from the parent company. Parent firms would privilege having less correlated line of businesses as it would decrease the overall firm riskiness. Thus, when parent and target companies are positively correlated the probability of a spin-off increases as the parent firm could remove the positive covariance - and additional volatility - between the two activities. Figure A.1 in the appendix plots the correlation measure against the predicted probability of a spin-off. As it can be seen, as correlation increases, the probability of a spin-off increases likewise.

If a firm is profitable it shall have less incentives to modify its current capital and organizational structure. To narrow its scope, and hence increase its value and profitability, a parent firm may decide to spin-off a subsidiary. While ROA and sales growth do not have any statistically significant impact on the spin-off likelihood, the economic significance of their coefficients signs is unchanged. If a firm is profitable and experienced a high growth in its sales, it is less likely to spin-off a subsidiary, hence maintaining its current structure. Compared with the matched sample, the lower impact of ROA in the full sample indicates that profitability is a less important factor in the spin-off decision in the full sample.

Leverage and the likelihood of a spin-off have a negative relationship as highlighted by the negative sign of the leverage coefficient. Lang, Poulsen, and Stultz (1995) and Powers (2001) show that sell-offs are preferred when parent firms have high leverage, and are more financially constrained. Hence, a high leverage may reduce the probability to choose a spin-off as divestiture mechanism compared to other techniques where the parent firm can raise additional capital. A firm that is

highly leveraged would prefer a sell-off rather than a spin-off to reduce its financial constraints and alleviate the total leverage. As a result, the negative sign associated with leverage does not mean that the company may not divest, it denotes that spin-off may not be the most effect way. As a result, this negative relationship may be due to the inappropriateness of a spin-off as a divestiture technique when leverage is high.

Firm's size is a less important factor for the full sample compared to the matched sample. Its economic significance varies between 0.2% and 3% accordingly to the sample used. The inclusion of asset volatility does not bring additional benefits as it is statistically insignificant. However, as the coefficient sign shows, the relationship between the spin-off likelihood and volatility is positive. As noted in chapter 3, the measure of asset volatility employed in this study needs to be treated with caution given that the riskiness of debt is not included (see 3.3.2). Future empirical research should study the effects of firm size and volatility with a more accurate estimate for asset volatility. Hence, a parent firm that is more correlated to the subsidiary, has a high volatility, and exhibits negative financial synergies, has a higher probability to spin-off a subsidiary.

Parent companies are less likely to spin off a subsidiary when the economic outlook is not favorable and investors are pessimistic. The coefficient associated with crisis remains negative and insignificant in all sample specifications and robustness checks. While not significant, the underlying idea of this negative relationship is clear: an economic downturn negatively affect the spin-off likelihood. Empirical evidence (cfr. Prezas and Simonyan (2015), Powers (2001)) shows that spin-offs are more likely in period of investors optimisms. Nevertheless, divesting through spin-offs in period of optimism would benefit the parent firm shareholders. As shareholders of parent firms - on average - experience gains associated with spin-offs, managers would have less incentives to spin off a subsidiary firm in a downturn market.

The estimation output results from the baseline regressions, and subsequent robustness checks, highlight that a parent company decides to spin-off its subsidiary in an effort to enhance the values of two positively correlated firms. While negative financial synergies seem not to have a statistical impact on the decision to spin off a subsidiary, the results obtained are promising. Among all regressors, correlation has the highest impact on the probability of a spin-off. All the remaining indepen-

dent variables have a moderate impact on the probability to spin off a subsidiary. However, they remain not statistically significant throughout all the regression specifications. Concluding, the results show that when negative financial synergies are present, the higher the positive correlation among firms, and the lower their profitability, the more likely a spin-off is to happen. Finally, as the spin-off is a mechanism to enhance the value of the two firms, this type of divestiture will happen in periods of investor optimism.

Hypothesis II

The results of hypothesis II show that - on average - after the spin-off, firms with negative proxy values for financial synergies have increased their leverage more than firms with positive financial synergies. The percentage change in leverage for firms with negative financial synergies is, on average, 5.56 %. On the other hand, the percentage change in leverage for firms with positive financial synergies is around 0.49%. As a sensitivity analysis, median values could provide additional insights (Table 6.3). Both median values for the two groups are similar to their average values. Hence, it can be concluded that firms with overall negative values for financial synergies have increased their total leverage more than firms with positive values. If two firms exhibit total negative financial synergies - and the LE term is negative - both firms would try to capitalize them increasing their total debt. The results from the estimation outputs confirm this intuition. Firms that would benefit from having two separate capital structures with higher leverage have on average increased their total leverage. On the other hand, firms have not substantially changed their aggregate leverage when their financial synergies proxy measure was positive. Hence, this minimal change confirms the idea that the total leverage for firms with positive financial was already adequate prior to the spin-off. As Table 6.3 shows, the results are not statistically significant. The low value for the t-test may be driven by the standard errors. The high variability across the few data points (71 firms) would increase the standard error in our sample, hence impacting our t-test. Despite the statistical insignificance, the early results from this study seems to confirm that on average firms that have negative value relative to financial synergies - with higher net benefits to leverage for the separate firms - increased their aggregate leverage after the spin-off. Future research should aim to investigate whether these results hold and check their significance.

8. Conclusions and further research

This paper attempted to understand whether financial synergies may be a precursor for spin-offs. In this sample, negative financial synergies, calculated using net benefits to leverage as proxy, seem not to have a significant statistical impact on the decision of divest a subsidiary through a spin-off. This result is robust using two different independent variables: an indicator for *negative* financial synergies and the estimated values. The presence of negative financial synergies, while statistically insignificant, has a moderate economic significance on the spin-off likelihood. Despite the results being statistically insignificant, they show that a positive relationship between negative financial synergies and the spin-off likelihood exists. The estimation outputs show that, when negative financial synergies are present, the probability to spin off a subsidiary is higher. Correlation among firms, expressed as correlation among asset returns, has a relevant impact on the odds to spin off a subsidiary. This result is robust across all model specifications (probit vs. logit), samples (matched vs. full sample), and robust to variable specifications (e.g. different leverage measure, inclusion of volatility, and different specifications regarding financial synergies). The more correlated the firms are, the more likely the subsidiary will be spun off by the parent company. The estimation outputs from this study hint to spin-offs as a value enhancing mechanism adopted by the parent firm. If parent firms have experienced low growth, exhibit negative financial synergies, are less profitable, and have a subsidiary that is highly positively correlated, to boost the value of the firm, parent firms may spin off their subsidiaries. In addition, leverage decreases the probability of a spin-off, as other types of corporate divestiture are preferable (sell-off, equity carve-out both involve cash inflows to the parent firm that can be used to reduce the leverage). Spin-offs are negatively impacted by economic downturns, as the probability to spin off a subsidiary is reduced in periods of crisis and recession. Parent firms will be more likely to spin off their subsidiary in periods of investor optimism. This result is consistent with the current empirical literature.

The estimation results from this paper are encouraging for future research. However, this study has important limitations. Firstly, employing a proxy for financial synergies and not the actual values may impact the significance of the results. The estimated proxy values used in this study have been calculated using the model estimates by Korteweg (2010). Different estimates, and different models, may result in different proxy values for financial synergies, hence affecting this study. Furthermore, the lack of a functional form for the LL effect creates an additional limitation for this study. Future research should design a functional form for the LL effect thus resulting in a more accurate estimation of financial synergies. Different sample selections may result in different outcomes. This study employs a sample of both public parent and target companies, limiting the number of possible parent companies that can be included. Besides, the low number of firms with available data useful to calculate financial synergies limit the sample, and thus, the extent of this research. Future research should select a different sample of "treated" parent and target companies. Nevertheless, for example, future research may employ a different selection process for the control companies (e.g. conglomerate firms that did not spin-off subsidiaries).

While this study has several limitations, the results are promising for further research. Upcoming empirical research should focus on a more accurate calculation of financial synergies and investigate the role of correlation (e.g. using different specifications for correlation), on the choice to spin-off a subsidiary. Further studies should also include a better measure for asset volatility and ought to better investigate the role of asset volatility in the spin-off decision. As spin-offs are not as frequent as mergers and acquisitions, potential future events will enrich the sample of public parent and target firms. To conclude, corporate divestitures, and specifically spin-offs, remain an interesting research topic worth to be investigated in the future to enable a deeper understanding of these events.

9. Bibliography

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Appendix

Table A.1: **Sample frequencies by Spin off Year**

Fiscal Year	Number of firms	Frequency	Fiscal Year	Number of firms	Frequency
1983	1	0,009	2000	13	0,123
1984	1	0,009	2001	10	0,094
1985	1	0,009	2002	2	0,019
1987	4	0.038	2003	2	0,019
1988	3	0,028	2004	2	0,019
1989	2	0,019	2005	4	0,038
1990	6	0,057	2006	4	0,038
1991	3	0,028	2007	4	0,038
1992	2	0,019	2008	4	0,038
1993	3	0,028	2009	3	0,028
1994	2	0,019	2010	1	0,009
1995	3	0,028	2011	3	0,028
1996	4	0,038	2013	3	0,028
1997	1	0,009	2014	2	0,019
1998	9	0,085	2015	1	0,009
1999	3	0,028			
			Total	106	1.00

Table A.2: **Spinoff Sample**

This table contains the sample of firms, parents and targets, that have undergone a spin-off during the period 1983 - 2015.

Fiscal Year	Company Name	Parent/Target	Fiscal Year	Company Name	Parent/Target	Fiscal Year	Company Name	Parent/Target
1983	DART GROUP CORP	P	1998	OMEGA HEALTHCARE INVS INC	P	2003	NEIGHBORCARE INC	P
1983	TRAK AUTO CORP	T	1998	OMEGA WORLDWIDE INC	T	2003	GENESIS HEALTHCARE CORP	T
1984	BAIRNCO CORP	P	1998	ITT CORP	P	2004	E-Z-EM INC	P
1984	KAYDON CORP	T	1998	ITT EDUCATIONAL SERVICES INC	T	2004	ANGIODYNAMICS INC	T
1985	SAFEGUARD SCIENTIFICS INC	P	1998	GREAT LAKES CHEMICAL CORP	P	2004	E-Z-EM INC	P
1985	NOVELL INC	T	1998	INNOSPEC INC	T	2004	DX SERVICES PLC	T
1987	STAAR SURGICAL CO	P	1998	BIOCHEM PHARMA INC	P	2005	RESOURCE AMERICA INC	P
1987	VISION SCIENCES INC	T	1998	CLINICHEM DEVELOPMENT INC	T	2005	ATLAS ENERGY GROUP LLC	T
1987	JARDINE MATHESON HOLDINGS	P	1998	COCA-COLA AMATIL LTD	P	2005	INVESTMENTS AB KINNEVIK	P
1987	MANDARINE ORIENTAL INTL LTD	T	1998	COCA-COLA BEVERAGES PLC	T	2005	INVIK AB	T
1987	JARDINE MATHESON HOLDINGS	P	1998	GOLD FIELDS SO AFRICA	P	2005	GP STRATEGIES CORP	P
1987	JARDINE STRATEGIC HOLDINGS	T	1998	GOLD FIELDS LTD	T	2005	GSE SYSTEMS INC	T
1987	GULF CANADA CORP	P	1998	HILTON WORLDWIDE HOLDINGS	P	2005	BWT GROUP	P
1987	ABITIBI CONSOLIDATED INC	T	1998	CAESARS ENTERTAINMENT INC	T	2005	CHRIST WATER TECHNOLOGY AG	T
1988	DUCOMMUN INC	P	1999	RODAMCO EUROPE NV	P	2006	SPRINT CORP	P
1988	ARROW ELECTRONICS INC	T	1999	RODAMCO NORTH AMERICA NV	T	2006	EMBARQ CORP	T
1988	BURLINGTON NORTHERN SANTA FE	P	2000	ASHLAND GLOBAL HOLDINGS INC	P	2006	ELECTROLUX AB	P
1988	BURLINGTON RESOURCES INC	T	2000	ARCH COAL INC	T	2006	HUSQVARNA AB	T
1988	HENLEY GROUP INC/DEL	P	2000	BCE INC	P	2006	GURIT HOLDING AG	P
1988	WHEELABRATOR TECHNOLOGIES	T	2000	NORTEL NETWORKS CORP	T	2006	COLTENE HOLDING AG	T
1989	EVERSOURCE ENERGY	P	2000	HP INC	P	2006	WENDY'S INTERNATIONAL INC	P
1989	YANKEE ENERGY SYSTEMS INC	T	2000	AGILENT TECHNOLOGIES INC	T	2006	TIM HORTONS INC	T
1989	SMITHKLINE BECKMAN CORP	P	2000	SILICON GRAPHICS INC	P	2007	ACACIA RESEARCH CORP	P
1989	BECKMAN COULTER INC	T	2000	MIPS TECHNOLOGIES INC	T	2007	COMBIMATRIX CORP	T
1990	MIM HOLDINGS LTD	P	2000	ORCKIT COMMUNICATI	P	2007	FIRSTRAND LTD	P
1990	HIGHLANDS GOLD	T	2000	TIOGA TECHNOLOGIES LTD	T	2007	DISCOVERY LTD	T
1990	PROSPECT GROUP INC	P	2000	FORD MOTOR CO	P	2007	SILVERLINE TECHNOLOGIES LTD	P
1990	SWISS ARMY BRANDS INC	T	2000	VISTEON CORP	T	2007	NEXTGEN ANIMATION MEDIA LTD	T
1990	COMMUNICATIONS SYSTEMS INC	P	1999	DAISYTEK INTL CORP	P	2007	SYNOVUS FINANCIAL CORP	P
1990	HECTOR COMMUNICATIONS CORP	T	2000	PFSWEB INC	T	2007	TOTAL SYSTEM SERVICES INC	T
1990	HONEYWELL INTERNATIONAL INC	P	1999	3COM CORP	P	2008	APPLERA CORP-CONSOLIDATED	P
1990	ORBITAL ATK INC	T	1999	PALM INC	T	2008	CELERA CORP	T
1990	SANTA FE PACIFIC CORP	P	2000	CABOT CORP	P	2008	IAC/INTERACTIVECORP	P
1990	SANTA FE SNYDER CORP	T	2000	CABOT MICROELECTRONICS CORP	T	2008	ILG INC	T
1990	SANTA FE PACIFIC CORP	P	2000	HNC SOFTWARE INC	P	2008	CYPRESS SEMICONDUCTOR CORP	P
1990	CATELLUS DEVELOPMENT CORP	T	2000	RETEK INC	T	2008	SUNPOWER CORP	T
1991	RACAL ELECTRONICS PLC	P	2000	ST JOE CO	P	2009	TIME WARNER INC	P
1990	VODAFONE GROUP PLC	T	2000	FLORIDA EAST COAST INDS	T	2009	TIME WARNER CABLE INC	T
1991	OCCIDENTAL PETROLEUM CORP	P	2000	ATEA ASA	P	2009	HARRIS CORP	P
1991	IBP INC	T	2000	HANDS ASA	T	2009	AVIAT NETWORKS INC	T
1991	NATIONAL HEALTHCARE CORP	P	2000	MASSEY ENERGY CO	P	2009	PRIDE INTERNATIONAL INC	P
1991	NATIONAL HEALTH INVESTORS	T	2000	FLUOR CORP	T	2009	SEAHAWK DRILLING INC	T
1993	PAN OCEAN ENERGY CORPORATION	P	2000	EATON CORP PLC	P	2008	SINGAPORE AIRLINES LTD	P
1993	LYNX ENERGY SERVICES INC	T	2000	AXCELIS TECHNOLOGIES INC	T	2008	SATS LTD	T
1993	DEAN WITTER DISCOVER & CO	P	2000	DELUXE CORP	P	2010	PIRELLI & CO	P
1993	SEARS ROEBUCK & CO	T	2000	EFUNDS CORP	T	2010	PRELIOS SPA	T
1993	FLETCHER CHALLENGE LTD	P	2001	TELMEX-TELEFONOS DE MEXICO	P	2011	EASTERN GOLDFIELDS INC	P
1993	FLETCHER FORESTRY (TENON LTD)	T	2001	AMERICA MOVIL SA DE CV	T	2011	VANTAGE GOLDFIELDS LTD	T
1994	GENCOR	P	2001	TENON LTD	P	2011	SEADRILL LTD	P
1994	ENGEN LTD	T	2001	FLETCHER BUILDING LTD	T	2011	NORTH ATLANTIC DRILLING LTD	T
1994	ALPINE GROUP INC	P	2001	SOUTHERN CO	P	2011	FOREST OIL CORP	P
1995	POLYVISION CORP	T	2001	GENON ENERGY INC	T	2011	LONE PINE RESOURCES INC	T
1995	SEARS ROEBUCK & CO	P	2001	TIGER BRANDS LTD	P	2011	SEARS HOLDINGS CORP	P
1995	ALLSTATE CORP	T	2001	ASTRAL FOODS LTD	T	2011	SEARS CANADA INC	T
1995	U S WEST INC	P	2001	THERMO FISHER SCIENTIFIC INC	P	2013	DEAN FOODS CO	P
1995	MEDIAONE GROUP INC	T	2001	KADANT INC	T	2013	WHITEWAVE FOODS CO	T
1995	DOLE FOOD CO INC	P	2001	AT&T INC	P	2013	HARVARD BIOSCIENCE INC	P
1995	CASTLE & COOKE INC	T	2001	LIBERTY CORP	T	2013	BIOSTAGE INC	T
1996	SAFELAND	P	2001	FMC CORP	P	2013	ENBRIDGE ENERGY P LP	P
1996	HERCULES PROPERTIES CO	T	2001	FMC TECHNOLOGIES INC	T	2013	MIDCOAST ENERGY PARTNERS LP	T
1996	SVENSKA HANDELSBANKEN	P	2001	UNITED STATES STEEL CORP	P	2014	MACQUARIE GROUP LTD	P
1996	NACKEBRO	T	2001	MARATHON OIL CORP	T	2014	SYDNEY AIRPORT	T
1996	STERLING SOFTWARE INC	P	2001	SCOTTISH POWER PLC	P	2014	EXELIS INC	P
1996	STERLING COMMERCE INC	T	2001	THUS GROUP PLC	T	2014	VECTRUS INC	T
1996	FLORIDA PROGRESS CORP	P	2002	TITAN CORP	P	2015	SPX CORP	P
1996	ECHELON INTERNATIONAL CORP	T	2002	SUREBEAM CORP	T	2015	SPX FLOW INC	T
1997	MICHAEL FOODS INC	P	2001	CIRCUIT CITY STORES INC	P			
1997	ENSTAR INC	T	2001	CARMAX INC	T			
1998	WMS INDUSTRIES INC	P	2002	UNITED OVERSEAS BANK LTD	P			
1998	MIDWAY GAMES INC	T	2002	HAW PAR CORP LTD	T			
1998	FORD MOTOR CO	P	2003	IMS HEALTH HOLDINGS INC	P			
1998	ASSOCIATES FIRST CAP CO	T	2003	COGNIZANT TECH SOLUTIONS	T			

Table A.3: **Summary Statistics Target Companies**

This table reports the summary statistics for the target "treated" and control firms used in our estimation models. The statistics are computed at the end-of-year when the spin-off was effective. ROA has been omitted given the impossibility to calculate the estimated value for all firms in the sample. Correlation between target and parent companies and financial synergies are omitted and only reported in Table 5.2.

	Obs.	Mean	Std. Deviation	Lower Quartile	Median	Upper Quartile
Panel A: Summary statics full sample of target companies						
LN (TA)	223	6.726	2.289	5.282	6.767	8.184
Leverage1	223	0.259	0.261	0.021	0.197	0.411
Leverage2	223	0.295	0.966	0.000	0.158	0.402
LN (Op. Costs)	223	5.875	2.486	4.274	5.779	7.548
Panel B: Summary statistics for the target companies (Spin-off)						
LN (TA)	106	6.754	2.251	5.390	6.711	8.124
Leverage1	106	0.252	0.264	0.019	0.189	0.412
Leverage2	106	0.354	1.359	0.000	0.144	0.404
LN (Op. Costs)	106	5.898	2.411	4.171	5.881	7.548
Panel C: Summary Statistics for the target companies (Control)						
LN (TA)	117	6.700	2.333	5.225	6.846	8.236
Leverage1	117	0.265	0.256	0.029	0.212	0.407
Leverage2	117	0.240	0.263	0.000	0.170	0.387
LN (Op. Costs)	117	5.852	2.566	4.335	5.738	7.618

Table A.4: **Variance inflated factor - results output I**

This table reports the results of the estimated VIF using the independent variables included in the baseline regression for matched firms and DFS is the indicator for *negative* financial synergies (regression in Panel A - Table 6.1). This test has been done to rule out any additional concern relative to multicollinearity.

Variable	VIF
Leverage	1.15
ROA	1.08
Correlation	1.22
DFS	1.07
LN (TA)	1.31
Sales growth	1.11
Crisis	1.05
Mean VIF	1.14

Table A.5: **Variance inflated factor - results output II**

This table reports the results of the estimated VIF using the independent variables included in the baseline regression for matched firms and FS are the estimated financial synergies (regression in Table 6.2). This test has been done to rule out any additional concern relative to multicollinearity.

Variable	VIF
Leverage	1.16
ROA	1.12
Correlation	1.16
FS	1.06
LN (TA)	1.26
Sales growth	1.11
Crisis	1.05
Mean VIF	1.13

Table A.6: **Variance inflated factor - results output III**

This table reports the results of the estimated VIF using the independent variables included in the baseline regression. Variables associated to financial synergies are omitted to enable the use of all data-points. This test has been done to rule out any additional concern relative to multicollinearity.

Variable	VIF
Leverage	1.05
ROA	1.05
Correlation	1.21
LN (TA)	1.20
Sales growth	1.05
Crisis	1.02
Mean VIF	1.10

Table A.7: **Variance covariance matrix**

This table reports the result of the estimated variance-covariance matrix after the baseline regression (using the probit model) is performed. Panel A contains the VC matrix for the matched sample when DFS is used in the regression. Panel B contains the VCE matrix for the matched sample when the estimated continuous values for financial synergies are included. Panel C reports the VC matrix for the baseline regression when the two independent variables for financial synergies are omitted and the full sample is used.

Panel A: Matched sample using the indicator for *negative* financial synergies								
	Leverage	ROA	Correlation	DFS	LN (TA)	Sales growth	Crisis	Constant
Leverage	0.6016							
ROA	-0.1816	3.3174						
Correlation	0.0982	-0.2500	0.6555					
DFS	-0.0191	-0.0130	-0.0439	0.0652				
LN (TA)	-0.0144	-0.0107	-0.0134	0.0011	0.0040			
Sales Growth	0.0006	0.0047	0.0014	-0.0029	0.0006	0.0092		
Crisis	0.0214	-0.0213	-0.0207	0.0073	-0.0011	-0.0014	0.0529	
Constant	-0.0224	-0.2115	0.0259	-0.0175	-0.0266	-0.0065	-0.0173	0.2769
Panel B: Matched sample using the estimated continuous values for financial synergies								
	Leverage	ROA	Correlation	FS	LN (TA)	Sales growth	Crisis	Constant
Leverage	0.6477							
ROA	-0.2652	3.5961						
Correlation	0.0934	-0.2448	0.6227					
FS	0.0047	0.0126	0.0037	0.0092				
LN (TA)	-0.0133	-0.0074	-0.0119	-0.0001	0.0042			
Sales Growth	0.0006	0.0210	0.0016	0.0029	0.0011	0.0162		
Crisis	0.0034	-0.0394	-0.0104	-0.0003	-0.0011	-0.0032	0.0540	
Constant	-0.0447	-0.2527	-0.0038	-0.0052	-0.0291	-0.0152	-0.0179	0.3149
	Panel C: Full sample							
	Leverage	ROA	Correlation	Sales growth	LN (TA)	Crisis	Constant	
Leverage	0.2403							
ROA	-0.0721	1.1785						
Correlation	0.0378	-0.0797	0.3647					
Sales growth	0.0001	-0.0105	-0.0008	0.0089				
LN (TA)	-0.0015	0.0025	-0.0088	0.0006	0.0016			
Crisis	0.0099	-0.0163	-0.0034	-0.0009	-0.0003	0.3243		
Constant	-0.0539	-0.1264	0.1203	-0.0053	-0.0114	-0.00962	0.1321	

Table A.8: **Robustness Check - Estimation Output I**

This table reports the output of the baseline specification using a logit model. The total number of treated firms, in the matched sample, is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. Panel A contains the estimates for the matched sample with the indicator for *negative* financial synergies included. Panel B contains the estimates for the companies included in the full sample. DFS is omitted to enable the usage of all available data points. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. When all the covariates are at their median values, the probabilities of a spin-off are 51.255 % for the matched sample and 46.106 % for the full sample. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
	Panel A: Matched sample		**Panel B: Full Sample**	
Leverage	-0.700	1.967 %	-0.709	2.375 %
	(-0.540)		(-0.880)	
ROA	-3.699	6.889 %	-0.989	1.170 %
	(-1.530)		(-0.560)	
Correlation	5.405***	16.333 %	4.298***	14.471 %
	(3.830)		(4.130)	
DFS	0.186	4.629 %	-	-
	(0.440)		-	
LN (TA)	0.092	3.166 %	-0.014	0.736 %
	(0.890)		(-0.220)	
Sales growth	-0.092	0.254 %	-0.031	0.079 %
	(-0.540)		(-0.850)	
Crisis	-0.421	-10.417 %	-0.242	-5.846 %
	(-1.100)		(-0.820)	
Constant	-0.986	-	-0.355	-
	(-1.170)		(-0.610)	
N (Spin Off)	71		N (Spin Off)	106
N (Control)	71		N (Control)	122
Model p-value	0.0003		Model p-value	0.0003
Pseudo R^2	0.139		Pseudo R^2	0.081

Table A.9: **Robustness Check - Estimation Output I - cont.**

This table reports the output of the logit model. The total number of treated firms is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. FS is the independent variable associated with the estimated continuous values for financial synergies.The full sample is omitted and is only reported in Table 6.1. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. When all the covariates are at their median values, the probabilities of a spin-off are 45.358 % for the matched sample and 43.332 % for the full sample. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

Variable	Coefficient estimate	Change in probability
Leverage	-0.872 (-0.660)	2.452 %
ROA	-4.358 (-1.410)	5.838 %
Correlation	4.585*** (3.410)	14.047 %
FS	-0.200 (-1.230)	1.053 %
LN (TA)	0.062 (0.590)	2.143 %
Sales growth	-0.137 (-0.680)	0.380 %
Crisis	-0.307 (-0.800)	-7.624 %
Constant	-0.444 (-0.490)	-
N (Spin-off)	71	
N (Control)	71	
Model p-value	0.0013	
Pseudo R^2	0.124	

Table A.10: **Robustness Check - Estimation Output II**

This table reports the output of the robustness check of the probit model. In addition, the logit model estimates are reported. The table contains the results of the probit and logit models using leverage defined as net total debt over total assets net of cash. The total number of treated firms, in the matched sample, is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. Panel A shows the estimates for the companies included in the matched sample. Panel B contains the estimate output for the companies included in the full sample omitting the financial synergies variables to enable the usage of all available data points. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. For the probit model: when all the covariates are at their median values, the probabilities of a spin-off are 42.525 % for the matched sample and 40.517 % for the full sample. For the logit model: when all the covariates are at their median values, the probabilities of a spin-off are 41.129 % for the matched sample and 42.072 % for the full sample. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

Probit Model					**Logit Model**				
Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability	Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
	Panel A: Matched Sample		**Panel B: Full Sample**			**Panel A: Matched Sample**		**Panel B: Full Sample**	
Leverage	-0.303 (-0.400)	1.797 %	-0.388 (-0.820)	2.749 %	Leverage	-0.423 (-0.340)	1.704 %	-0.629 (-0.820)	2.789 %
ROA	-2.344 (-1.610)	4.876 %	-0.647 (-0.590)	1.222 %	ROA	-3.815 (-1.590)	5.113 %	-1.077 (-0.610)	1.275 %
Correlation	3.256*** (4.000)	15.225 %	2.569*** (4.200)	12.765 %	Correlation	5.427*** (3.800)	16.392 %	4.262*** (4.060)	13.231 %
DFS	0.107 (0.420)	4.243 %	- -	-	DFS	0.173 (0.410)	4.290 %	- -	-
LN (TA)	0.061 (0.950)	3.579 %	-0.006 (-0.140)	0.490 %	LN (TA)	0.087 (0.830)	3.011 %	-0.013 (-0.200)	0.680%
Sales growth	-0.049 (-0.490)	0.218 %	-0.019 (-0.860)	0.077 %	Sales Growth	-0.089 (-0.550)	0.248 %	-0.031 (-0.850)	0.079 %
Crisis	-0.240 (-1.050)	-9.529 %	-0.138 (-0.760)	-5.421 %	Crisis	-0.410 (-1.080)	-10.149 %	-0.234 (-0.790)	-5.745 %
Constant	-0.678 (-1.300)	-	-0.262 (-0.740)	-	Constant	-1.017 (-1.200)	-	-0.396 (-0.690)	-
N (Spin-off)	71		N (Spin-off)	106	N (Spin-off)	71		N (Spin-off)	106
N (Control)	71		N (Control)	122	N (Control)	71		N (Control)	122
Model p-value	0.0003		Model p-value	0.0004	Model p-value	0.0003		Model p-value	0.0004
Pseudo R^2	0.139		Pseudo R^2	0.080	Pseudo R^2	0.139		Pseudo R^2	0.080

Table A.11: **Robustness Check - Estimation Output II - cont**

This table reports the output of the robustness check of the probit model. In addition, the logit model estimates are reported. The table contains the results of the probit and logit models using leverage defined as net total debt over total assets net of cash. The total number of treated firms, in the matched sample, is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. FS is the independent variable associated with the estimated continuous values for financial synergies.The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. For the probit model: when all the covariates are at their median values, the probabilities of a spin-off are 43.695 % for the probit model and 43.651 % for the logit model. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

	Probit Model		**Logit Model**	
Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
Leverage	-0.279 (-0.370)	1.799 %	-0.408 (-0.330)	1.646 %
ROA	-2.889 (-1.540)	4.192 %	-4.606 (-1.500)	4.172 %
Correlation	2.816*** (3.530)	13.910 %	4.631*** (3.390)	14.207 %
FS	-0.119 (-1.270)	1.006 %	-0.194 (-1.230)	1.024 %
LN (TA)	0.039 (0.600)	2.172 %	0.054 (0.510)	1.871 %
Sales growth	-0.081 (-0.630)	0.359 %	-0.1341 (-0.670)	0.372 %
Crisis	-0.169 (-0.730)	-6.700 %	-0.281 (-0.740)	-6.985 %
Constant	-0.344 (-0.620)	-	-0.498 (-0.550)	-
N (Spin-off)	71		N (Spin-off)	71
N (Control)	71		N (Control)	71
Model p-value	0.0014		Model p-value	0.0015
Pseudo R^2	0.123		Pseudo R^2	0.122

Table A.12: **Robustness Check - Estimation Output III**

This table reports the output of the robustness check of the probit model. In addition, the estimates of the logit model are reported. Volatility is defined as in chapter 3. The total number of treated firms, in the matched sample, is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. Panel A shows the estimates for the companies included in the matched sample. Panel B contains the estimate output for the companies included in the full sample omitting the financial synergies variables to enable the usage of all available data points. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. When all the covariates are at their median values, the probabilities of a spin-off are 47.475 % for the matched sample and 44.680 % for the full sample. For the logit model: when all the covariates are at their median values, the probability of a spin-off are 47.715 % for the matched sample and 44.781 % for the full sample. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

	Probit Model					**Logit Model**			
Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability	Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
	Panel A: Matched Sample		**Panel B: Full Sample**			**Panel A: Matched Sample**		**Panel B: Full Sample**	
Leverage	-0.375 (-0.480)	1.628%	-0.356 (-0.710)	1.896%	Leverage	-0.605 (-0.460)	1.652%	-0.589 (-0.720)	1.966%
ROA	-2.283 (-1.550)	5.905%	-0.299 (-0.220)	0.563%	ROA	-3.715 (-1.530)	6.033%	-0.545 (-0.250)	0.641%
Correlation	3.263*** (4.020)	15.839%	2.510*** (4.140)	12.491%	Correlation	5.480*** (3.820)	16.404%	4.163*** (4.020)	12.595%
DFS	0.123 (0.480)	3.150%	- -	-	DFS	0.212 (0.500)	3.960%	- -	-
LN (TA)	0.073 (1.140)	4.171%	-0.001 (-0.010)	0.218%	LN (TA)	0.106 (1.010)	3.870%	-0.004 (-0.070)	0.223%
Sales growth	-0.065 (-0.520)	0.277%	-0.018 (-0.820)	0.075%	Sales Growth	-0.116 (-0.600)	0.310%	-0.030 (-0.810)	0.076%
Volatility	0.452 (1.360)	3.749%	0.202 (0.830)	1.088 %	Volatility	0.752 (1.360)	4.581%	0.333 (0.840)	1.121%
Crisis	-0.311 (-1.310)	-10.633 %	-0.153 (-0.840)	-5.982 %	Crisis	-0.539 (-1.360)	-11.471%	-0.265 (-0.880)	-6.437%
Constant	-0.844 (-1.550)	-	-0.377 (-0.990)	-	Constant	-1.281 (-1.450)	-	-0.577 (-0.950)	-
N (Spin-off)	71		N (Spin-off)	106	N (Spin-off)	71		N (Spin-off)	106
N (Control)	71		N (Control)	122	N (Control)	71		N (Control)	122
Model p-value	0.0004		Model p-value	0.0009	Model p-value	0.0003		Model p-value	0.0008
Pseudo R^2	0.149		Pseudo R^2	0.079	Pseudo R^2	0.149		Pseudo R^2	0.081

Table A.13: **Robustness Check - Estimation Output III - cont**

This table reports the output of the robustness check of the probit model. In addition, the estimates of the logit model are reported. Volatility is defined as in chapter 3. The total number of treated firms, in the matched sample, is reduced from the original sample (106) due to lack of data needed for the estimation of financial synergies. FS is the independent variable associated with the estimated continuous values for financial synergies. The change in probability is the increase in the probability when the variable's median is replaced with the lower or upper quartile (that value which results in an increase in probability), while all the other variables are evaluated at their median. For the probit model: when all the covariates are at their median values, the probabilities of a spin-off are 40.595% for the probit model and 39.965% for the logit model. The parenthesis contains the t-test of the estimated coefficient. ***, **, or * indicate that the estimated coefficient is significant at the 1%, 5%, 10% respectively.

	Probit Model		**Logit Model**	
Variable	Coefficient estimate	Change in probability	Coefficient estimate	Change in probability
Leverage	-0.497 (-0.610)	2.233%	-0.809 (-0.610)	2.234%
ROA	-2.759 (-1.440)	5.919%	-4.406 (-1.410)	5.926%
Correlation	2.829*** (3.570)	14.003%	4.688*** (3.430)	14.042%
FS	-0.124 (-1.250)	1.042%	-0.204 (-1.210)	1.042%
LN (TA)	0.052 (0.800)	1.847%	0.075 (0.700)	2.192%
Sales growth	-0.093 (-0.750)	0.414%	-0.157 (-0.800)	0.414%
Volatility	0.329 (1.020)	2.733%	0.546 (-1.050)	2.416%
Crisis	-0.238 (-0.990)	-9.391%	-0.405 (-1.020)	-9.371%
Constant	-0.461 (-0.790)	-	-0.680 (-0.720)	-
N (Spin-off)	71		N (Spin-off)	69
N (Control)	71		N (Control)	70
Model p-value	0.0016		Model p-value	0.0017
Pseudo R^2	0.129		Pseudo R^2	0.129

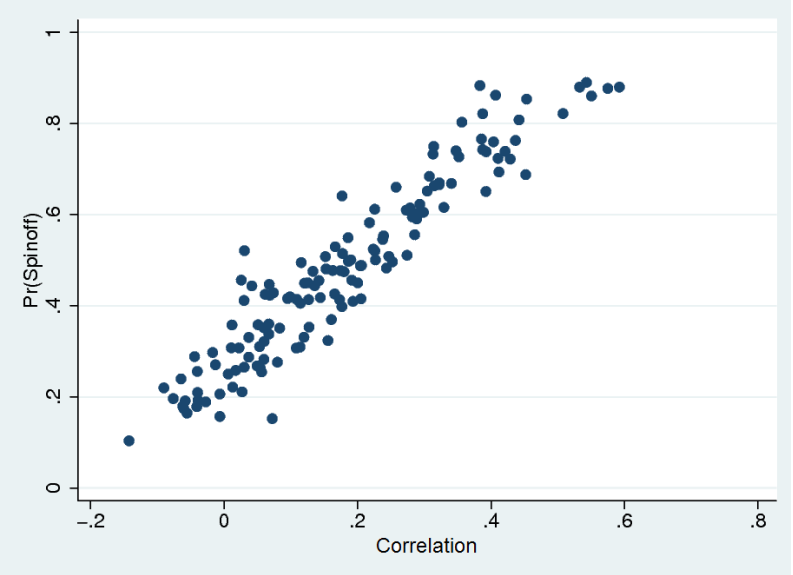

Figure A.1: Correlation and predicted probabilities