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Essays on leveraged buyouts and distressed asset pricing

by

Brian Ayash

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Business Administration

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Christine Parlour, Chair
Professor Dmitry Livdan
Professor Robert Bartlett, III

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by

Brian Ayash

Abstract

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Doctor of Philosophy in Business Administration

University of California, Berkeley

Professor Christine Parlour, Chair

This dissertation consists of three chapters that concern leveraged buyouts and the risk-return relationship of distressed stocks. The first chapter uses hand collected cash flow statements to present the origin, ownership and use of cash in leveraged buyouts of large publicly traded U.S. firms by private equity funds between 1980 and 2006. I find suggestive evidence that target firms exhibit inefficient investment in the form of empire building pre-acquisition. Once controlled by private equity funds, firms exhibit a significant decline in investment, sales and asset growth, and employment growth as debt is used to motivate managers and forces the release of excess free cash flows. I do not find evidence of value creation, as the profitability of the underlying assets does not increase under private equity control. There is evidence of an increase in cash flows from financial management expertise. This form of excess cash generation contributes to the funding of dividends but the majority of the funding is from asset sales and reduced investment prior to exit. Cash flow statements are also used to evaluate returns. I find that the IRR generated by underlying assets is insufficient to cover the cost of financing debt, adversely affecting the IRR to equity holders.

The second chapter, co-authored with Harm Schütt, tests whether leveraged buyouts improve targets operating performance? We hand collect complete, comprehensive financial statements for a sample of 138 large public U.S. firms that were acquired by private equity funds in leveraged buyouts between 1980 and 2006, and we examine the operating performance of these companies. Because of our comparatively large dataset with comprehensive financial statements we can better scrutinize operating performance and the technical accounting issues associated with leveraged buyouts. We find that the acquired firms do not

exhibit post-buyout improvements compared to industry peers. In addition to operations, we evaluate outcomes for the acquired firms. In an expanded sample of 531 large public to private leveraged buyouts we find that 109 (21%) subsequently declare bankruptcy or were restructured outside the bankruptcy court while held by private equity funds. Our results suggest that while private equity managers might be savvy investors, they are not better operators of the target companies.

The third chapter explores the breakdown in the risk-return relationship of financially distressed stocks. I model firms in financial distress using an endogenous default model and demonstrate that distressed firms have nonsymmetric return distributions and are systematically mispriced under the CAPM. I propose the use of a CRRA utility model to correct for the mispricing of positive skewness in the return distribution of distressed stocks. I create portfolios using four distress measures and compare the risk-return relationship under both models. I find that the anomalously low return delivered by portfolios of the most distressed stocks is driven by the inclusion of OTC traded stocks.

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1 Chapter 1
Piercing the Veil: The origin and use of cash flow in LBOs

1.1 Introduction

The capacity of private equity funds exceeds $3 trillion dollars, of which approximately $1.2 trillion is in buyout funds.[1] By comparison, hedge funds have only $2.4 trillion under management.[2] Do Leveraged buyouts (LBOs) create economic value? Theory suggests that they do: Jensen (1986) argued that high debt levels reduce free cash flows and force managers to eliminate inefficient investment. Thus, the financial structure should increase the return on firm assets. Indeed, following this logic, Jensen (1989) even suggested that the public corporation has outlived its usefulness in many sectors of the economy. While limited data and lack of market prices impede direct tests of his theory, given the economic significance of LBOs, understanding whether the LBO structure is economically efficient or just a method to extract rents is of critical importance.

Once a firm is taken private, a veil drops. Acquired firms typically do not publish financial statements and no market prices are available. It is therefore extremely difficult to impute returns to the various stakeholders and to determine changes in the economic value of the underlying assets. However, each of these calculations is important: Is the private equity LBO structure economically efficient? How are returns to private equity funds generated?

In this paper, I use hand collected data to study the relationship between investment, growth and value creation in a sample of large, publicly traded firms acquired by private equity funds in leveraged transactions between 1980 and 2006. I use deals listed in SDC Platinum and impose a minimum transaction value of at least $50 million to avoid the erroneous LBO indicator. I then take the approach followed by theory models and consider cash flows. Indeed, this paper is the first to use cash flow statements to answer many questions surrounding private equity controlled firms. Of the 521 LBOs identified, I hand collected post-acquisition cash flow statements for 183 firms controlled by private equity funds. These firms represent approximately 35% of public to private LBOs and 58% of the transaction value over the sample period.

To frame Jensen's theory, I present a one-period analytical framework where future value is a function of investment decisions. If private equity funds reduce wasteful investment in firms by imposing leverage, there has to be an initial agency conflict. To induce one, I assume managers of publicly traded firms are empire builders and grow the firms to maximize their personal power and wealth in a way that may not be in the best interests of shareholders.

[1] Preqin estimates that the current unrealized value of equity investments of private equity funds is just over $2 trillion, with an additional $1 trillion in funding commitments.

[2] Hedge Fund Research.

This friction results in inefficient investment as managers maximize the size of the firms they manage. In this setting, private equity funds create value by liquidating unproductive capital. The premium that private equity funds are able to pay over market prices is increasing in over-investment and leverage. In addition, this setting predicts that target firms experience positive cash flow shocks providing the excess cash necessary to over-invest.

To test these predictions, I use a sub-sample of LBOs that have complete financial information for five years prior to the LBO and find evidence to support the theory of over-investment in the pre-acquisition period. There is suggestive evidence that these firms experienced positive cash flow shocks, and that these cash flows were reinvested resulting in significant asset growth. This sub-sample also reports an average Tobin's q, indicating that these firms are perceived by the market to have modest growth opportunities.

In this paper, value creation at the firm level occurs when the underlying assets generate more cash. This could come from two sources: First, the reduction of inefficient investment which increases the profitability of the remaining assets; and second, improved cash management. To test the first source, I consider operating income[3] normalized by either sales or tangible assets. Consistent with Guo, Hotchkiss, and Song (2011) and Ayash and Schütt (2013), I do not find evidence of value creation through this channel. A separate test of value creation using only LBOs from the 1980s produces similar results, suggesting that the small sample size or variable selection of Kaplan (1989) may have obfuscated the true results.

I do find evidence of value creation through improved cash management consistent with Smith (1990). Firms controlled by private equity funds demonstrate effective collection of monies due, an ability to negotiate favorable credit terms with suppliers, a decrease in inventory on hand, and an ability to operate with less cash in the system. However, using cash flow statements, I illustrate how this form of cash generation is temporary in nature and argue that the majority of the gains are merely temporary transfers from vendors and customers to the LBO firms.

In the presence of ambiguous results on value creation, I investigate the relationship between investment decisions and growth, cash management transfers and dividends, and between cash flows and returns. These results shed some light on why so much capital is committed to LBOs. I use a sub-sample of LBOs that have complete financial information for an seven-year window beginning three years prior to the LBO and ending four years after the LBO. This group is special in that it contains a fixed set of firms that were private equity controlled for four years post-acquisition.

The cash flow statements show that the private equity controlled firms reduce investment and increase asset sales in the post-acquisition period. Sales and asset growth decline relative to publicly traded firms in the same industry. Employment growth also declines in the post-

[3]Operating income is defined as net income plus interest, taxes, amortization and depreciation, and impairments of goodwill. Operating income as defined is similar to EBITDA but would capture spending on restructuring initiatives implemented by the new private equity owners.

acquisition period. I illustrate that the gains from cash management are temporary in nature, and although they contribute to the funding of dividends, they are not the primary source. Dividends are primarily funded through proceeds generated from asset sales and reduced investment prior to the sale of the firms.

Finally, I use cash flows to decompose returns in an attempt to reconcile the positive abnormal returns presented in Harris, Jenkinson, and Kaplan (2012) with the lack of value creation presented in Guo et al. (2011) and Ayash and Schütt (2013). I use a multiples approach to estimate the exit value in the absence of prices, similar to the approach used by Harris et al. (2012). I find that the underlying assets generate a 9.0% internal rate of return which is below the borrowing cost of 9.3%. This implies that the cash generating power is insufficient to cover the cost of servicing debt. Whenever this relationship exists, the return to equity holders is adversely affected as illustrated by the low 8.3% IRR to equity holders. To accurately present returns to equity holders, I incorporate a typical fee structure as private equity funds typically extract additional rents in the form of one time transaction fees and annual maintenance charges. These rents increase the internal rate of return to equity holders by approximately 2%.

The remainder of the paper is structured as follows: In Section 1, I provide a literature review. In Section 2, I present an analytical framework to illustrate the source of value creation in the LBO process and present hypotheses tested. Section 3 discusses the data collection process and sub-samples presented and tested. Section 4 provides an unrivaled picture of the financial characteristics of LBOs including summary statistics and cash flow statements. Section 5 documents the results for tests of industry adjusted operating improvements, cash management and inefficient investment. Section 6 concludes.

1.2 Literature Review

There is suggestive evidence that high debt levels adversely affect the performance of LBOs, as the bankruptcy rate for LBOs is in excess of non-investment grade debt.[4] Andrade and Kaplan (1998) find that 23% of larger public to private transactions from the 1980s defaulted by 1995 and Ayash and Schütt (2013) document a 21% bankruptcy rate in 531 large U.S. public to private LBOs from 1980 to 2006. Hotchkiss, Smith, and Strömberg (2011) evaluate 2,156 non-investment grade loans made between 1997 and 2010 and find that private equity controlled firms have a higher default rate and higher leverage. Clearly, the benefit of the private equity structure is an empirical question. However, evaluating the tradeoffs has been extremely difficult. Where information has been collected, technical

[4]Moody's Investors Services, Global Credit Research, Measuring Corporate Default Rates, November 2006. Table A1. Average Cumulative Default Rates by Whole Letter Rating, Unadjusted. Ba: Obligations rated Ba are judged to be speculative and are subject to substantial credit risk. B: Obligations rated B are considered speculative and are subject to high credit risk. Default rates for B to Ba rated debt five years after cohort formation ranges from 7.86% to 20.66%.

accounting issues associated with LBOs make the comparison of pre- and post-acquisition operational performance difficult. To date, Kaplan (1989) is the most widely cited study to collect financial information for leveraged buyouts and test operational performance. He reports significant improvements in a sample of 42 firms, with 15 firms tested three years post-acquisition. This finding has influenced the general perception that private equity funds create value through operational improvements.

With evidence that private equity funds create value, the focus of the literature has been to estimate returns, albeit without market prices. Most recently, Harris, Jenkinson, and Kaplan (2012) show that private equity funds have outperformed the S&P 500 net of fees and carried interest during the 1980s, 1990s, and 2000s. Their estimates imply that each dollar invested in the average fund returned at least 20% more than a dollar invested in the S&P 500 and more than 3% annually. The authors use prices inferred primarily from accounting data. Of the 598 private equity funds they evaluate, 69% were originated in the 2000s. Of these funds, only 27% were paid out in cash. The remaining 73% were evaluated using the private equity funds' estimates of value, referred to as net asset value (NAV). The use of inferred prices to present returns is somewhat controversial. Phalippou and Gottschalg (2007) use a sub-sample of funds that had exited all investments in target firms and returned all cash to investors, and conclude that private equity funds underperformed the S&P 500 by 3% annually. However, subsequent research by Brown, Gredil, and Kaplan (2013) and Jenkinson, Sousa, and Stucke (2013) present evidence that NAVs have historically been conservative estimates of the ultimate cash returned to shareholders.

The dispersion in estimates makes the return performance of private equity difficult to evaluate. In addition, investments in private equity funds are typically illiquid and have ten year commitments. The historical spread between 2-year treasury bonds and 10-year treasury bonds is approximately 1.0%.[5] Finally, implicit in a comparison with the S&P is that private equity funds have a beta of one. Of course, this is difficult to measure, but the volatility is high, as one in five investments goes bankrupt (results in a -100% return).

Recently, researchers are reevaluating private equity firms' ability to create value. Guo et al. (2011) look at a sample of 94 large U.S. public to private leveraged buyouts from 1990 to 2006. They find modest increases in operating performance. Ayash and Schütt (2013) analyze the technical accounting associated with 60 LBOs from the 1980s and 78 LBOs from 1990 to 2006 and illustrate that the variables previously tested in the literature are inappropriate for this asset class and lead to bias. Their tests using modified proxies for profitability do not find evidence of value creation.

More recently, there has been a push to overcome the lack of publicly available financial data by reviewing tax filings and U.S. census data. Boucly, Sraer, and Thesmar (2011) use tax data and present evidence of significant growth and operating improvements in a sample of 839 French LBOs. Davis, Haltiwanger, Jarmin, Lerner, and Miranda (2011) use

[5]Source: Yieldcharts.com

U.S. census data to study employment in a sample of approximately 3,000 LBOs between 1980 and 2005. However, both of these studies suffer from erroneous labeling by data service providers of transactions completed with moderate to nominal leverage as LBOs. The smaller transactions studied by Boucly, Sraer, and Thesmar (2011) experience a significant increase in investment, funded with additional debt, post-acquisition. These small, family run firms demonstrate characteristics of underinvestment pre-acquisition, not the wasteful investment target by private equity funds in LBO transaction. Indeed, only 36 large public to private transactions in Boucly, Sraer, and Thesmar (2011) exhibit post-acquisition characteristics similar to U.S. public to private LBOs, including declining sales and asset growth, and reduced investment and employment. Therefore, it is important to utilize a transaction value threshold below which transactions are excluded, to ensure the study is specific to LBOs and the reduction of wasteful investment.

Cohn, Mills, and Towery (2014) also use tax documents to evaluate operating performance in U.S. public to private LBOs with assets in excess of $10 million, and therefore include some smaller, moderately leveraged transactions in their sample. They test operating performance in a sample of 317 U.S. transactions between 1995 and 2007 and do not find evidence of operating performance improvements. However, they also test a sub-sample of 70 LBOs that continue to produce publicly available financial statements while private and find significant improvements in operating performance. It is difficult to interpret these results as these 70 LBOs are the larger deals in their sample and the results could be reflecting significant tax planning expertise at larger private equity funds rather than significant operational performance.

The use of cash flow statements is basically nonexistent in the literature and any reference to investment is limited to a review of capital expenditures, excluding merger and acquisition activity, divestitures and the sale of physical and other assets. In this study, cash flow statements are used to understand the origin, ownership and use of cash, and answer the following questions: Does the leveraged structure of the private equity LBO lead to operational improvements in the specific sense that the overall value of the assets has increased? Or, are the large debt levels and transfer of control rights a way to extract rents?

1.3 Analytical Framework

The purpose of this section is to present a simple framework to understand the agency conflict described in Jensen (1986) and illustrate the source of value creation in corporate control transactions by private equity funds. Consider a firm with assets in place, K_0. Value is determined in a one period setting, where the cash flows available to managers are allocated between investment and dividends. The value of the firm is given by the function $V_0(K_0, Z_0)$, where K_0 is assets or capital in place and Z_0 represents total factor productivity (TFP). TFP

next period, $\tilde{Z}_1$, is a random variable and the only source of uncertainty in this setting.[6] Assets in place depreciate at a constant rate, δ, and are replenished with investment, I_0, made at $t = 0$. For the value maximizing private equity (PE) managers, the value of the firm is defined as follows:

$$V_0^{PE}(K_0, Z_0) = \underbrace{\pi_0(K_0, Z_0)}_{\text{just realized profits}} + \max_{I_0^{PE}} \left\{ \beta \mathbb{E}[\pi_1(K_1, \tilde{Z}_1)] - I_0^{PE} \right\} \tag{1.1}$$

and where future capital is determined as follows:

$$K_1 = (1 - \delta)K_0 + I_0^{PE} \tag{1.2}$$

The private equity manager maximizes the value of the firm through the investment decision made at t = 0 or equivalently, with respect to future capital, K_1. The cash flows available to managers to invest or pay dividends is from the just realized, after tax (τ) profit, π_0, which is defined as follows:

$$\pi_t = (1 - \tau)Z_t K_t^{\alpha} \quad \text{where} \quad \alpha < 1 \qquad t \in \{0, 1\} \tag{1.3}$$

Taking the derivative of equation (1.1) with respect to future capital gives the following envelope result.

$$V_K(K_1^{PE}, \tilde{Z}_1) = \pi_K(K_1^{PE}, \tilde{Z}_1) \tag{1.4}$$

Private equity managers will continue to invest in capital as long as one dollar invested increases the discounted, expected increase in the value of the firm by one dollar.

$$\beta \mathbb{E}[\pi_K(K^{PE}, \tilde{Z}_1)] = 1 \tag{1.5}$$

Therefore, the value of the firm under private equity control is given by equation (1.6) and the optimal level of future capital is given by equation (1.7).

$$V_0^{PE} = \pi_0 + \beta \mathbb{E}[(1 - \tau)\tilde{Z}_1 K_1^{PE\alpha}] - \underbrace{K_1^{PE} + (1 - \delta)K_0}_{I_0^{PE}} \tag{1.6}$$

$$K_1^{PE} = ((1 - \tau)\alpha\beta \mathbb{E}[\tilde{Z}_1])^{\frac{1}{1-\alpha}} \tag{1.7}$$

To incorporate an initial agency conflict, it is assumed that managers of publicly traded (PT) firms are empire builders and grow the firms in ways that maximize their personal power and wealth, that may not be in the best interests of shareholders. In this setting, managers maximize the size of the firms they manage.[7] For the manager of publicly traded

[6] Assume $\tilde{Z}_1 \mid Z_0 \sim \ln \mathcal{N}(\mu, \sigma) \implies \mathbb{E}[\tilde{Z}_1] = Z_0 e^{\mu + \frac{\sigma}{2}}$

[7] This assumption is consistent with any incentive plans that pay managers one time bonuses for conducting acquisitions, or focus on sales and EBITDA growth rather than compensation schemes that focus on profitability and equity value.

firms, the investment decision is simply $I_0 = \pi_0$, implying that all profits are reinvested. The uncertainty regarding the future state of the world, $\tilde{Z}_1$, does not enter the managers decision. Therefore, the value of publicly traded firms is given by equation (1.8), where managers of publicly traded firms (PT) maximize with respect to size.

$$V_0^{PT}(K_0, Z_0) = \beta\mathbb{E}[(1-\tau)\tilde{Z}_1 K_1^{PT\alpha}] \tag{1.8}$$

where future capital is determined by π_0:

$$K_1^{PT} = (1-\delta)K_0 + \pi_0 \tag{1.9}$$

In states of the world where $\pi_0 > I_0^{PE}$, managers of publicly traded firms over-invest, deviating from optimal investment. Private equity managers target these firms and implement optimal investment, where first best requires less capital, $K_1^{PT} > K_1^{PE}$. Therefore, the premium that private equity funds pay over the current market value to gain control is a function of over-investment. The value of the firm once controlled by the private equity fund is expressed as follows:

$$V_0^{PE}(K_0, Z_0) = \Delta K + \beta\mathbb{E}[\pi(K_1^{PE}, \tilde{Z}_1)] \tag{1.10}$$

where proceeds from the sale of inefficient investment equal:

$$\Delta K = K_1^{PT} - K_1^{PE} \tag{1.11}$$

Liquidating over-investment creates value because the cash generated, ΔK, is greater than the decrease in firm value associated with reduced capital. This is because each dollar invested in excess of first best generates less than 1 dollar of discounted future expected value, $\beta\mathbb{E}[\pi_K(K^{PT}, \tilde{Z}_1)] < 1$. Therefore, value creation from the reduction of inefficient investment is defined as follows:

$$0 < \Delta K + \beta\mathbb{E}[\pi_1(K_1^{PE}, \tilde{Z}_1) - \pi_1(K_1^{PT}, \tilde{Z}_1)] \tag{1.12}$$

Assuming debt financing, private equity managers borrow the purchase price, (B), and repay (D) at t = 1. The rate of borrowing is r_D, where $\beta_D = \frac{1}{1+r_D}$. Therefore, the value of the firm under private equity control increases by the present value of the interest tax shield, PV(ITS).

$$V_0^{PE}(K_0, Z_0) = \Delta K + \beta\mathbb{E}[\pi_1(K_1^{PE}, \tilde{Z}_1)] + \underbrace{\beta_D B r_D \tau}_{PV(ITS)} \tag{1.13}$$

Therefore, an LBO occurs when $V_0^{PE} \geq V_0^{PT} + \Gamma$, where Γ represents the control premium.[8] The maximum premium a private equity fund will pay can be expressed as follows by expanding equation (1.12) and incorporating the interest tax shield.

[8] I do not take a position on how the surplus is shared but rather focus on how the surplus is generated.

$$\Gamma = K_1^{PT} - K_1^{PE} + \beta\mathbb{E}[\pi_1(K_1^{PE}, \tilde{Z}_1) - \pi_1(K_1^{PT}, \tilde{Z}_1)] + \beta_D Br_D\tau \tag{1.14}$$

Taking the derivative of equation (1.14) with respect to K_1^{PT} illustrates that the premium is increasing in the level of over-investment.

$$\frac{\partial\Gamma}{\partial K_1^{PT}} = 1 - \beta\mathbb{E}[\pi_K(K_1^{PT}, \tilde{Z}_1)] = 1 - \frac{(1-\tau)\alpha\beta\mathbb{E}[\tilde{Z}_1]}{K_1^{PT(1-\alpha)}} > 0 \tag{1.15}$$

1.3.1 Hypotheses

In practice, over-investment occurs when firms experience positive total factor productive shocks that generating the excess cash flows, enabling the managers to invest inefficiently. Understanding that firms need to have excess free cash flows to be able to empire build, this framework makes the following predictions.

Hypothesis 1. *Prior to takeover, target firms experience positive total factor productivity stocks and these shocks result in excess free cash flows.*

Hypothesis 2. *Prior to takeover, excess free cash flows from positive shocks are reinvested and firms experience positive asset growth.*

Hypothesis 3. *Post-acquisition, the least productive assets are liquidated and the size of the firm is reduced to the optimal level and the underlying assets become more profitable.*

1.4 Data Collection

The sample consists of U.S. private equity fund acquisitions of public companies announced between January 1, 1980 and December 31, 2006 with a total transaction value in excess of $50 million.[9] Sources include the SDC Platinum database and the list of LBOs from both Kaplan (1989) and Guo et al. (2011).[10] This produces a list of 521 firms which is linked to COMPUSTAT for financial records. A manual search of filings (S-1, S-4, 10-K, 10-Q, etc.) from the SEC Edgar database and microfiche records at the Haas School of Business complements COMPUSTAT. Using this unique data set and presentation, private equity is no longer private. The veil is removed for approximately 35% of the traditional public to private LBOs.

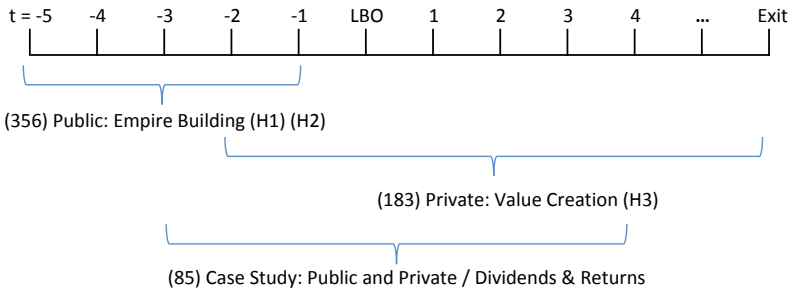
[9] Any acquisitions where the private equity did not obtain control are excluded. Infrequently, private equity funds will partner with non-private equity investors, management or ESOPs and own less than 50% of the equity. These deals are also excluded.

[10] From these lists 48 LBOs are identified that are not included in SDC's database.

Table 1.1: Public to Private LBO Sub-Samples Presented

Table 1.1 reports summary statistics for the three sub-samples presented in this paper: (Public) 356 firms that have complete financial statements for 5 years prior to LBO; (Private) 183 firms that have complete financial statements for 2 years prior to the LBO and while controlled by the private equity fund; and (Case Study) 85 firms that have complete financial statements for 3 years prior and 4 years post-acquisition while controlled by the private equity fund. Select financial information is provided for each group using the financial information available from period t = -1. Values are in millions of dollars. A timeline is also presented with a description. (H) indicates the hypothesis that the sub-sample will be used to test.

Sub-samples	**Public**	**Private**	**Case Study**
Number of LBOs	356	183	85
Periods	-5:-1	-2:Exit	-3:4
Economic Significance			
% of Total Value of Deals	50%	38%	19%
% of Total Number of Deals	23%	12%	6%
% of Public to Private Value	77%	58%	30%
% of Public to Private Deals	68%	35%	16%
Type of Exit			
Strategic Buyer	22%	19%	14%
Still Private	23%	20%	25%
Financial Buyer	12%	0%	8%
IPO	24%	35%	34%
Bankruptcy	18%	22%	16%
Out of court restructuring	2%	4%	2%
	100%	**100**%	**100**%
Financial Summary			
Assets (Mean)	1,251	1,553	1,565
Assets (Median)	312	457	478
Sales (Mean)	1,271	1,660	1,916
Sales (Median)	424	598	598
Vintage			
1980s	145	66	24
Post 1980s	211	117	61
Timeline			



Cash flow statements are created for three sub-samples shown in Table 1.1: (i. *Public*) 356 firms that have complete financial statements for 5 years prior to LBO. This group is used to better understand the characteristics of target firms and inefficient investment; (ii. *Private*) 183 firms that have complete financial statements for 2 years prior to the LBO and while controlled by the private equity fund.[11] This sample is used to test value creation and cash flow improvements. To dampen the attrition in this group, two adjustments are made: (1) Transactions between financial buyers are not treated as exits. These firms are followed until they exit the control of private equity funds; and (2) When firms exit private control via an IPO, often the fund still owns more than 50% of the firm's equity. These firms are included in this sample until private equity ownership falls below 50%; and (iii. *Case Study*) 85 firms that have complete financial statements for 3 years prior and 4 years post-acquisition while controlled by the private equity fund. This group is used as a case study because it contains a fixed set of firms for an seven year window. Therefore, this data set can be used to illustrate the relationship between cash flows and returns and between investment and growth pre- and post-acquisition.

1.4.1 Economic Significance

This paper focuses on traditional private equity investments. This refers to publicly traded firms that are acquired and taken private using a capital structure consisting mostly of debt. Non-traditional private equity investments include the acquisition of private companies and divisions of firms that are divested. The number and economic significance of the traditional versus non-traditional LBOs are presented in Table 1.2. The total transaction value of all 1,540 LBOs between 1:1980 and 12:2006 is $1.1 trillion. There were 521 traditional public to private LBOs, 255 private to private LBOs and 764 divestiture LBOs. The need to evaluate financial statements pre- and post-acquisitions narrows the focus to public to private LBOs. This limitation may appear significant when one considers the number of LBOs that are excluded. However, considering the economic importance of these transactions, public to private LBOs account for 65% of the economic value and the 183 LBOs tested in this paper account for 38% of the total value. Even the 85 LBOs used as a case study for illustrative purposes account for 19% of the total transaction value.

[11] We determine control using publicly available financial statements, Factiva, Lexis-Nexis, Hoover's and other major news sources to follow the history of the firm and specifically determine how and when the company exited private equity ownership. The possible exit strategies are initial public offering (IPO), sale to a strategic buyer, sale to another financial buyer (i.e. private equity fund), and bankruptcy or out of court restructuring.

Table 1.2: Economic Significance of Traditional Private Equity Investments

Table 1.2 uses SDC to identify LBOs completed with a transaction value in excess of $50 million over the sample period of 1:1980 - 12:2006. The number of LBOs and aggregate transaction values are presented. Additionally, the sub-samples with complete financial statements that are evaluated post-acquisition are presented. Values are in millions of dollars.

		Public	Private		In This Paper	
	All LBOs	**to Private**	**to Private**	**Divestitures**	**Private**	**Case Study**
Value	1,086,003	709,881	68,411	307,711	410,667	210,353
% of Value	100%	65%	6%	28%	38%	19%
# of LBOs	1,540	521	255	764	183	85
% of LBOs	100%	34%	17%	50%	12%	6%

1.4.2 Outcomes for Firms Acquired by Private Equity Funds

Table 1.3, Panel A presents outcomes for firms acquired by private equity funds and provides the average number of years controlled by the private equity funds. The average time controlled by private equity funds is 6.3 years with 24% exiting via IPO and 10% traded between private equity funds. Table 1.3, Panel B presents outcomes with the two adjustments.[12] With these adjustments, the holding period increases to 7.0 years and there is an approximately even split between IPOs, sales to strategic buyers, bankruptcy or restructuring, and still private.

1.4.3 Sample Selection Bias

There is a potential sample selection bias as a result of the focus on firms with publicly available financial statements. The firms that continue to produce public financial statements after being acquired by private equity funds are typically the larger LBOs that issued "widely held" debt to finance the acquisition. Additionally, firms that exit private equity ownership via IPO are more likely to be included in our sample as historical financial statements are required as part of the IPO process. Table 1.1 presents firm size and exits for the different subsamples. The sub-samples with financial information post-acquisition are clearly the larger LBOs and disproportionately exit private equity control via IPO. As IPOs are typically associated with positive outcomes, tests of profitability will be biased in favor of finding positive operating performance.

[12]IPOs are only adjusted if financial statements are available on EDGAR. Older IPOs are not adjusted as proxy statements used to determine ownership are not available in the microfiche records at UC Berkeley. Companies were phased on to the EDGAR filing system over a three-year period, ending May 6, 1996. As of that date, all public domestic companies were required to make their filings available on EDGAR.

Table 1.3: Outcomes for Firms Acquired by Private Equity Funds

Table 1.3 reports the methods utilized by private equity funds to monetize investments over the sample period of 1:1980 - 12:2006. Bankruptcy and out of court restructuring would indicate a loss of equity invested by the private equity fund. The table also presents the average number of years that firms were held by private equity funds. Results for both the 521 firms identified in our analysis and for the sub-sample firms with complete financial statements are provided. To dampen the attrition in this sub-sample of 183 LBOs tested, two adjustments are made: (1) Transactions between financial buyers are not considered exits. These firms are followed until they exit the control of private equity funds; and (2) When firms exit private equity control via an IPO, often the fund still owns more than 50% of the firm's equity. These firms are included in this sample until the ownership falls below 50%.

Panel A			
Type of Exit	**# of LBOs**	**% of LBOs**	**Years Held**
Strategic Buyer	117	22%	5.2
Still Private	114	22%	11.6
Financial Buyer	53	10%	5.0
IPO	126	24%	4.1
Bankruptcy	101	19%	5.3
Out of court restructuring	10	2%	4.4
	521	**100%**	**6.3**
Panel B			
Type of Exit	**# of LBOs**	**% of LBOs**	**Years Held**
Strategic Buyer	124	24%	6.0
Still Private	143	27%	11.4
Financial Buyer	0	0%	0
IPO	131	25%	5.1
Bankruptcy	110	21%	5.7
Out of court restructuring	13	2%	5.7
	521	**100%**	**7.0**

1.4.4 LBOs versus Other Private Equity Investments

The term private equity is used generically to describe an array of investment strategies. It describes everything from investments in start-ups by venture capitalists to the acquisition of entire firms using significant leverage. The literature typically relies on a leveraged buyout indicator from SDC Platinum to identify LBOs. Unfortunately, SDC's LBO indicator is

Table 1.4: Understanding the SDC LBO Flag

Table 1.4 uses SDC to identify public to private LBOs over the sample period of 1:1980 - 12:2006 with a transaction value in excess of $50 million and LBOs between $10 and $50 million. The number of LBOs with pre- and post-acquisition financial statements is presented with the total. Select financial information is presented for both groups to illustrate capital structure changes and specifically changes in debt between periods t = -1 and t = 0. Values are in millions of dollars.

	In this Paper		**LBOs $10 - 50**	
Number of Firms	**183 of 521**		**20 of 154**	
Period	**t = -1**	**t = 0**	**t = -1**	**t = 0**
Cash	92	59	21	24
Current assets Total	440	453	119	164
Plant, property & equip.	642	693	26	25
Intangibles	330	1,082	10	8
Total assets	**1,553**	**2,442**	**432**	**449**
Total current liabilities	303	368	270	268
Long term debt	510	1,568	44	42
Total liabilities	**996**	**2,254**	**388**	**409**
Shareholders' equity	**557**	**188**	**46**	**43**

misleading for smaller transactions.[13,14] To illustrate this, Table 1.4 presents SDC identified LBOs greater than $50 million and LBOs between $10 - $50 million that have financial information for the periods t= -1 and t = 0. For the LBOs presented in this paper, the average long term debt increase from $0.5 billion to $1.6 billion. This implies that the debt level post-acquisition is greater than assets pre-acquisition. For LBOs in the $10 - $50 million range, there is no evidence of the use of debt to reduce agency conflicts. The financing of these smaller acquisitions is not leveraged, therefore, a transaction value cutoff is required to ensure the study is specific to LBOs.

In this paper, a transaction size cutoff of $50 million is used to ensure that the results

[13]Because the majority of firms acquired by private equity funds do not publish financial statements, data service providers cannot use leverage to classify transactions. Rather, the presence of a private equity fund is sufficient to receive the LBO indicator. The lack of financial information makes this shortcoming common among all data service providers.

[14]Source: SDC definitions. Leveraged Buyout Flag: Retrieves leveraged buyout transactions. Thomson Reuters includes transactions in which management forms a part of the investor group in this definition, as well as transactions that are identified as an LBO in the financial press if a majority interest of the target company is acquired.

are specific to buyouts financed with significant leverage. The literature, including Boucly, Sraer, and Thesmar (2011), Cohn, Mills, and Towery (2014) and Davis et al. (2011), fails to make this distinction and therefore limits or distorts our understanding of the effect of leveraged buyouts on growth, investment, employment and value creation.

1.5 Summary Statistics

The objective of this paper is to understand the origin, use, and ownership of cash flows generated by private equity controlled firms. In a perfect world, researchers would use prices to determine value. As prices do not exist, I take the approach followed by theory models and consider cash flows. For LBOs between 1:1980 and 12:2006, I have reconstructed integrated financial statements. For each firm there is a balance sheet, income statement and cash flow statement, and the change in cash balance agrees to the penny. Throughout the paper I use an event study format, where period t = 0 represents the year of the LBO. In this section I only present summary statistics for the 85 LBOs in the *case study* sub-sample. This sub-sample presents financial information for an seven year window, beginning three years prior to and ending four years after the LBO. Therefore, this sub-sample provides a unique look into the operations of firms controlled by the private equity funds. In this paper, I use cash flow statements to answer three frequently debated questions: (1) Do private equity controlled firms generate more cash from underlying assets than public firms? (2) What is the source of cash used to fund dividends to private equity owners? and (3) Are returns to private equity funds generated by value creation?

1.5.1 Origin, Ownership and Use of Cash Flows

Some accounting information is arcane, so it is useful to review how accounting information maps into the economic fundamentals. A firm's assets in place are used to generate cash flows. Following theory models, where ownership is determined by absolute priority rules, I allocate cash flows to taxes due to the government and debt service with the remainder available to management to reinvest or pay as dividends. Figure 1.1 presents a summary of the origin, ownership and use of cash flows pre- and post-acquisition for the case study sub-sample of 85 LBOs. The factories can be interpreted as the assets in place and the origin of the cash flows. The pie charts allocate ownership of cash generated and present investment decisions pre- and post-acquisition. *Cash generated* is defined as tax expense plus interest expense (from income statements, Table 1.21) plus cash from operations (from cash flow statements, Table 1.23). In the pre-acquisition period, the cash flows presented are the average cash flows over periods t = -1 and t = -2. The post-acquisition period is split into two periods: the restructuring period, periods t = 1 and t = 2 and the post-restructuring period, periods t = 3 and t = 4. In the pre-acquisition period, approximately half of the

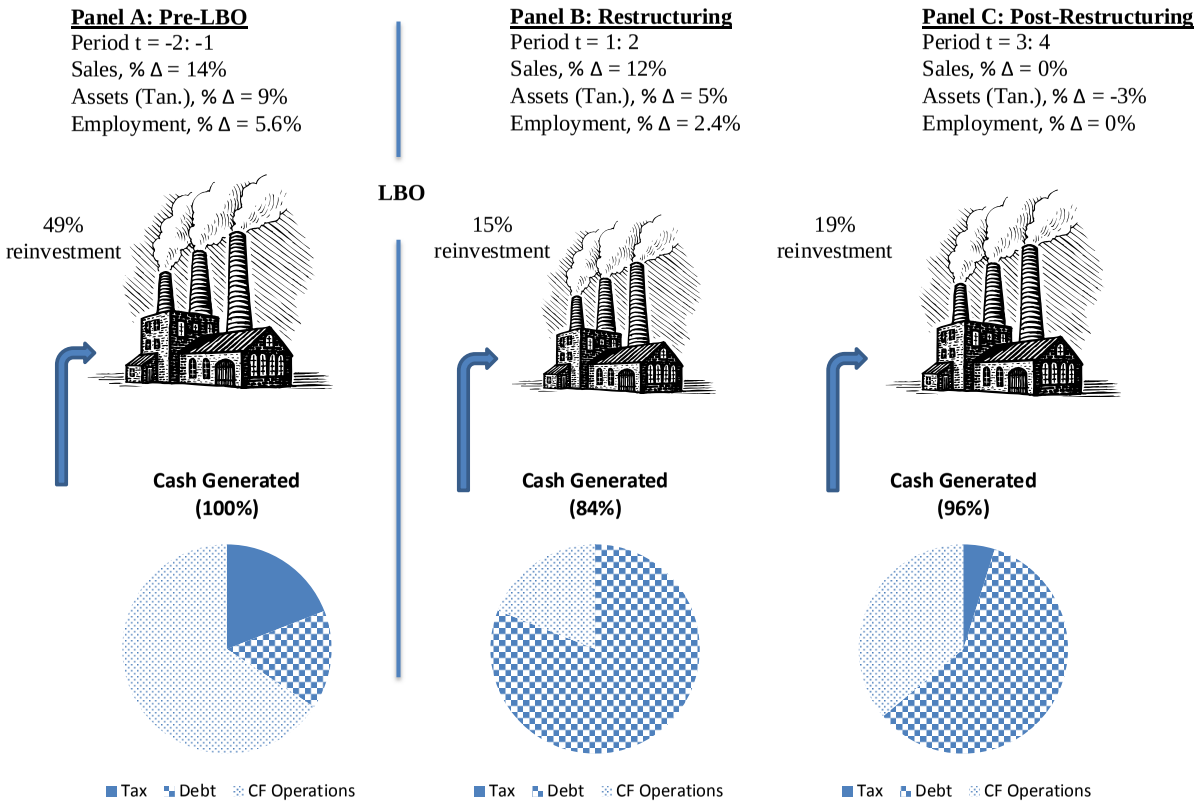


Figure 1.1: Origin, Ownership and Use of Cash

Figure 1.1 presents a summary of the origin, ownership and use of cash flows pre- and post-acquisition for a sub-sample of 85 LBOs. In the pre-acquisition period, the allocation of cash flows and the reinvestment rate are the average over periods t = -1 and t = -2. The post-acquisition period is split into two periods: the restructuring period, periods t = 1 and t = 2 and the post-restructuring period, periods t = 3 and t = 4. The cash generated post-acquisition is presented normalized to the average pre-acquisition balance the in parentheses below the pie charts. Also presented are average growth rates for sales and tangible assets between the periods indicated in the panel. The employment figures are medians and are based on 51 firms that provide employment figures over the entire seven year window (see Table 1.5).

cash generated is reinvested in the company. The *reinvestment ratio* is defined as cash used for investing (see Table 1.23) divided by cash generated. Post-acquisition, less than 20% of the cash generated is reinvested. The cash generated decreases to 84% of the average pre-acquisition balance and then recovers to 96%. The short-term reduction in cash flows is the result of restructuring initiatives implemented by the private equity owners, while the long term reduction is due to assets sales reducing the capital base.[15] The interest tax shields play an important role in financing the interest on the debt. The average firm does not pay taxes in the first two years post-acquisition.

Also presented in Figure 1.1 are average growth rates pre- and post-acquisition. Tangible asset growth declines from 9% pre-acquisition to 5% in the restructuring period, and is negative in the post-restructuring period. Declines in sales growth appear to follow reductions in investment with a lag. However, four years of reduced investment results in stalled sales and employment growth. All figures are taken from Table 1.5. The employment figures are medians and are based on 51 firms that provide employment figures over the entire seven year window.

1.5.2 Reduction of Investment

Private equity funds use debt to motivate the reduction of wasteful investment. Figure 1.2 presents an analysis of investment decisions pre- and post-acquisition for the case study sub-sample of 85 LBOs. Cash used for investment (*net investment*) declines significantly in the post-acquisition period. Overall, net investment decreases 74% when comparing the average balance for the two years prior to the acquisition with the average balance for the two years after. Also, gross investment[16] is slower to decline as long term projects may be more difficult to decommission or face capital adjustment cost that are increasing in the rate of decommissioning. Therefore, divestment of the least productive assets generates the cash necessary to fund the investment of the most productive assets and service the substantial debt. Asset sales include the sale or divestment of PP&E and intangibles, the sale of investments in other firms and the sale of other long term assets. These figures are presented in the cash used for investing analysis in Table 1.24. Additionally, equity financing of investment contributes to cash available to managers in the post-acquisition period.[17] With this understanding, the cash flow statements are used to answer the first question: Do private

[15] Restructuring costs are included in the special items line on the income statement (see Table 1.21).

[16] Gross investment is defined as capital expenditures, acquisitions, investments in other firms or the purchase of other long term assets (see Table 1.24).

[17] A review of annual reports filed with the Securities and Exchange Commission (SEC) indicates that additional stock is issued to finance investment. This occurs in two ways; (1) the private equity fund invests additional cash in exchange for new shares; and (2) firms acquired by the LBO firm accept stock in lieu of cash. This second method of financing is more common and results in dilution of ownership. Cash from equity financing is presented in Table 1.23.

Table 1.5: Growth and Employment for Firms Acquired by Private Equity Funds

Table 1.5 reports average tangible assets and sales growth for a sub-sample of 85 firms in Panel A. Net investment is presented as a percentage of the average pre-acquisition balance over periods t = -1 and t = -2. The reinvestment ratio is defined as cash used for investing divided by cash generated, where cash generated is defined as interest and tax expense plus cash from operations. Panel B reports employee statistics for a reduced sample of 51 firms. Summary statistics are provided for two full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Panel A: Growth							
Number of Firms	85	85	85	85	85	85	85
Tangible Asset Growth	15%	9%	12%	6%	5%	-2%	-3%
Sales Growth	18%	14%	16%	12%	12%	1%	0%
Net Investment	100%			29%	24%	40%	35%
Reinvestment Ratio	55%	44%		16%	14%	21%	17%
Panel B: Employment							
Number of Firms	51	51	51	51	51	51	51
Employees (mean)	21,089	21,203	19,895	20,543	21,316	21,246	21,164
Employee growth (mean)	11.4%	9.5%	2.3%	10.0%	3.7%	-3.4%	-2.0%
Employees (median)	3,700	3,711	4,100	4,500	4,200	4,400	4,700
Employee growth (median)	3.5%	5.6%	2.6%	4.8%	2.4%	-0.9%	0.0%

equity controlled firms generate more cash from underlying assets?

1.5.3 Cash Flows

As defined in this paper, value creation occurs when the underlying assets generate more cash. In practice, increases in cash flows are generated from two sources: (1) the reduction of inefficient investment that increase the profitability of the remaining underlying assets; and (2) financial management. Table 1.6, Panel A presents select profitability measures for the case study sub-sample of 85 LBOs over the period t = -2 to t = 4. Return on net operating assets (RNOA) is the accounting equivalent to return on invested capital and measures how many dollars of income a company creates per dollar of net operating

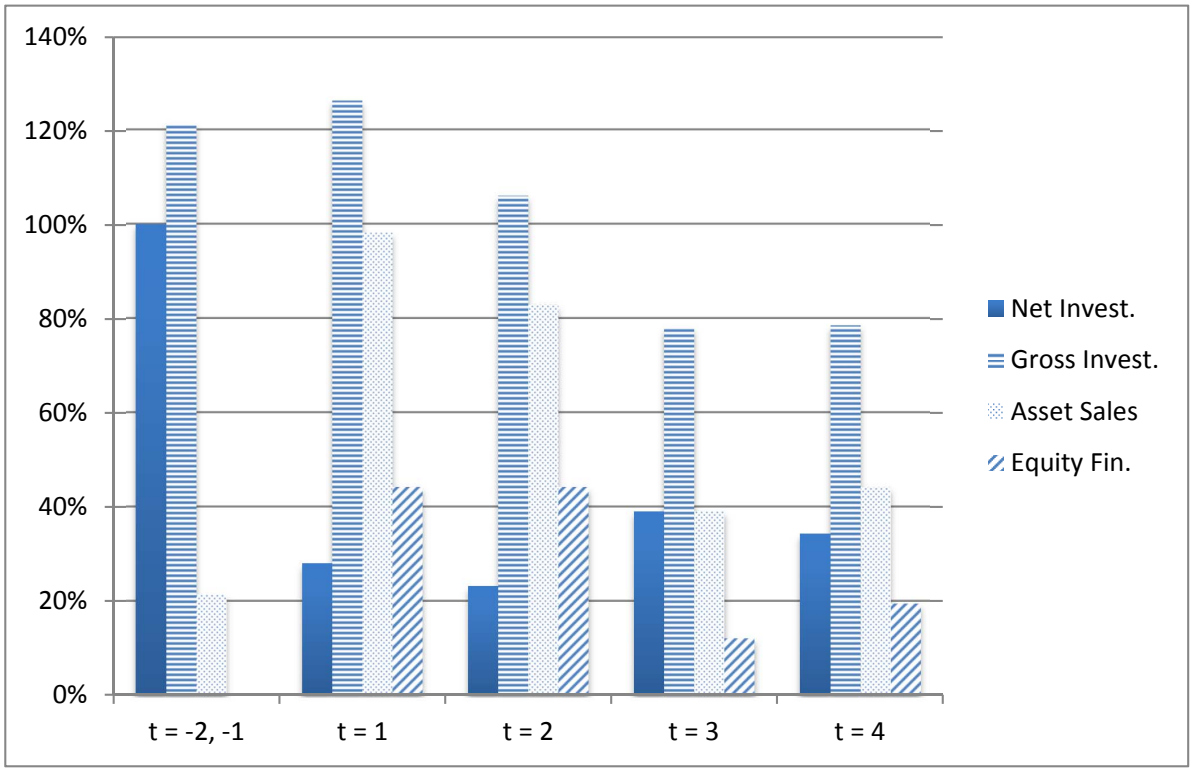


Figure 1.2: Investment

Figure 1.2 illustrates investment decisions pre- and post-acquisition for a sub-sample of 85 LBOs. Net investment is cash used for investing from the cash flow statements (see Table 1.24). The net investment balance pre-acquisition is the average balance over periods t = -1 and t = -2, while the post-acquisition balances are normalized to this period. Gross investment is defined as capital expenditures, acquisitions, investments in other firms or the purchase of other long term assets (see Table 1.24). Gross investment is presented as a percentage of net investment. Asset sales include the sale or divestment of PP&E and intangibles, the sale of investments in other firms and the sale of other long term assets (see 1.24). Asset sales and equity financing are also presented as a percentage of net investment. Equity financing is presented in the cash flow statements (see Table 1.23).

assets.[18] *Operating income* is defined as net income plus interest, taxes, amortization and depreciation, and impairments of goodwill. To account for asset sales and acquisitions, operating income is normalized by both sales and tangible assets. Earnings before interest, taxes, depreciation and amortization (EBITDA) is also presented normalized by both sales and tangible assets to highlight its shortcomings in evaluating LBOs. Evaluating periods t = 1 and t = 2, EBITDA remains constant while operating income declines. EBITDA fail to incorporate all of the cash flows associated with the restructuring of the firm once acquired.[19]

[18]See Nissim and Penman (2001) for RNOA derivation.

[19]See Ayash and Schütt (2013) for a discussion of variable selection in the LBO environment.

Operating income as defined is similar to EBITDA but captures spending on restructuring initiatives implemented by the new private equity owners. Tests of significance are presented in the *Empirical Results* section using medians for seven years post-acquisition. In summary, there is no evidence that the reduced investment improves profitability. The reduction in RNOA post-acquisition in Table 1.6 is due to LBO accounting and is shown to illustrate why variables are normalized using tangible assets.

Financial management includes increases in cash flows associated with working capital management, risk management and cash management. Table 1.6, Panel B presents proxies for working capital management for the case study sub-sample of 85 LBOs over the period t = -2 to t = 4. Financial management expertise is demonstrated in effective collection of monies due, an ability to negotiate favorable credit terms with suppliers in the short term, a decrease in inventory on hand, and an ability to operate with less cash on hand. Tests of significance are presented in the *Empirical Results* section using medians for seven years post-acquisition. In summary, there is evidence of improved working capital management in the post-acquisition period. These findings are consistent with improved working capital management presented in Smith (1990) and improved total factor productivity presented in Lichtenberg and Siegel (1990). As in Lichtenberg and Siegel (1990), the results indicate that gains are temporary, or one-time increases in cash flows, as excess cash is removed from the working capital management process.

An evaluation of risk management practices was conducted through a manual review of SEC filings, specifically, reviewing Item 7A: Quantitative and Qualitative Disclosures About Market Risk in the annual reports at periods t = -1 and t = 1 to evaluate changes in derivative use and hedging activities. Results indicate that there is an increase in hedging activities and derivatives use in the post-acquisition period. Of the 85 LBOs in the private sub-sample, 48 report Item 7a in both periods t = -1 and t = 1. Of these firms, 22 increase hedging activities while 23 do not change risk management activities. For 3 firms I notice a reduction in hedging, exposing target firms to increased interest rate and commodity price risk. The results are presented in Table 1.6, Panel C. Although cash flows are not directly allocated to risk management activities in this paper, these actions could be construed as value creation if they reduced the volatility of cash flows to private equity owners.[20]

1.5.4 Funding of Dividends

The study of cash flows results in evidence supporting the position that private equity controlled firms generate more cash flow from underlying assets using financial expertise. Unfortunately, determining the source of cash used to fund dividends is more difficult, but linking cash flows to their origination provides useful insights. Table 1.7 presents the underlying assets and growth rates for the case study sub-sample of 85 LBOs pre- and post-acquisition.

[20]LBO bankruptcy rates are in excess of 20%. Therefore, hedging activities may provide benefits to private equity owners if they reduce cash flow uncertainty during the short-term holding period.

Table 1.6: Performance of Firms Acquired by Private Equity Funds

Table 1.6, Panel A, reports profitability proxy averages for a sub-sample of 85 firms. Return on net operating assets (RNOA), and *Operating Income* and EBITDA normalized by both sales and tangible assets are presented. *Operating Income* is defined as net income plus interest, taxes, amortization and depreciation, and impairments of goodwill. EBITDA is defined as earnings before interest, taxes, depreciation and amortization. Table 1.6, Panel B, reports cash management proxy averages for a sub-sample of 85 firms. Days of accounts payable (AP) outstanding is calculated as accounts payable divided by costs of goods sold multiplied by 365 days. Days of accounts receivable (AR) outstanding is calculated as accounts receivables divided by sales multiplied by 365 days. Days of inventory on hand is calculated as inventory divided by cost of goods sold multiplied by 365 days. Summary statistics are provided for two full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Table 1.6, Panel C, evaluates risk management activities using Item 7A in the annual reports.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Number of Firms	85	85	85	85	85	85	85
Panel A: Operational Mgmt.							
Operating Income / Assets (Tan.)	19%	22%	21%	16%	17%	19%	19%
Operating Income / Sales	14%	15%	15%	10%	12%	13%	10%
EBITDA / Tangible Assets	20%	22%	19%	21%	22%	21%	21%
EBITDA / Sales	14%	15%	14%	15%	14%	14%	13%
Return on Net Operating Assets	13%	14%	13%	3%	1%	9%	7%
Panel B: Cash Mgmt.							
Days AP Outstanding	40	38	43	41	43	40	39
Days AR Outstanding	51	49	48	48	47	48	43
Days Inventory on Hand	70	67	68	67	63	63	63
Cash	122	134	75	73	86	98	91
Panel C: Risk Mgmt.							
Item 7A		48/85		48/85			
Increase in Risk Management				22/48			
No Change in Risk Management				23/48			
Decrease in Risk Management				3/48			

The average tangible assets balance declines 6% over the four years post-acquisition. The cash generated[21] to tangible assets (*cash to assets) ratio* is approximately 20%. The restruc-

[21]The definition of cash generated is modified slightly to present the *Funding of Dividends*. In Figure 1.1, cash generated was defined as interest and tax expense plus cash from operations. In Table 1.7, I use the same definition but back out cash flows from changes in working capital and tax refunds (see Tables 1.21

turing process reduces the cash generated in periods t = 1 and t = 2, but firms recover by period t = 3. So although the average firm gets smaller, the cash to assets ratio remains constant.

Table 1.7: Origin and Ownership of Cash Flows

Table 1.7 reports value weighted asset growth and the average cash generated for a sub-sample of 85 firms. The definition of cash generated is modified slightly. Previously, cash generated was defined as interest and tax expense plus cash from operations. In this table, I use the same definition but back out cash flows from changes in working capital and tax refunds (see Tables 1.23 and 1.21). Working capital and tax refunds are presented separately as sources and uses of cash in Table 1.8 to illustrate the cash management expertise displayed by private equity controlled firms. The *residual* available to managers is cash from operations before cash from working capital and tax refunds. Summary statistics are provided for two full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values are in millions of dollars.

Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**
Number of Firms	85	85	85	85	85	85	85
Cash Generated (Modified)	**228**	**247**	**282**	**161**	**205**	**263**	**234**
Cash Generated (Mod.)/Assets (Tan.)	19%	20%	21%	13%	16%	20%	19%
Assets	1,511	1,565	2,560	2,436	2,330	2,290	2,199
Asset Growth	9%	4%	64%	-5%	-4%	-2%	-4%
Assets (Tangible)	1,214	1,259	1,325	1,283	1,283	1,282	1,249
Asset Growth (Tan.)	8%	4%	5%	-3%	0%	0%	-3%
Cash Allocation							
i) Taxes	45	50	12	-	5	13	10
ii) Interest	36	40	118	177	161	145	134
iii) Residual	147	158	153	(16)	39	104	90
Cash Generated (Modified)	**228**	**247**	**282**	**161**	**205**	**263**	**234**

Ownership of cash flows generated by the underlying assets is also presented in Table 1.7. In the pre-acquisition period, managers received the majority of the cash flows (the residual). The government and debt holders received an average of 20% and 16%, respectively, of cash generated over periods t = -2 and t =-1. Evaluating the post-acquisition period is best done by first understanding the restructuring process in periods t = 1 and t = 2. The cash to assets ratio is low because the firm is spending cash on restructuring items, such as layoffs or operations consolidation, which reduces the cash flow to managers after debt service. Debt

and 1.23). I present working capital and tax refunds separately in Table 1.8 as sources and uses of cash to illustrate the cash management expertise displayed by private equity controlled firms. The *residual* is cash from operations before cash from working capital and tax refunds.

holders receive on average 91% of cash generated in periods t = 1 and t = 2, while managers incur a loss in period t = 1. In periods t = 3 and t = 4 the cash to assets ratio recovers and the managers again begin to receive cash flows from the underlying assets. Debt continues to receive the majority of the cash flows, but managers and the government receive an average of 39% and 5%, respectively.

With this understanding, Table 1.8 presents the sources and uses of cash for the case study sub-sample of 85 LBOs pre- and post-acquisition. In the pre-acquisition period, managers receive the residual and generate additional cash from other sources. They sell assets, use the "flexibility" of working capital, issue debt and enter alternative financing arrangements.[22] These actions provide additional cash for investment and dividends. In this period, firms have stable dividend policies with a payout ratio of approximately 30% and reinvest approximately half of the cash generated. The *payout ratio* is defined as cash dividends divided by cash from operations.

During the restructuring period, t = 1 and t = 2, managers compensate for the reduction in cash from assets by selling unproductive assets, reducing working capital, financing investment with equity[23] and alternative financing. The LBO structure also allows these firms to use post-acquisition accounting losses to recover taxes paid in the pre-acquisition period as firms receive a tax refund in period t = 1.[24] In financing LBOs, assets are pledged as collateral to debt holders. As assets are sold, debt holders require some repayment as illustrated by the corresponding debt reduction in the post-acquisition period. However, even with these cash raising activities, net investment is only 27% of the average pre-acquisition level in periods t = -1 and t = -2.

In periods t = 3 and t = 4, the cash to assets ratio recovers to 20%, but due to the change in capital structure the average residual managers received is only 39% of the cash generated versus an average of 64% under the old capital structure. Asset sales are reduced but remain above the pre-acquisition level. Working capital is replenished, returning the amount "borrowed" during the restructuring period. The funding of dividends is done by keeping net investment in periods t = 3 and t = 4 near levels necessary during the restructuring periods. The discipline instilled on the organization during periods t = 1 and t = 2 is essentially maintained during periods t = 3 and t = 4. Therefore, in period t = 3, when the cash to assets ratio recovers, managers replenish working capital and increase the cash balance

[22]This would include capitalized leases.

[23]An ongoing review of annual reports filed with the Securities and Exchange Commission (SEC) indicates that additional stock is issued to finance investment. This occurs in two ways; (1) the private equity fund invests additional cash in exchange for new shares and the firms use this money to finance acquisitions; and (2) private equity controlled firms acquire other firms using stock in lieu of cash. This second method of financing is more common and results in dilution of ownership.

[24]Clearly there is a difference between accounting and tax records but the accounting records indicate that these firms are eligible to file for tax refunds. The extent of this financing can only be determined by reviewing IRS data or additional hand collection within the accounting records which is beyond the scope of this project.

Table 1.8: Source of Funding for Dividends

Table 1.8 reports average sources and uses of cash flows for a sub-sample of 85 firms. The residual to managers is supplemented with additional cash sources. The residual available to managers is cash from operations before cash from working capital and tax refunds. The cash to assets ratio is from Table 1.7 and sources and uses of cash are from Tables 1.23 and 1.24. Net investment is cash used for investing and is also presented normalized to the average balance over periods t = - 2 and t = -1. The reinvestment ratio is defined as cash used for investing divided by cash generated, where cash generated is defined as interest and tax expense plus cash from operations. The payout ratio is defined as cash dividends divided by cash from operations. Summary statistics are provided for two full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values are in millions of dollars.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Number of Firms	85	85	85	85	85	85	85
Sources of Cash							
Residual	147	158	153	(16)	39	104	90
Cash to Assets Ratio	19%	20%	21%	13%	16%	20%	19%
Additional Sources							
Assets Sales	29	31	62	122	104	49	55
Working Capital	8	13	(12)	34	0	(33)	11
Debt Financing	53	1	1,280	-	-	-	-
Equity Financing	-	-	-	55	55	15	24
Alternative Financing	10	-	53	13	6	7	-
Tax refunds	-	-	-	18	-	-	-
Cash Available	**246**	**203**	**1,536**	**227**	**204**	**142**	**181**
Uses of Cash							
Gross Investment	(158)	(145)	(1,133)	(157)	(133)	(97)	(98)
Dividends	(44)	(45)	(463)	(6)	(8)	(9)	(60)
Repayment of Debt	-	-	-	(65)	(51)	(23)	(18)
Alternative Financing	-	(0)	-	-	-	-	(12)
Change in Cash	**44**	**13**	**(60)**	**(2)**	**13**	**13**	**(7)**
Cash on Hand	122	134	75	73	86	98	91
Net Investment	(130)	(113)	(1,070)	(35)	(29)	(49)	(43)
% of Pre-LBO Invest.	100%			29%	24%	40%	35%
Reinvestment Ratio	55%	44%		16%	14%	21%	17%
Payout Ratio	28%	27%					59%

in anticipation of paying a dividend. In period t = 4, private equity managers choose a level of net investment that is 35% of the average pre-acquisition level, which corresponds

to a 59% payout rate. This decision enables the payment of a large dividend. The financial management expertise allows private equity managers to better manage cash flows during the restructuring process but the payment of dividends is clearly funded by a decision to reduce investment prior to selling the firm.

1.5.5 Returns

I use cash flow statements to answer the final question addressed in this paper: Are returns to private equity funds generated by value creation? As prices are not available, returns are calculated using an estimated firm value, referred to as net asset value (NAV). Harris et al. (2012) are forced to use a similar approach to estimate returns in the absence of prices. In this paper, the estimate of NAV at period t = 4 is calculated using a multiple of enterprise value to EBITDA.[25] The exit multiple used to calculate the NAV is the same as the average multiple reported at LBO. This approach is conservative in that it assumes that the price of the cash flow proxy EBITDA pre- and post-acquisition is unchanged and that value only increases with increases in cash flows. To account for dilution associated with equity financing, private equity fund control is calculated using an NAV approach.[26]

Table 1.9, Panel A presents returns separately for equity and debt holders and as total invested capital for the case study sub-sample of 85 LBOs. The cash flow statements capture all distributions between t = 1 and t = 4 and the median enterprise value to EBITDA multiple observed at LBO of 9.0x is used to calculate NAV at exit.[27] The internal rate of return (IRR) on invested capital is 9.0%. However, the cost of borrowing of 9.3% is greater than the return generated by the underlying assets. This implies that the cash generating power is insufficient to cover the cost of funding debt. Whenever this relationship exists, the return to equity holders is adversely affected. This is clearly illustrated in the low 8.1% IRR to equity holders. This analysis, while not based on market prices, supports the position that firms controlled by private equity funds do not experience significant improvements in profitability. Equity value will always be reduced when borrowing costs are greater than the underlying profitability of the firms' assets. However, fees paid by target firms to private equity funds are illustrated to substantially bolster returns. A review of the financial statements[28] indicates that most firms acquired pay one time acquisition fees to the private equity owners and annual maintenance

[25]Enterprise value is defined as the book value of total debt plus the book value of preferred equity plus the market value of equity.

[26]For example, the LBO firms raised an average of $55 million in period t = 1. Using lagged EBITDA of $234, enterprise value is calculate as 9.0x $234 = $2,105 million. Subtracting total debt of $1,691 in period t = 1, equity has a NAV of $414 million. Therefore, the $55 million in equity financing raised in period t = 1 is worth 13% of the firm.

[27]The multiple is calculated using Enterprise Value at LBO from SDC Platinum divided by lagged EBITDA, from period t = -1. When Enterprise Value is not provided Transaction Value from SDC is used.

[28]Specifically, the Related Parties Transactions section of the annual reports.

Table 1.9: NAV and Return Estimates for Private Equity Investments

Table 1.9, Panel A presents returns separately for equity and debt holders and as total invested capital for a sub-sample of 85 LBOs. The cash flow statements capture all distributions between t = 1 and t = 4 and the median enterprise value to EBITDA multiple observed at LBO of 9.0x is used to calculate the NAV at exit. The internal rate of return (IRR) on invested capital is 9.0%, the cost of borrowing is 9.3%, and the return to equity holders is 8.1%. To account for dilution associated with equity financing, private equity fund control is calculated using the same NAV approach. Fees are incorporated by adding a 5% one time fee at acquisition and a $3 annual service charge which increases the reported IRR to 10.2%. Panel B provides a sensitivity analysis using various EBITDA multiples to calculate the exit value. Values are in millions of dollars. Negative values represent investment.

Panel A:

Period	**Capital**	**Interest**	**Principal**	**Dividends**	**Control**	**Total**
t = 0	(2,216)					(2,216)
t = 1	-	177	65	5	87%	248
t = 2	-	161	51	6	79%	219
t = 3	-	145	23	7	77%	176
t = 4	2,162	134	18	45	74%	2,359
					IRR	**9.0%**

Period	**Debt**	**Int.**	**Prin.**	**Total**
t = 0	(1,757)			(1,757)
t = 1	-	177	65	243
t = 2	-	161	51	212
t = 3	-	145	23	168
t = 4	1,600	134	18	1,751
			IRR	**9.3%**

Period	**Equity**	**Div.**	**Control**	**Total**	**Fees**	**Total**
t = 0	(460)			(460)	23	(437)
t = 1	-	5	87%	5	3	8
t = 2	-	6	79%	6	3	9
t = 3	-	7	77%	7	3	10
t = 4	562	45	74%	607	3	610
			IRR	**8.1%**	**IRR**	**10.2%**

Panel B:

	LBO Multiple	**Exit Multiple**	**IRR Capital**	**IRR Debt**	**IRR Equity**
i.	9.0	9.0	9.0%	9.3%	8.1%
ii.	9.0	8.5	8.0%	9.3%	3.4%
iii.	9.0	9.5	10.0%	9.3%	12.3%

Table 1.10: NAV and Return Estimates for Publicly Traded Firms

Table 1.10 presents returns separately for equity and debt holders and as total invested capital for a subsample of 85 LBOs. The cash flow statements capture all distributions between t = -3 and t = -1 and the median enterprise value to EBITDA multiple observed at LBO of 9.0x is used to calculate the NAV at t = -3 and t = -1. The internal rate of return (IRR) on invested capital is 12.4%, the cost of borrowing is 8.5%, and the return to equity holders is 13.6%. There is no dilution of equity control between the periods t = -3 and t = -1. Values are in millions of dollars. Negative values represent investment.

Period	**Capital**	**Interest**	**Principal**	**Dividends**	**Equity**	**Total**
t = -3	(1,701)					(1,701)
t = -2	-	36	(53)	44	100%	28
t = -1	2,031	40	(1)	45	100%	2,116
					IRR	**12.4%**
Period	**Debt**	**Interest**	**Principal**	**Total**		
t = -3	(423)			(423)		
t = -2	-	36	(53)	(17)		
t = -1	477	40	(1)	515		
			IRR	**8.5%**		
Period	**Equity**	**Dividends**	**Control**	**Total**		
t = -3	(1,278)			(1,278)		
t = -2	-	44	100%	44		
t = -1	1,555	45	100%	1,600		
			IRR	**13.6%**		

fees of a few million dollars. To understand how these fees increase the returns to equity, I incorporate fees by adding a 5% one time fee at acquisition and a $3 million annual service charge which increases the reported IRR to 10.2%. This illustration is only an attempt to highlight alternative methods used by private equity funds to generate returns but is consistent with the study of fees presented in Ayash, Bartlett, and Poulsen (2010). Table 1.9, Panel B illustrates how sensitive the return calculation is to NAV estimates. Decreasing the exit multiple to 8.5x reduces the IRR to equity holders to 3.4%, while increasing the multiple to 9.5x generates a 12.3% IRR to equity holders.

The same analysis is preformed using the 85 LBOs in the pre-acquisition period in Table 1.10. The median multiple of 9.0x at LBO is used to calculate the NAV at t = -3 and at t = -1.[29] The cash flow statements capture all distributions between t = -3 and t = -1.

[29]To calculate the NAV at t=-3, median EBITDA at t = -4 is required. However, only 81 firms report EBITDA at t = -4. I use the median EBITDA at t = -4 for the 81 firms of $189 to calculate enterprise value. The four firms that fail to report EBITDA in t = -4 have EBITDAs well below the median EBITDA at t = -3. Therefore, this approach is conservative as it inflates the purchase price and understates the returns.

The IRR on invested capital is 12.4%, the cost of borrowing is 8.5%, and the return to equity holders is 13.6%. The analysis of pre-acquisition returns provides additional evidence supporting the position that firms controlled by private equity funds do not experience significant improvements in profitability.

1.6 Empirical Results

1.6.1 Methodology

This section evaluates the characteristics and performance of target firms while both public and private and controlled by private equity funds. The characteristics of LBOs prior to being acquired are studied using the *public* sub-sample of 356 LBOs for the full four years pre-acquisition. The *private* sub-sample of 183 LBOs is used to study the characteristics and performance of LBO firms while controlled by private equity funds, up to seven years post-acquisition. Year 0 is the first year where the acquisition is recorded in the financial statements. As firms exit private equity control they exit the sample, with two exceptions: (1) Transactions between financial buyers are not considered exits. These firms are followed until they exit the control of private equity funds; and (2) When firms exit private equity control via an IPO, they are included in this sample until ownership falls below 50%. The analysis presents variables in two ways: (1) in levels; and (2) the percentage changes in the first seven full years after the buyout (periods +1, +2, +3, etc.) compared to the first full year before the buyout (period -1).

In order to evaluate the statistical significance of firm performance adjusted for economy wide and industry effects, industry adjusted figures are presented. The industry adjustment uses firms with assets greater than $50 million in the same four-digit SIC code as the acquired firm. Comparisons are made at the three-digit level and the two-digit level when fewer than three industry matches are found. The industry file is the merged COMPUSTAT and CRSP databases limited to firms that trade on the NYSE, AMEX and NASDAQ stock exchanges. Also excluded from the industry file are the LBO firms under analysis in this study.

To abstract from outliers that dominate the means in the small samples analyzed, I focus on medians. The results for Wilcoxon signed rank tests are used to test the significance of median values. All significance levels are based on two-tailed tests. This approach is conservative and implicitly assumes a null hypothesis that post-acquisition variables equal pre-acquisition variables.

1.6.2 Evaluation of Pre-Acquisition Performance

To investigate investment in target firms in the pre-acquisition period, Table 1.11 presents *net investment* normalized by both assets and sales for the *public* sub-sample of 356 LBOs. Net investment is defined as cash used for investing taken from the cash flow statement

Table 1.11: Investment Activities Pre-Acquisition

Table 1.11 reports median and mean values for investment measures and these same measures industry adjusted. Investment measures are provided for the four full years prior to acquisition by the private equity fund. Panel A presents net investment to assets, Panel B presents net investment to sales in millions, and Panel C presents the number of employees per million in sales. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels are based on two-tailed t-tests and Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t = -4**		**t = -3**		**t = -2**		**t = -1**	
Panel A: Net Investment to Assets Ratio								
Unadjusted								
Median	8%		8%		7%		6%	
Mean	11%		10%		10%		7%	
N	356		356		356		356	
Industry adjusted								
Median	1%	**	1%		0%		-2%	***
Mean	4%	***	2%	**	1%		-2%	***
N	224		252		272		295	
Panel B: Net Investment to Sales Ratio								
Unadjusted								
Median	5%		5%		6%		4%	
Mean	23%		15%		11%		8%	
N	356		356		356		356	
Industry adjusted								
Median	1%	**	1%		0%		-2%	***
Mean	19%		6%	*	2%		-1%	
N	224		252		272		295	
Panel C: Employees to Million in Sales								
Unadjusted								
Median	10		9		9		9	
Mean	13		12		11		11	
N	346		350		350		331	
Industry adjusted								
Median	0.4	**	0.6	**	0.2		0.3	
Mean	0.6	**	0.8	***	0.7	**	0.5	*
N	248		271		293		292	

presented in Table 1.23. Interestingly, there is significant investment in periods t = -4 and t = -3, and a significant decline in investment in period t = -1. It appears that investment is

Table 1.12: Investment Opportunities Pre-Acquisition

Table 1.12 reports median and mean values for Tobin's q and industry adjusted values for the four full years prior to acquisition by the private equity fund. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels are based on two-tailed t-tests and Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t = -4**		**t = -3**		**t = -2**		**t = -1**	
			Tobin's q					
Unadjusted								
Median	0.94		1.00		0.94		0.99	
Mean	1.14		1.14		1.11		1.15	
N	345		351		352		341	
Industry adjusted								
Median	(0.1)	*	(0.1)	***	(0.2)	***	(0.2)	***
Mean	(0.3)	***	(0.3)	***	(0.4)	***	(0.4)	***
N	246		271		294		300	

cut the year prior to the LBO. This could be because managers know their firms are targets and attempt to reduce wasteful investment to avoid acquisition. Alternatively, negotiations with private equity funds began in period t = -1 and, while negotiations with the private equity funds are underway, large investment is postponed. Additionally, Table 1.11 presents employees normalized by sales in millions. There is evidence of over-investment in labor in target firms. Although this paper focuses on capital investment, private equity funds may target inefficiencies in the labor market.

To understand the market's view of the investment opportunities these firms face in the pre-acquisition period, Table 1.12 presents Tobin's q. Tobin's q is defined as the market value of equity plus total debt at book value plus preferred stock at book value divided by total assets. Theory predicts that firms experiencing inefficient empire building would have a Tobin's q of less than one. In this sample, the median value is just below one and the average value is 1.14. Compared to their industry peers, target firms have a significantly lower Tobin's q, indicating that the market does not value the investment opportunity set of target firms as highly as other firms in the industry.

Firms experience annual sales growth of 10% and annual asset growth of 8% in the pre-acquisition period as presented in Table 1.13. These growth rates are essentially in line with industry peers. There is significant asset growth in period t = -4 consistent with the significant investment made in period t = -4. Also, there is a significant decline in growth in period t = -1, consistent with the decline in investment presented in Table 1.11.

Pre-acquisition profitability measures are presented in Table 1.14. Operating income

Table 1.13: Growth Rates Pre-Acquisition

Table 1.13 reports median and mean values for growth measures and these same measures industry adjusted. Growth measures are provided for the four full years prior to acquisition by the private equity fund. Panel A presents sales growth, Panel B presents asset growth, and Panel C presents the employment growth. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels are based on two-tailed t-tests and Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t = -4**		**t = -3**		**t = -2**		**t = -1**	
Panel A: Sales Growth								
Unadjusted								
Median	11%		10%		10%		7%	
Mean	26%		18%		14%		12%	
N	356		356		356		356	
Industry adjusted								
Median	1%		-1%		-2%		-3%	***
Mean	9%	***	7%	*	2%		1%	
N	224		252		272		295	
Panel B: Asset Growth								
Unadjusted								
Median	11%		9%		8%		4%	
Mean	32%		18%		16%		7%	
N	356		356		356		356	
Industry adjusted								
Median	2%	***	-1%		-2%		-4%	***
Mean	28%	*	10%	**	6%	**	-3%	**
N	224		252		272		295	
Panel C: Employment Growth								
Unadjusted								
Median	3%		5%		3%		2%	
Mean	16%		13%		70%		4%	
N	333		346		350		330	
Industry adjusted								
Median	0.4%	*	1%		-2%		-3%	***
Mean	6%	***	10%	***	80%		-1%	
N	208		247		271		277	

normalized by both tangible assets and sales return on net operating assets (RNOA) are presented. *Operating income* is defined as net income plus interest, taxes, amortization

Table 1.14: Profitability Pre-Acquisition

Table 1.14 reports median and mean values for profitability measures and these same measures industry adjusted. Profitability measures are provided for the four full years prior to acquisition by the private equity fund. Panel A presents operating income to assets, Panel B presents operating income to sales, and Panel C presents return on net operating assets (RNOA). Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels are based on two-tailed t-tests and Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t = -4**		**t = -3**		**t = -2**		**t = -1**	
Panel A: Operating Income to Tangible Assets Ratio								
Unadjusted								
Median	16%		18%		17%		18%	
Mean	17%		18%		18%		18%	
N	356		356		356		356	
Industry adjusted								
Median	0%		1%	*	0%		1%	*
Mean	2%	*	2%	**	2%	**	2%	**
N	253		272		294		311	
Panel B: Operating Income to Sales Ratio								
Unadjusted								
Median	11%		12%		11%		12%	
Mean	14%		15%		15%		14%	
N	356		356		356		356	
Industry adjusted								
Median	-1%		0%		0%		0%	
Mean	1%		1%		1%		0%	
N	253		272		294		311	
Panel C: RNOA								
Unadjusted								
Median	10%		11%		10%		10%	
Mean	-13%		20%		2%		21%	
N	356		356		356		356	
Industry adjusted								
Median	-1%		0%		-1%		-1%	*
Mean	-35%		15%	*	7%	*	-4%	*
N	224		252		272		295	

and depreciation, and impairments of goodwill.[30] The table shows that firms exhibit sig-

[30] *Operating income* as defined is similar to EBITDA but would capture spending on restructuring initia-

nificant profitability in the pre-acquisition period. This evidence corroborates the over-investment hypothesis, as significant profitability generates excess cash flows required for over-investment to occur. Target firms experienced a series of positive productivity shocks that generated excess free cash flow, enabling the managers to empire build.

1.6.3 Evaluation of Post-Acquisition Performance

To investigate investment in target firms in the post-acquisition period, Table 1.15 presents *net investment* normalized by both assets and sales and employees to sales for the *private* sub-sample of 183 LBOs. Investment declines significantly in the post-acquisition when firms are controlled by private equity funds. Reduced investment presented in Table 1.15 results in significant declines in asset growth in the post-acquisition period presented in Table 1.20. Sales growth and employment growth also decline significantly when compared to industry peers. Median sales growth declines from 11% pre-acquisition to an average of 5% in the post-acquisition period. Median tangible asset growth is negative in the first four years post-acquisition, declining from 6% in the pre-acquisition period. Median employment growth is reduced from 3% in the pre-acquisition period to 0% for the majority of the post-acquisition period.

Profitability measures pre- and post-acquisition are presented in Tables 1.16, 1.17 and 1.18. Table 1.16 presents operating income normalized by both tangible assets and sales. Median operating income to tangible assets of 19% pre-acquisition is significant and remains significantly above industry peers until period t =5. Median operating income to sales is significant when compared to industry peers in the pre-acquisition period, but by period t = 5 is significantly below industry peers. Table 1.16, Panel C illustrates how the sample changes as firms exit. Interestingly, exits to strategic buyers occur sooner resulting in a sample that includes approximately 50% IPO exits by period t = 7.

To further investigate this decline in profitability in periods t = 5 to t = 7, Table 1.17 presents a similar analysis using just the 77 firms that are controlled for 7 years. The firms presented in Table 1.17 are not significantly profitable in the pre-acquisition period with median operating income to tangible assets and operating income to sales of 18% and 12%, respectively. Operating income to tangible assets is significantly greater than industry peers in the first four years post-acquisition, but after period t = 4 profitability is in line with industry peers. Operating income to sales is basically consistent with industry peers in the post-acquisition period with the exception of period t = 5, where performance is significantly below the industry peers. These firms also exhibit growth in assets and employment significantly below industry peers. Given that this sample consists mainly of firms that eventually exit via IPOs and that IPOs are traditionally associated with positive

tives implemented by the new private equity owners.

private equity outcomes, the results support the position that firms acquired by private equity funds do not create value by generating more profit from underlying assets.

Profitability is evaluated in Table 1.18 as the percentage change from pre-acquisition levels. The percentage change is negative over all time periods evaluated with one exception, but not statistically different from the industry percentage change. Again, there is no evidence of value creation when profitability is evaluated in this manner. To address conjecture in the literature that the industry has changed and that LBOs today are different from those in the 1980s, I also test 66 LBOs from the 1980s. In Panels C and D, there is no evidence of valuation creation when older LBOs are reevaluated.

Increases in cash flows may also be generated by cash management expertise. Table 1.19 reports median values for cash management measures and these same measures industry adjusted for the *private* sub-sample of 183 LBOs over the period t = -1 to t = 7. Panel A presents days of accounts receivable outstanding, calculated as accounts receivable divided by sales multiplied by 365 days. Panel B presents days of accounts payable outstanding, calculated as accounts payable divided by costs of goods sold multiplied by 365 days. Panel C presents days of inventory on hand, calculated as inventory divided by cost of goods sold multiplied by 365 days. Table 1.19 shows that the firms exhibit enhanced cash management expertise in the post-acquisition period when compared to industry peers. In particular, private equity controlled firms demonstrate effective collection of monies due and an ability to negotiate favorable credit terms with suppliers. However, cash flows statements presented in Table 1.8 for the *case study* sub-sample indicate that the majority of these cash flow gains are temporary in nature.

1.7 Conclusion

This paper tests Jensen's theory of inefficient investment and the motivational benefits of debt using hand collected cash flow statements of large U.S. public to private leveraged buyouts between 1980 and 2006. The evidence reveals that private equity funds inefficiently investment in the form of empire building during the pre-acquisition period, as target firms generate excess free cash flows which are reinvested. I find that in the post-acquisition period, these firms experience a reduction in sales growth and employment growth, as debt disciplines private equity owners to reduce inefficient investment. However, there is no evidence that the mechanism described by Jensen increases the profitability of the underlying asset. The evidence also shows that private equity controlled firms generate excess cash flows through cash management expertise, but the results indicate that these cash flows are merely temporary transfers.

The cash flow statements presented in this paper illustrate the origin, ownership and use of cash, removing the veil from leveraged buyout transactions. Cash from asset sales, reduction in capital expenditures, cash management expertise and the LBO tax structure are mapped to debt reduction, dividends and reinvestment. Cash flow statements are also

used to illustrate that private equity owners fund dividends through asset sales and reduced reinvestment prior to exit, highlighting the short-term nature of these investments. The study of returns indicates that the cost of funding debt is greater than the return generated by the underlying assets, adversely affecting the return to equity. The analysis also shows that returns to equity are significantly bolstered by fees levied on target companies.

Overall, the study of cash flow statements demonstrates that private equity controlled firms operate on a knife's edge and rely on asset sales, the flexibility in working capital, alternative financing and tax refunds to service debt and fund operations. Hedging and derivative use increases post-acquisition in an attempt to reduce volatility of cash flows, but the bankruptcy rate associated with LBOs still remains in excess of 20%. Moreover, on September 23, 2013, the SEC published detailed rules that eliminated the prohibition against private equity funds advertising to retail clients. These changes, mandated by the JOBS Act, will allow private equity funds to target retail investors and expand their control over the U.S. economy. Given the reduction in investment and job growth, the high bankruptcy rate and the absence of value creation, it is difficult to conclude that LBOs are economically efficient from a social perspective.

Table 1.15: Investment Pre- and Post-Acquisition

Table 1.15 reports median values for investment measures and these same measures industry adjusted. Investment measures are provided for the two full years prior to acquisition by the private equity fund and while controlled by the private equity fund. Panel A presents net investment to tangible assets, Panel B presents net investment to sales and Panel C presents employees to sales in millions. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on two-tailed Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t=-1**	**t=0**		**t=1**		**t=2**		**t=3**		**t=4**		**t=5**		**t=6**		**t=7**	
Panel A: Net Investment to Tangible Assets Ratio																	
Unadjusted																	
Median	9%	52%		4%		5%		4%		4%		4%		5%		7%	
N	183	183		183		161		150		131		104		83		72	
Industry Adj.																	
Median	0%	40%	***	-4%	***	-4%	***	-4%	***	-4%	***	-3%	***	-3%	***	-2%	
N	173	178		181		160		147		125		95		75		70	
Panel B: Net Investment to Sales Ratio																	
Unadjusted																	
Median	5%	35%		3%		2%		2%		2%		2%		3%		3%	
N	183	183		183		161		150		131		104		83		72	
Industry Adj.																	
Median	0%	30%	***	-3%	***	-2%	***	-3%	***	-3%	***	-2%	***	-3%	***	-2%	**
N	173	178		181		160		147		125		95		75		70	
Panel C: Employees to Million in Sales																	
Unadjusted																	
Median	8	8		7		7		7		6		7		7		7	
N	166	127		140		131		127		119		96		82		71	
Industry Adj.																	
Median	(0.2)	(0.2)		-		(0.2)		(0.1)		0.1		(0.1)		0.4		0.9	*
N	162	127		139		130		124		115		88		74		69	

Table 1.16: Profitability Pre- and Post-Acquisition

Table 1.16 reports median values for profitability measures and these same measures industry adjusted. Profitability measures are provided for the two full years prior to acquisition by the private equity fund and while controlled by the private equity fund. Panel A presents operating income to tangible assets, Panel B presents operating income to sales, Panel C presents exits for the various samples tested. Bankruptcy includes restructuring out of court. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on two-tailed Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t=-1**		**t=0**		**t=1**		**t=2**		**t=3**		**t=4**		**t=5**		**t=6**		**t=7**
Panel A: Operating Income to Tangible Assets Ratio																	
Unadjusted																	
Median	19%		13%		18%		18%		17%		19%		17%		17%		17%
N	183		183		183		161		150		131		104		83		72
Industry Adj.																	
Median	2%	***	-4%	***	1%	*	2%	***	1%	**	3%	**	1%		1%		3%
N	178		181		181		160		147		125		95		75		70
Panel B: Operating Income to Sales Ratio																	
Unadjusted																	
Median	13%		8%		11%		11%		11%		11%		9%		9%		10%
N	183		183		183		161		150		131		104		83		72
Industry Adj.																	
Median	1%	**	-2%	***	0%		0%		0%		0%		-2%	**	-1%	*	0%
N	178		181		181		160		147		125		95		75		70
Panel C: Exits for Samples																	
Strategic Buyer	19%		19%		19%		14%		14%		11%		11%		8%		10%
Still Private	20%		20%		20%		22%		23%		22%		21%		18%		14%
IPO	35%		35%		35%		40%		39%		41%		44%		47%		49%
Bankruptcy	26%		26%		26%		24%		23%		25%		24%		27%		28%

Table 1.17: Profitability Pre- and Post-Acquisition for a Fixed Sample of LBOs

Table 1.17 reports median values for profitability measures and these same measures industry adjusted. Profitability measures are provided for the two full years prior to acquisition by the private equity fund and while controlled by the private equity fund. Panel A presents operating income to tangible assets, Panel B presents operating income to sales, Panel C presents tangible asset growth, and Panel D presents employment growth.

Period	**t=-1**	**t=0**		**t=1**		**t=2**		**t=3**		**t=4**		**t=5**		**t=6**		**t=7**
Panel A: Operating Income to Tangible Assets Ratio																
Unadjusted																
Median	18%	14%		19%		19%		18%		20%		17%		17%		17%
Industry Adj.																
Median	0%	-3%	***	2%	**	2%	**	2%	**	4%	***	2%		2%		3%
N	70	71		71		71		71		71		71		71		70
Panel B: Operating Income to Sales Ratio																
Unadjusted																
Median	12%	9%		13%		11%		11%		12%		9%		9%		10%
Industry Adj.																
Median	-1%	-2%	***	2%	*	0%		0%		1%		-2%	**	-1%		0%
N	70	71		71		71		71		71		71		71		70
Panel C: Tangible Asset Growth																
Unadjusted																
Median	6%	17%		0%		0%		0%		0%		5%		1%		5%
Industry Adj.																
Median	-3%	6%		-10%	***	-9%	***	-5%	***	-5%	***	-3%		-5%	***	-1%
N	67	70		71		71		71		71		71		71		70
Panel D: Employment Growth																
Unadjusted																
Median	4%	0%		2%		2%		1%		0%		0%		0%		1%
Industry Adj.																
Median	-3%	-7%	***	-1%		-2%		-3%	**	-3%	**	-2%		-2%	*	-1%
N	61	53		54		59		59		63		67		67		68

Table 1.18: Profitability Pre- and Post-Acquisition, Percentage Change

Table 1.18 reports median values for profitability measures and these same measures industry adjusted. Profitability measures are provided as the percentage change in the first seven full years after the buyout (periods +1, +2, +3, etc.) compared to the first full year before the buyout (period -1). Panel A presents operating income to tangible assets, Panel B presents operating income to sales. Panels C and D present the same variables for LBOs that occurred in the 1980s.

From year i to year j	**-1 : +1**		**-1 : +2**	**-1 : +3**	**-1 : +4**	**-1 : +5**	**-1 : +6**	**-1 : +7**
Panel A: Operating Income to Tangible Assets Ratio								
Unadjusted								
Median	-14%		-11%	-4%	-3%	-4%	-10%	1%
Industry Adj.								
Median	-1%		0%	11%	11%	5%	3%	8%
N	178		157	143	121	92	73	68
Panel B: Operating Income to Sales Ratio								
Unadjusted								
Median	-4%		-13%	-11%	-17%	-21%	-17%	-9%
Industry Adj.								
Median	3%		2%	2%	-5%	-9%	-4%	8%
N	178		157	143	121	92	73	68
Panel C: Operating Income to Tangible Assets Ratio - LBOs from 1980s								
Unadjusted								
Median	5%		-5%	-4%	-3%	-24%	-15%	-6%
Industry Adj.								
Median	8%	**	5%	11%	6%	2%	-5%	1%
N	64		62	55	47	42	39	38
Panel D: Operating Income to Sales Ratio - LBOs from 1980s								
Unadjusted								
Median	7%		-7%	-5%	-18%	-30%	-15%	-9%
Industry Adj.								
Median	15%	***	7%	7%	-6%	-6%	-4%	2%
N	64		62	55	47	42	39	38

Table 1.19: Cash Management Pre- and Post-Acquisition

Table 1.19 reports median values for cash management measures and these same measures industry adjusted. Cash management measures are provided for the two full years prior to acquisition by the private equity fund and while controlled by the private equity fund. Panel A presents days of accounts receivable outstanding. Days of accounts receivable outstanding is calculated as accounts receivables divided by sales multiplied by 365 days. Panel B presents days of accounts payable outstanding. Days of accounts payable outstanding is calculated as accounts payable divided by costs of goods sold multiplied by 365 days. Panel C presents days of inventory on hand. Days of inventory on hand is calculated as inventory divided by cost of goods sold multiplied by 365 days. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on two-tailed Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**	**t=5**	**t=6**	**t=7**
Panel A: Days of Accounts Receivable Outstanding									
Unadjusted									
Median	48	42	43	42	44	40	38	40	40
N	183	183	183	161	150	131	104	83	72
Industry Adj.									
Median	(1)	(3) **	(3) ***	(5) ***	(3) ***	(5) ***	(4) ***	(4) **	(3)
N	178	181	181	160	147	125	95	75	70
Panel B: Days of Accounts Payable Outstanding									
Unadjusted									
Median	32	31	33	35	32	30	34	36	37
N	183	183	183	161	150	131	104	83	72
Industry Adj.									
Median	(3) *	(1)	(0)	1	0	1	3 *	5 **	6 ***
N	178	181	181	160	147	125	95	75	70
Panel C: Days of Inventory on Hand									
Unadjusted									
Median	52	48	48	45	45	52	47	59	51
N	183	183	183	161	150	131	104	83	72
Industry Adj.									
Median	(2)	(3)	(2)	(2)	(4) **	(3) *	(1)	1	1
N	175	178	178	158	145	123	95	75	70

Table 1.20: Growth Pre- and Post-Acquisition

Table 1.20 reports median values for growth measures and these same measures industry adjusted. Growth measures are provided for the two full years prior to acquisition by the private equity fund and while controlled by the private equity fund. Panel A presents sales growth, Panel B presents tangible asset growth and Panel C presents employment growth. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on two-tailed Wilcoxon rank tests. Asterisks ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in the sample.

Period	**t=-1**	**t=0**		**t=1**		**t=2**		**t=3**		**t=4**		**t=5**		**t=6**		**t=7**	
Panel A: Sales Growth																	
Unadjusted																	
Median	11%	7%		7%		6%		5%		3%		5%		4%		6%	
N	183	183		183		161		150		131		104		83		72	
Industry Adj.																	
Median	-1%	-2%	***	-4%	**	-1%		-2%	**	-5%	***	-2%	**	-5%	***	-3%	**
N	173	178		181		160		146		125		95		75		70	
Panel B: Tangible Asset Growth																	
Unadjusted																	
Median	6%	14%		-1%		0%		0%		-1%		3%		1%		5%	
N	183	183		183		161		150		131		104		83		72	
Industry Adj.																	
Median	-2%	6%	***	-7%	***	-4%	***	-5%	***	-7%	***	-4%	*	-5%	***	-1%	
N	173	178		181		160		146		125		95		75		70	
Panel C: Employment Growth																	
Unadjusted																	
Median	3%	2%		1%		2%		0%		0%		0%		0%		1%	
N	164	118		123		124		116		109		96		79		70	
Industry Adj.																	
Median	-2%	-6%	***	-3%		-2%	**	-1%	*	-3%	***	-2%	**	-2%	*	-1%	
N	155	116		123		123		113		105		88		71		68	

Table 1.21: Income Statements for Firms Acquired by Private Equity Funds

Table 1.21 reports income statement averages for a sub-sample of 85 firms. Summary statistics are provided for three full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values presented are dollars in millions.

Period	**t = -3**	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Number of Firms	85	85	85	85	85	85	85	85
Sales	1,665	1,802	1,916	1,917	2,038	2,154	2,164	2,174
Cost of goods sold	1,188	1,283	1,352	1,351	1,429	1,513	1,519	1,537
Gross profit	477	519	564	566	609	641	645	637
Sales, general & admin.	273	292	313	316	333	362	367	362
EBITDA	202	226	246	234	264	268	267	262
Interest	36	36	40	118	177	161	145	134
Taxes	45	45	50	12	(18)	5	13	10
Nonoperating income	8	6	10	9	(25)	12	2	(1)
Special items	(0)	(13)	(6)	(67)	(68)	(105)	(7)	(55)
Minority interest	2	2	2	3	3	3	4	5
Extraordinary items	2	(1)	(3)	(0)	(0)	(3)	(8)	(2)
Discontinued operations	(1)	6	(1)	1	(1)	(1)	0	(1)
Depreciation expense	62	67	69	71	85	81	81	78
Amortization expense	3	4	4	18	39	39	33	27
Net income	64	71	84	(27)	(104)	(107)	(10)	(38)

Table 1.22: Balance Sheets for Firms Acquired by Private Equity Funds

Table 1.22 reports balance sheet averages for a sub-sample of 85 firms. Summary statistics are provided for three full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values presented are dollars in millions.

Period	**t = -3**	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Number of Firms	85	85	85	85	85	85	85	85
Cash	78	122	134	75	73	86	98	91
Receivables	164	179	182	176	174	180	203	204
Inventories	195	198	197	212	211	220	214	215
Prepaid expenses	4	6	6	9	9	7	8	9
Other Current assets	40	44	39	74	49	50	54	55
Current assets Total	482	548	558	545	516	543	577	574
Plant, property & equip.	515	539	550	617	598	593	576	567
Investments at equity	14	15	18	18	20	25	19	15
Investments other	50	58	70	46	44	31	26	19
Intangibles	264	296	305	1,235	1,153	1,047	1,009	950
Deferred charges	3	4	4	24	28	24	20	16
Assets other	57	51	59	76	76	66	63	59
Total assets	**1,384**	**1,511**	**1,565**	**2,560**	**2,436**	**2,330**	**2,290**	**2,199**
Accounts Payable	104	118	127	136	143	150	140	148
Note Payable	14	21	15	12	13	14	21	28
Accrued expenses	96	106	103	123	123	123	125	149
Taxes payable	11	11	11	13	13	9	9	8
Debt due in one year	25	36	30	67	46	41	57	33
Other current liabilities	45	50	55	60	60	71	67	51
Total current liabilities	294	344	342	410	397	408	419	417
Long term debt	384	418	432	1,678	1,633	1,586	1,540	1,539
Deferred taxes	49	55	59	175	148	132	125	124
Investment tax credit	0	0	0	-	-	0	-	-
Liabilities other	82	92	91	144	157	163	170	158
Noncontrol interest	13	12	12	14	16	17	16	16
Total liabilities	**822**	**921**	**936**	**2,421**	**2,351**	**2,306**	**2,270**	**2,253**
Shareholders' equity	**562**	**589**	**628**	**139**	**84**	**24**	**20**	**(54)**

Table 1.23: Cash Flow Statements for Firms Acquired by Private Equity Funds

Table 1.23 reports cash flow statement averages for a sub-sample of 85 firms. Summary statistics are provided for three full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values presented are dollars in millions.

Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**
Number of Firms	85	85	85	85	85	85	85
Beginning cash balance	78	122	134	75	73	86	98
Ending cash balance	122	134	75	73	86	98	91
Change in Cash	43	13	(60)	(2)	13	13	(7)
Cash from Operations							
Net income	71	84	(27)	(104)	(107)	(10)	(38)
add depreciation	67	69	71	85	81	81	78
add amortization	4	4	18	39	39	33	27
add impairment	0	0	-	22	44	7	19
less gain on sale of PP&E	(1)	(5)	(5)	(8)	(6)	(3)	2
less increase in working capital	8	13	(12)	34	0	(33)	11
less increase in deferred charges	(1)	1	(20)	(5)	4	4	4
less decrease in tax liabilities	7	4	116	(27)	(16)	(8)	(1)
Cash from Operations	**154**	**171**	**141**	**36**	**39**	**71**	**101**
Cash for Investing (Table 1.24)	**(130)**	**(113)**	**(1,070)**	**(35)**	**(29)**	**(49)**	**(43)**
Cash from Financing							
Alternative Financing	10	(0)	53	13	6	7	(12)
Issuance / (Retirement) of Debt	53	1	1,280	(65)	(51)	(23)	(18)
Dividends	(27)	(17)	(12)	(6)	(8)	(9)	(60)
Issuance / (Purchase) of Equity	(16)	(28)	(451)	55	55	15	24
Cash from Financing	**19**	**(45)**	**870**	**(3)**	**3**	**(10)**	**(65)**

Table 1.24: Investing Cash Flows for Firms Acquired by Private Equity Funds

Table 1.24 reports detailed investing cash flow averages for a sub-sample of 85 firms. Gross investment is defined as capital expenditures, acquisitions, investments in other firms or the purchase of other long term assets. Asset sales include the sale or divestment of PP&E and intangibles, the sale of investments in other firms and the sale of other long term assets. Net investment is cash used for investing. Summary statistics are provided for two full years prior to acquisition by the private equity fund through the fourth year owned by the private equity fund. Period t = 0 is the year the firm was acquired by the private equity fund. Values presented are dollars in millions.

Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**
Number of Firms	85	85	85	85	85	85	85
PP&E Investment							
Capital expenditures	(90)	(95)	(86)	(75)	(75)	(70)	(71)
Sale of PP&E and intangibles	22	31	36	119	81	35	39
Net Investment in PP&E	**(68)**	**(64)**	**(50)**	**44**	**5**	**(35)**	**(32)**
Acquisitions							
PP&E	(16)	(5)	(80)	(24)	(16)	(7)	(11)
Intangibles	(42)	(20)	(950)	(57)	(36)	(20)	(16)
Investment via Acquisition	**(58)**	**(25)**	**(1,030)**	**(81)**	**(53)**	**(27)**	**(27)**
Investments in Other Firms							
Equity investments in other firms	(2)	(2)	(1)	(2)	(5)	5	5
Minority Interest in other firms	(1)	(0)	2	2	1	(1)	(1)
Investments other	(8)	(12)	24	1	13	5	8
Net investment in Firms	**(10)**	**(15)**	**26**	**2**	**9**	**10**	**12**
(Purchase)/Sale of Other Assets	**6**	**(9)**	**(17)**	**0**	**9**	**4**	**4**
Cash used for Investing	**(130)**	**(113)**	**(1,070)**	**(35)**	**(29)**	**(49)**	**(43)**
Gross Investment	(158)	(145)	(1133)	(157)	(133)	(97)	(98)
Asset Sales	29	31	62	122	104	49	55
Net Investment	**(130)**	**(113)**	**(1,070)**	**(35)**	**(29)**	**(49)**	**(43)**

2 Chapter 2
Does Going Private Add Value?

2.1 Introduction

A large and growing share of the economy is controlled by the private equity (PE) industry. At the beginning of 2011, private equity industry leader Kohlberg Kravis Roberts & Co. (KKR) owned stakes in over 60 firms for a total of more than $205 billion in sales and over 900,000 employees. This made KKR the second largest domestic employer after Wal-Mart Stores Inc. and the fourth largest domestic company by revenue.[31] Nominal dollars committed each year to U.S. private equity funds have increased exponentially from $0.2 billion in 1980 to over $200 billion in 2007.[32]

Given the increasing share of private equity owned firms in our economy, we want to examine whether LBO management shows superior management expertise and increases operating performance sufficiently to add value. We contribute to the literature in two ways. First, by highlighting the accounting issues in measuring operating profitability hitherto ignored, and second, by examining the change in operating performance post-buyout using a clean measure of operating profitability. We focus on return on net operating assets because conceptually it is the cleanest measure of operating profitability, separating the effects of leverage from operating performance. To be able to do this, we hand collect a complete set of thoroughly audited financial statements for a sample of 138 public to private LBOs with a deal value over $50 million. This comprehensive sample allows us to compute all components of RNOA as well as present the technical accounting associated with LBOs.

The results suggest that, during the five years after an LBO, operating profitability is not significantly higher than the respective industry median. While it is possible that LBO transactions add firm value by moving a firm's capital structure closer towards the optimum, the high amount of bankruptcies and out of court restructurings in our sample as well as the subsequent steady reduction in leverage post-LBO speak against this possibility.[33]

By definition, leveraged buyouts employ significant amounts of leverage to take a company private. The purpose of our paper is to test whether subsequent firm performance after the LBO increases enough to offset the additional risk that comes with higher leverage. Leverage increases return on equity, earnings growth, and even residual earnings if borrowing costs are sufficiently low. However, taxes aside, standard finance theorems postulate that these increases should be value neutral as they are offset by a higher expected return (Modigliani and Miller (1958) Proposition 2). Expected return will rise due to the higher risk associated

[31] Source: KKR 10-K dated December 31, 2010.

[32] Source: Kaplan and Strömberg (2009).

[33] We do not explicitly test for the optimal capital structure. Also, since we focus on firm value rather than investment value, we do not pursue other options to increase investment value, such as market timing acquisitions or tax advantages at the fund level.

with higher leverage. Taking taxes into account, the leverage adds value via the tax shield associated with interest expenses (Modigliani and Miller (1963)). On the other hand, taking bankruptcy costs into account, these tax advantages are offset at some point, yielding an optimal cost structure (Kraus and Litzenberger (1973), Hackbarth, Hennessy, and Leland (2007)). If this is true and the target of an LBO was operating with an optimal capital structure before, management needs to improve the operating performance of the company after an LBO in order to add value to the company. Previous literature suggests private equity, with its concentrated ownership and high-powered incentives, creates value through managerial incentive alignment and by mitigating the excess free cash flow problem (see Kaplan and Strömberg (2009) for a summary). But, as private equity firms have a short-term investment horizon, it invites one to question the mechanisms utilized to identify and acquire companies, and subsequently increase their value in the typical five-year holding period.

The lack of publicly available financial information has always limited this area of research. When firms are acquired by private equity funds, the financial disclosure requirements are reduced as the common equity is no longer traded. However, some firms are still required to report financial statements due to specific securities used to finance the LBO, specifically preferred stock or widely held debt. Additionally, any firms that eventually sell (or plan but fail to sell) common equity are required to provide historical financial statements providing a glimpse of the operating performance while they were controlled by the private equity fund. Using the SDC Platinum database, we identify more than 500 public to private LBOs with a deal value of $50 million or greater announced between January 1980 and December 2006. Our focus on public to private LBOs ensures that financial statements are available in the pre-acquisition period. We hand collect complete, comprehensive financial statements for 138 of these firms for the period beginning three years prior to the LBO, and while controlled by the private equity fund.

Using our dataset we present summary balance sheet, income statement and cash flow statement information to highlight the problems of technical accounting issues associated with an LBO that make comparisons of financial statements pre- and post-acquisition difficult. Specifically, when a firm is acquired the premium paid is recorded differently, depending on whether recapitalization accounting or purchase accounting was applied. Prior studies have attempted to deal with parts of the issue, namely significant goodwill amounts that were the consequence of transactions recorded under purchase accounting. These premia affect the use of the scale variable total assets that control for asset divestitures prominent in private equity controlled firms. In an attempt to deal with this issue, Kaplan (1989) and Guo, Hotchkiss, and Song (2011) both increase the value of total assets pre-acquisition by the goodwill on the balance sheet post-acquisition. This is done so that asset based performance measures are comparable pre- and post-acquisition as the premium has been added to the pre-acquisition financial statements. However, first an LBO effectively exchanges the invested capital in a firm. The question therefore is whether such a pre-acquisition adjust-

ment does not distort the underlying economics of the firm. Second, our analysis shows that 17% of the firms in our sample are forced by their auditors to write down goodwill in the post-acquisition period. Following the existing methodology, a goodwill impairment post-acquisition would result in a positive increase in the percentage change in operating performance, *ceteris paribus*. The high bankruptcy rate, as documented in Andrade and Kaplan (1998), also suggests a high impairment rate. Therefore, it is possible that the results in the literature are influenced by the interaction of the pre-acquisition adjustment to goodwill with the post-acquisition impairment of goodwill.

With these accounting issues in mind, our primary question is whether private equity funds affect the value of a firm through operating improvements. After adjusting the financials to account for differences in acquisition accounting, we focus on classic financial analysis techniques to present operating performance while accounting for leverage. When operating and financial assets are correctly separated, net operating assets are equivalent to capital invested. Therefore, return on net operating assets (RNOA) is the accounting equivalent to return on capital invested at the firm level and measures how many dollars of income a company creates per dollar of net operating asset. Our results show that the acquired firms do not exhibit post-buyout improvements in RNOA for up to five years post-acquisition compared to industry peers. In this sense, we map the "buy-improve-sell" mandate of private equity funds to the financial statements and investigate whether private equity funds are better owner-operators and add value by better utilizing a target firm's assets. The "improve" component of the mandate could lead to consolidation of manufacturing facilities, a streamlined distribution system with fewer warehouses, a reduction in head count, or discontinuing a business line. The most common performance measure, EBITDA, currently presented in the literature excludes some operating costs and specifically exclude costs associated with improvement initiatives. In addition, using total assets or sales as a scaling variable does not cleanly separate true operating performance from the effects of leverage.

Finally, we evaluate outcomes for firms acquired by private equity funds. In our sample of 138 large publicly traded firms that were acquired by private equity funds, we find that 25% subsequently filed for bankruptcy protection or were restructured outside the bankruptcy court. In an expanded sample of 531 large public to private leveraged buyouts between 1980 and 2008 we find that 109 (21%) subsequently declared bankruptcy or were restructured outside bankruptcy court. These high bankruptcy rates, relative to expected default rates for non-investment grade debt,[34] yield some support to the thesis that the purpose of the LBO is not to move the firm closer to the optimal capital structure.

The remainder of the paper is structured as follows: In Section 2.2 we provide a liter-

[34]Moody's Investors Service, Global Credit Research, Measuring Corporate Default Rates, November 2006. Appendix A. 20-Year cumulative default rate tables. Table A1 Average Cumulative Default Rates by Whole Letter Rating, Unadjusted. Ba: Obligations rated Ba are judged to be speculative and are subject to substantial credit risk. B: Obligations rated B are considered speculative and are subject to high credit risk. Ba to B (7.86% to 20.66%).

ature review. Section 2.3 discusses the data collection and auditing process used and the methodology for variables we construct as proxies for operating performance. Section 2.4 uses our dataset to provide a hitherto unknown picture of the financial characteristics of LBOs over time including summary statistics of major balance sheet, income statement and cash flow statement items pre- and post-acquisition for the 138 firms in our sample. Section 2.5 documents our results for tests of industry adjusted operating improvements. Section 2.6 concludes.

2.2 Literature Review

In his seminal paper, Jensen (1986) summarizes the benefits of the private equity ownership structure (concentrated ownership and high-powered incentives) and argues its superiority to the traditional public, diverse ownership form. He argues that LBOs create wealth through managerial incentive alignment and by forcing the release of excess free cash flow. Opler and Titman (1993) call this Jensen's free cash flow thesis. Lowenstein (1985) takes a different view and argues that extraordinary gains to private equity funds are wealth transfers mainly achieved by tax savings and expropriation of non-equity stakeholders. Lehn and Poulsen (1989) find that there is a significant relation between undistributed cash flow and the decision to go private. But whether there are actual operating improvements under private equity ownership is a crucial question not only in practice but also one hotly debated in the academic literature.

There have been various studies in the accounting and finance literature that examined LBOs and operating performance. Cumming, Siegel, and Wright (2007) and Kaplan and Strömberg (2009) provide detailed reviews of the literature on buyout performance and document positive performance effects.[35] Kaplan (1989) is among the first studies to look at management buyout (MBO) performance in the 1980s and finds significant improvements over a three year horizon from the LBO date. However, due to data constraints, this and most studies on buyout performance test relatively broad and noisy measures of performance. Kaplan (1989) focuses on EBITDA scaled by assets or sales as well as operating cash flow minus capital expenditures scaled by assets or sales. Similar results can be found in Smith (1990) who uses similar measures. Guo, Hotchkiss, and Song (2011) reviewed 94 public to private leveraged buyouts from 1990 to 2006 but found only modest increases in operating and cash flow margins. Recently, Boucly et al. (2011) used a data set of 839 French deals and tested for the growth effects of LBOs. Using tax data, they found that in the three years after the LBO, targets became more profitable and grow faster than comparable firms. However their measure of profitability is ROA, defined as EBITDA scaled by equity plus debt minus trade payables. Also using tax data, but with contrary results, Cohn, Mills, and

[35]Palepu (1990) summarizes the earlier literature on LBO performance, which mostly documents positive performance effects.

Towery (2014) study a large sample of 317 US firms and find little improvement in operating performance. An exception is a subsample of 71 firms with public financial statements which does show operating improvement. Their measure of operating performance is based on a tax EBIT measure, scaled by sales, assets, or adjusted by a cost of capital charge.

Apart from operating performance increases, Kaplan (1989), Smith (1990) and Opler (1992) all document sizable reductions in capital expenditures after a buyout. Such reductions do not necessarily impair long-term profitability if they target mainly wasteful investments. However, it seems plausible that reductions in capital expenditures of 33%, as documented in Kaplan (1989), may go beyond cutting wasteful investment and actually impair long-term profitability. Andrade and Kaplan (1998) document a 22% bankruptcy rate in 136 large public to private LBOs in the 1980s illustrating the increased default risk associated with the LBO capital structure.

The literature's mostly positive verdict on post-LBO operating performance hinges on two study characteristics; variables and time horizon. Most studies gauge firm performance using a combination of return on assets, operating cash flow and free cash flow. These variables can be inaccurate due to data limitations and frequently obfuscate real operating changes by not considering certain accounting issues and by not separating the effects of leverage. Second, most studies use three years after the LBO as the horizon over which firm performance is evaluated. The effect of reduced reinvestment associated with private equity acquisitions may take longer to be reflected in operating performance measures. Given these limitations, the literature leaves open the question whether the reduced reinvestment environment associated with LBOs affects long-term competitiveness.

2.3 Data Collection, Auditing Process and Variable Selection

2.3.1 Data Collection and Auditing Procedures

Using the SDC Platinum database, we start by identifying completed U.S. private equity transactions announced between the dates January 1, 1980 and December 31, 2006 with a total transaction value in excess of $50 million. This produces a list of approximately 1500 firms. We then eliminate any transactions where the private equity fund purchased a division of a company reducing the list to approximately 750 firms. We focus only on firms that were publicly traded prior to being acquired by the private equity fund, further reducing the list to 511 deals. Our focus on public to private transactions reduces the sample size significantly as illustrated in Figure 2.1. However, the public to private transactions represent a disproportionate amount of the transaction value as shown in Figure 2.2. Also, these criteria seem appropriate for comparing public ownership vs private management.

Our list of deals quickly drops from 511 to 138 as we impose additional conditions and auditing procedures.[36] First, we only include firms with three years of financial statements

[36]We note a few misclassifications in the SDC database and also exclude a few deals where we cannot

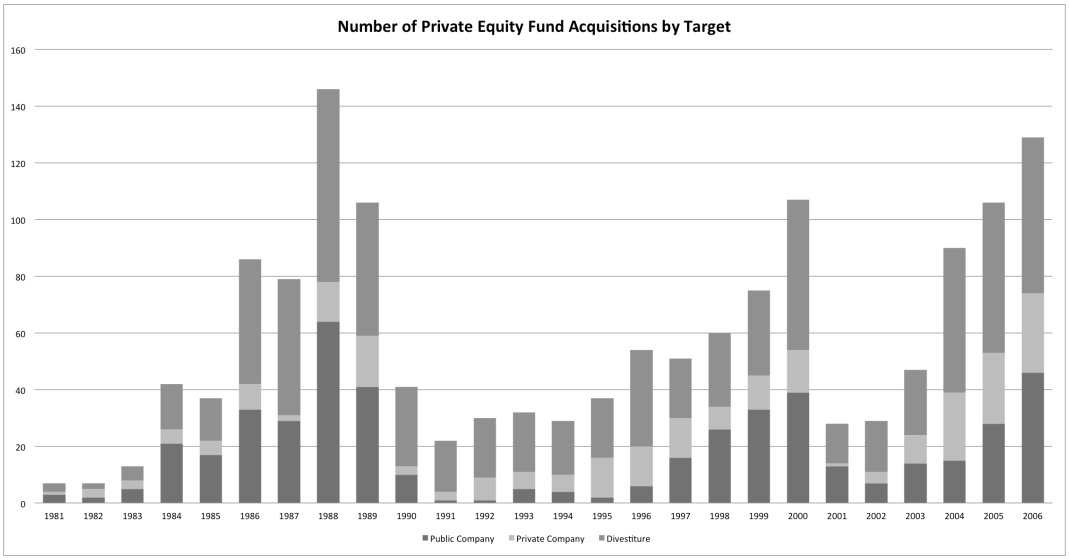


Figure 2.1: Number of Private Equity Fund Acquisitions by Target

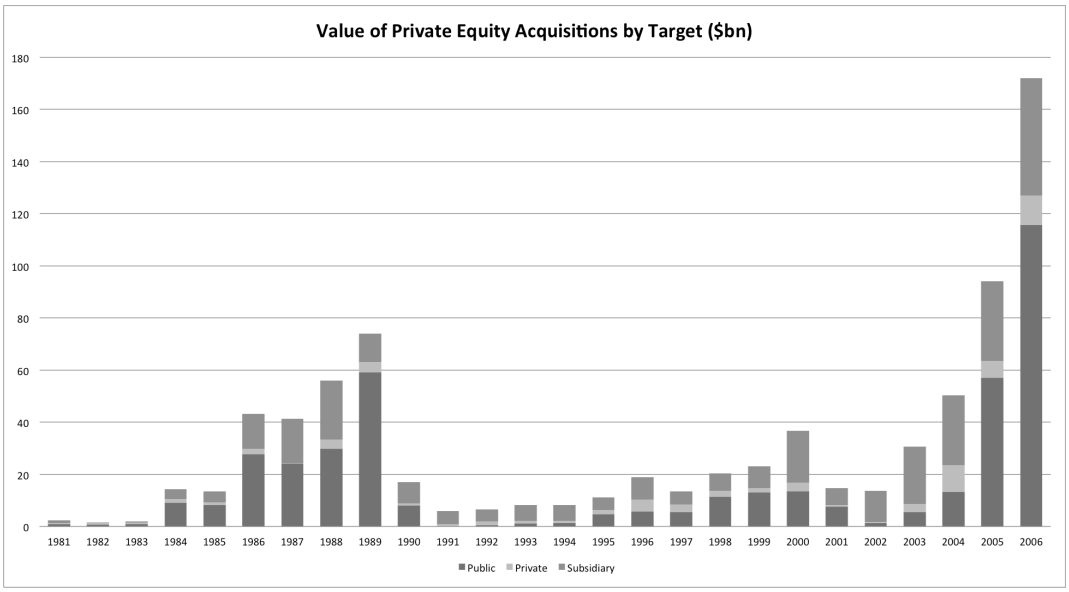


Figure 2.2: Transaction Value of Private Equity Fund Acquisitions by Target

Figure 2.1 presents LBOs from 1:1981 to 12:2006 by target type. Figure 2.2 presents transaction value of LBOs from 1:1981 to 12:2006 by target type. Source: SDC Platinum database.

specifically identify private equity fund involvement.

prior to the acquisition by the private equity fund. Second, we only include firms with complete, audited financial statements available while controlled by the private equity fund. A manual search of filings (S-1, S-4, 10-K, 10-Q, etc.) from the SEC Edgar database and microfiche records for missing financial information allows us to increase the sample size. Third, we ensure that the private equity fund acquired a controlling stake in the firm.

Next, a manual search of filings (S-1, S-4, 10-K, 10-Q, etc.) from the SEC Edgar database and microfiche records for missing financial information allows us to increase the sample size to 129 firms with complete financial statements. Finally, utilizing the list of LBOs from both Kaplan (1989) and Guo et al. (2011) we identify 48 LBOs not included in SDC's database for a total of 531 LBOs identified in our initial search.[37] We applied the same criteria and auditing to these new firms and expand our sample to 138.

Finally, for the 138 deals identified we review filings from the SEC Edgar database and microfiche records for deals prior to 1996[38] to determine the acquisition accounting method: recapitalization or purchase accounting.[39] In instances where filings are not available, a detailed review of the COMPUSTAT financial statements was used to determine the type of accounting used for the acquisition. Given our reasonable sample size, we have audited the classification of the asset goodwill as intangible versus tangible in the COMPUSTAT database and note that 14% of the firms misclassified goodwill as a tangible asset. We have made a reclassification adjustment. We then use Factiva, Lexis-Nexis, Hoover's, and other major news sources to follow the history of the firm and specifically determine how and when the company exited private equity ownership. The possible exit strategies are initial public offering (IPO), sale to a strategic buyer, sale to another financial buyer, and bankruptcy or out of court restructuring. This is a critical step in our analysis, as firms in our sample are removed from the analysis once the private equity fund has given up ownership of the firm.

There is a potential sample selection bias as a result of our collection method. Firms that exit private equity ownership via IPO are more likely to be included in our sample as they are required to make public historical financial statements as part of the IPO process. Additionally, more profitable firms could be financing themselves with private debt and thus be omitted from our sample. Also, the enterprise value of a firm may influence the LBO financing with larger acquisitions financed with publicly traded debt and smaller acquisitions financed with privately held debt. We cannot completely rule this out but attempt to ensure the representativeness of the sample by hand collecting financial information to expand our sample. In any case, to the extent that IPO exits and publicly financed firms are likely to be the more profitable LBOs, this biases our sample in favor of finding operating performance improvements.

[37] We thank the authors for sharing their data.

[38] Companies were phased in to EDGAR filing over a three-year period ending May 6, 1996. As of that date, all public domestic companies were required to make their filings on EDGAR.

[39] See Appendix A (Chapter 4.1) for details on the two methods used to account for LBOs.

2.3.2 Variable Selection

2.3.3 Disentangling Operating Performance from Leverage

Given the highly leveraged capital structure post-acquisition, we believe the best way to evaluate private equity's skill as business operators is to disentangle operating performance from leverage. To this end, we apply a standard approach used in financial statement analysis.[40] Return on Net Operating Assets (RNOA) is our measure of profitability. We define operating profitability as the profitability of the firm's underlying business. The rationale can be deduced by the following decomposition of return on equity into operating performance and leverage effects.

$$ROE = RNOA + \underbrace{(RNOA - \text{Financing Costs})}_{[Spread]} * \underbrace{\frac{NFO}{Equity}}_{[Leverage]} \tag{2.1}$$

If operating and financial assets are correctly separated, net operating assets are equivalent to capital invested, as measured by the accounting system.[41] RNOA is the accounting equivalent to return on capital invested and measures how many dollars of income a company creates per dollar of net operating asset. The increased leverage associated with LBOs makes RNOA the most valid measure of the operating profitability of a firm when comparing pre- and post-acquisition operating performance. RNOA is equal to net operating income (NOI) divided by net operating assets (NOA). Net operating income is defined as net income plus interest adjusted for the tax benefit plus minority interest plus preferred dividends. Net operating assets are total assets less cash, less investments and less operating liabilities. Operating liabilities include all liabilities with the exception of debt and notes payable. NFO is net financial obligations, the difference between financial liabilities such as debt, preferred stock, etc., and financial assets.

$$\underbrace{RNOA}_{[Operating\ Profitability]} = \underbrace{\frac{NOI}{Sales}}_{[Operating\ Margin]} * \underbrace{\frac{Sales}{NOA}}_{[Operating\ Turnover]} \tag{2.2}$$

2.3.4 Previously Tested Proxies and Accounting Concerns

The literature has focused on whether the operating cash flow generated by the assets in place is greater when the assets are controlled by private equity funds. The standard proxy for operating cash flow adjusted for capital structure is EBITDA. To control for the frequent asset divestitures associated with private equity investing, the level of cash flow is

[40] The advanced DuPont model presented below is specifically designed to decompose return on equity into its operating part and the additional effect of financial leverage.

[41] Appendix B (Chapter 4.2) shows in detail how the different components of the analysis are computed.

divided by total assets or sales. First we should point out that EBITDA by construction omits expenses related to investments. Since investments are part of normal operations, this is a crucial omission if one tries to assess operating profitability. This is because a constant stream of reinvestments is needed to sustain operating performance. Either depreciation and amortization or capital expenditures need to be taken into account. Second, simply looking at EBITDA or even EBIT scaled by assets does not provide a clear picture of operating profitability. One needs to scale net operating income appropriately to separate leverage effects. As equation (5.21) shows, one can increase operating income and even ROE by using leverage without affecting the underlying operating performance RNOA. This would not be indicative of superior management skills, however. At best it would be a sign of moving the capital structure closer to its optimum.

The use of a proper scaling variable is therefore vital. Scaling by sales does not separate leverage effects. It merely provides a short term view of operating margins, not providing the full profitability picture. As equation (5.8) shows, an increase in operating margin only increases RNOA if asset turnover remains constant. Scaling by assets is a step in the right direction. But it omits a potential source of operating improvements. LBO management might very well be able to stretch suppliers, etc., thereby reducing the amount of invested capital necessary to run operations. What's more, scaling by assets or as is appropriate, by net operating assets, is problematic due to various accounting issues.

Pre- and post-acquisition financial statements are drastically different due to the accounting for these kind of acquisitions. Additionally, the accounting is not consistent. Some acquisitions are accounted for using recapitalization accounting, while others apply purchase accounting. Recap accounting does not require the revaluation of a firm's assets and liabilities. Instead the capital structure is "'swapped out"' with equity being the residual. This can lead to negative equity if the amount of net financial obligations used to finance the acquisition is higher than a firm's net operating assets. Purchase accounting, on the other hand, revalues all assets and liabilities at fair value. The difference between purchase price and revalued book value enters the balance sheet as goodwill. On top of that the treatment of goodwill has changed over time. Goodwill used to be amortized over 15-30 years, depending on the industry. This accounting treatment was replaced in 2002 by annual impairment tests (SFAS No.142). Appendix A (Chapter 4.1) compares average balance sheets for recap vs. purchase accounting.

Some studies have tried to adjust for some of these issues. For example, if a company increased the value of land and goodwill post-acquisition, both Kaplan (1989) and Guo et al. (2011) adjust the pre-acquisition financial statements by increasing the value of the land and goodwill. This is correct, as long as the goodwill reflects intangible assets that accounting rules forbade to put on the firms' books and are now correctly included on the balance sheet. In a sense, the balance sheet did not include all of a firm's assets pre-acquisition but does so post-acquisition. However, it is incorrect if the premium paid to acquire the firm is not associated with hitherto unrecognized assets; if the fund "overpaid". After a

detailed review of the firms in our sample, we find the majority of the change in financial statements pre- and post-acquisition is associated with the asset goodwill or the premium paid to acquire the firm. It is important to note that the asset goodwill undergoes a review by the auditors annually[42] and is often reduced when a firm is not performing well. Such goodwill impairments are an indication that, given the current operating performance, the auditors feel that the private equity fund paid too much for the firm.[43] In our sample, 23 of 138 (17%) of the firms are forced by their auditors to reduce the asset goodwill in the post-acquisition period. In addition, the high bankruptcy rate documented in Andrade and Kaplan (1998) would suggest a high impairment rate. Thus, the pre-acquisition adjustment made by prior studies is frequently removed by the auditors, which induces an upward shift in asset-scaled performance measures post-acquisition. Table 2.1 gives an example of the difference in variable construction. Here, a goodwill impairment generates a marked increase in proxy EBITDA to assets in later periods. It is not clear ex ante what the right treatment should be. For our main tests, we propose to look at RNOA and its components without a pre-acquisition adjustment and augment it by computing RNOA and its components using tangible net operating assets. Looking at both will highlight the influence of goodwill effects. Looking at tangible RNOA will overstate RNOA if goodwill indeed represents unrecognized assets, but it will do so consistently over time, so that changes in tangible RNOA will still provide an accurate measure. In addition, we pro-forma transform recap accounting into purchase accounting by including the difference between book value and purchase price as goodwill. We do not pro forma revalue any assets. As highlighted before, it seems as if the main difference between pre- and post-acquisition balance sheets is due to goodwill in our sample. For periods after 2001, we also include pro forma goodwill amortization over a 30 year horizon to have a consistent goodwill treatment across sample years and firms.

In addition to goodwill impairments, we frequently observe restructuring initiatives in the financial statements. These restructuring initiatives could result in a consolidation of manufacturing facilities, a streamlined distribution system with fewer warehouses, a reduction in head count, or discontinuing a business line. All of these actions will cost money at the time of implementation with the hope of future increases in operating performance. These restructuring costs are recorded in special and extraordinary items which are below EBITDA on the income statement. Table 2.2 presents a COMPUSTAT income statement and illustrates the accounting for improvement initiatives. For this reason we define *Operating Income* in our sensitivity tests as net income plus interest, taxes, and amortization & depreciation. We believe this is a very subtle difference, but important given the particular firms and investment process we are trying to evaluate. EBITDA which is typically used in

[42]The annual impairment was mandatory even before goodwill amortization was abolished.

[43]See Delco Remy 10K 12/31/2002 for an example. The company, with the assistance of an outside valuation firm, performed the impairment tests of its goodwill required by SFAS No. 142. As a result of this assessment, the company recorded a non-cash charge of $74,176, to reduce the carrying value of its goodwill to its estimated fair value.

Table 2.1: Technical Accounting and Variable Selection

Table 2.1 illustrates the issue with comparing financial statements pre- and post-acquisition. The firm in our example has $100 million in assets that generate 15% profits. Panel A presents a partial balance sheet where t = 0 is the year of the LBO. Panel B presents a partial income statement to EBITDA. Panel C calculates the operating performance proxies. Adjusted assets pre-acquisition is calculated as the difference between intangible assets at t = 0 and t = -1. In this example the firm increased intangible assets (goodwill) by 30 million from period t = -1 to t = 0. The adjustment of 30 million is added to the pre-acquisition total asset balance. In period t =4, the firm is forced to reduce the intangible asset balance by its auditors.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**	**t = 5**
Panel A								
Balance Sheet								
Intangible Assets	-	-	30	30	30	30	-	-
Tangible Assets	100	100	100	100	100	100	100	100
Total Assets	100	100	130	130	130	130	100	100
Total Assets (Adjusted)	130	130	130	130	130	130	100	100
Panel B								
Income Statement								
Sales	150	150	150	150	150	150	150	150
Profit Margin, %	10	10	10	10	10	10	10	10
EBITDA	15	15	15	15	15	15	15	15
Panel C								
Variables								
EBITDA to Assets	15%	15%	12%	12%	12%	12%	15%	15%
EBITDA to Assets (Adjusted)	12%	12%	12%	12%	12%	12%	15%	15%
EBITDA to Tangible Assets	15%	15%	15%	15%	15%	15%	15%	15%

the literature excludes costs associated with the "improve" component of the "buy-improve-sell" mandate.

2.4 Summary Statistics

2.4.1 Balance Sheet Analysis

We present summary statistics for major balance sheet items both for the year prior to the acquisition and the year of the acquisition in Table 2.3, Panel A. The average total asset balance increases 52% from $1,449 million to $2,206 million from the full year prior to the year of the LBO. The majority of the increase in the value of total assets is the premium paid during the LBO, as 84% of the increase in total assets can be attributed to the increase

Table 2.2: Accounting for Restructuring Initiatives

Table 2.2 reports average income statement items for the firms in our sample. Summary statistics are provided for the two full years prior to acquisition by the private equity fund and until the firm exits the private equity fund. The summary statistics are presented for a maximum of five years after acquisition by the private equity fund. Year t = 0 is the year the firm was acquired by the private equity fund. Values presented are dollars in millions.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**	**t = 5**
Number of Firms	138	138	138	138	113	87	64	44
Sales	1,449	1,578	1,548	1,630	1,788	1,944	1,730	1,853
Cost of Goods Sold	1,010	1,080	1,076	1,141	1,254	1,326	1,214	1,279
Sales, General & Admin.	266	293	278	276	300	350	317	359
EBITDA	173	205	193	213	234	268	199	214
Depreciation & Amort.	53	61	72	85	96	106	85	73
Interest Expense	37	44	111	149	156	158	107	99
Non-Operating Income	10	6	3	4	8	(1)	1	(1)
Special Items	(10)	(9)	(100)	(40)	(32)	(26)	(53)	(62)
Taxes	35	40	2	13	7	4	1	19
Minority Interest	1	4	2	4	3	5	0	0
Extraordinary Items	(1)	(1)	(1)	(3)	(2)	(7)	(3)	(6)
Discontinued Operations	4	1	10	(1)	1	(1)	(1)	(4)
Net Income (Loss)	50	54	(80)	(77)	(54)	(41)	(50)	(50)

in intangible assets. The average debt increases 173% from $537 million to $1,468 million from the full year prior to the year of the LBO. This level of debt is greater than the value of total assets pre-acquisition, again illustrating the premium paid during the LBO. The equity balance decreases 64% from $509 million to $181 million from the full year prior to the year of the LBO. The equity to total assets decreases from 35% to 8% pre and post-acquisition and the debt to total assets increases from 37% to 66% over the same period.

2.4.2 Income Statement Analysis

We present summary statistics for major income statement items both for the year prior to the acquisition and the year of the acquisition in Table 2.3, Panel B. Sales and EBITDA are relatively stable pre- and post-acquisition. Interest expense increases 251% from $44 million to $111 million as firms service the increased debt. Taxes are reduced 96% from $40 million to $2 million due to the tax shield associated with interest payments. The firms generate negative net income on average in the post-acquisition period, which further reduces the balance sheet equity.

Table 2.3: Major Changes in the Financial Statements

Table 2.3 reports major financial statement items and market valuation information for the 138 firms in our sample with complete financial statements. Summary statistics are provided from the financial statements for the full year prior to acquisition by the private equity fund and for the year of acquisition by the private equity fund. Panel A presents major balance sheet items, while Panel B presents major income statement items. Values are U.S. $ in millions.

	Year Prior			**Year of Acq.**		
	Median	**Mean**	**Std Dev**	**Median**	**Mean**	**Std Dev**
Panel A						
Balance Sheet						
Tangible Assets	397	1,134	2,826	428	1,255	3,203
Intangible Assets	19	315	1,238	190	951	2,841
Total Assets	455	1,449	3,732	623	2,206	5,501
Debt	132	537	1,703	447	1,468	3,630
Equity	187	509	1,155	55	181	844
Panel B						
Income Statement						
Sales	594	1,578	2,888	632	1,548	2,721
EBITDA	71	205	480	64	193	427
Dep. & Amort. Exp.	21	61	125	25	72	154
Interest Expense	13	44	119	32	111	359
Taxes Expense	13	40	97	3	2	72
Net Income	19	54	162	(4)	(80)	567

2.4.3 Balance Sheet & Income Statement Timeline

To better understand the implications of changes in firms' financial statements pre- and post-acquisition, we have presented a timeline of both the balance sheet and the income statement in Tables 2.4 and 2.5, respectively.

In Table 2.4 we present average balance sheet items as a percent of assets. The changes we want to highlight are in the intangible and the capital structure (debt and equity) balances. The intangible balance increase from 14% of assets to 33% of assets from the full year prior to the full year after the LBO. This increase is the result of the use of purchase accounting[44] by the majority of firms in our sample, where the purchase price in excess of the fair market value of assets is recorded as goodwill. We note that the intangible balance as a percent of total assets decreases to 25% five full years after the LBO. This is driven by the fact that 23 of 138 of the firms (17%) are forced by their auditors to reduce or write off the goodwill

[44]See Appendix A (Chapter 4.1) for details on the two methods used to account for LBOs.

Table 2.4: Balance Sheet while Controlled by Private Equity Fund

Table 2.4 reports average balance sheet items as a percent of assets. Summary statistics are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. The summary statistics are presented for a maximum of five years after acquisition by the private equity fund. Year t = 0 is the year the firm was acquired by the private equity fund.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**	**t = 5**
Number of Firms	138	138	138	138	113	87	64	44
Balance Sheet								
Current Assets	43%	43%	30%	30%	31%	32%	36%	39%
Plant, Property & Equip.	37%	37%	30%	30%	31%	30%	30%	31%
Intangibles	13%	14%	32%	33%	32%	32%	30%	25%
Other Assets	7%	6%	7%	7%	6%	5%	4%	5%
Total Assets	100%	100%	100%	100%	100%	100%	100%	100%
Current Liabilities	20%	20%	17%	17%	19%	20%	22%	25%
Short Term Debt	5%	4%	4%	6%	11%	7%	8%	8%
Long Term Debt	29%	29%	70%	69%	64%	67%	71%	72%
Other Liabilities	6%	6%	7%	8%	8%	9%	9%	11%
Total Liabilities	59%	59%	98%	100%	103%	103%	110%	115%
Total Shareholders Equity	41%	41%	2%	0%	-3%	-3%	-10%	-15%
Total Liabilities & Equity	100%	100%	100%	100%	100%	100%	100%	100%

balance. As we have observed, a goodwill impairment is an indication that the private equity fund overpaid for the firm acquired. Again, goodwill impairments are the reason that we propose an alternative variable construction methodology using tangible assets to make the pre- and post-acquisition financial statements comparable.

Turning our focus to the capital structure, we clearly see the expansive use of debt in the capital structure and the reduced level of equity pre- and post-acquisition. Debt increases from 33% of assets to 75% of assets from the full year prior to the full year after the LBO. Equity decreases from 41% of assets to 0% of assets over the same period. Additionally, the equity balance continues to decline post-acquisition as a result of the income statement losses presented in Table 2.5 below.

In Table 2.5 we present the average income statement items as a percent of sales. Net income decreases from 3.8% of sales to -4.4% of sales from the full year prior to the full year after the LBO and remains negative for the five years evaluated. Additional changes we wish to highlight are the interest expense and the tax expense. The interest expense increases from 3% of sales to 11% of sales from the full year prior to the full year after the LBO and then declines to 7% of sales in period +5. Tax expense decreases from 3% of sales to 0% of sales from the full year prior to the full year after the LBO and essentially remains at 0%

Table 2.5: Income Statement while Controlled by Private Equity Fund

Table 2.5 reports average income statement items as a percent of sales for the firms in our sample. Summary statistics are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. The summary statistics are presented for a maximum of five years after acquisition by the private equity fund. Year t = 0 is the year the firm was acquired by the private equity fund.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**	**t = 5**
Number of Firms	138	138	138	138	113	87	64	44
Income Statement								
Sales	100%	100%	100%	100%	100%	100%	100%	100%
Cost of Goods Sold	67%	66%	66%	67%	69%	69%	68%	68%
Sales, General & Admin.	19%	18%	19%	18%	18%	18%	20%	20%
EBITDA	14%	15%	15%	15%	13%	14%	12%	12%
Interest Expense	3%	3%	7%	11%	11%	9%	8%	7%
Depreciation & Amort.	5%	5%	6%	8%	7%	6%	5%	5%
Non-Operating Income	1%	1%	0%	0%	1%	0%	0%	0%
Special Items	-1%	-1%	-5%	-1%	-5%	-1%	-4%	-6%
Income Taxes	3%	3%	0%	0%	-1%	0%	0%	1%
Minority Interest	0%	0%	0%	0%	0%	0%	0%	0%
Extraordinary Items	0%	0%	-1%	0%	0%	0%	0%	-1%
Discontinued Operations	0%	0%	0%	0%	4%	0%	0%	0%
Net Income (Loss)	2.9%	3.8%	-3.5%	-4.4%	-4.2%	-3.1%	-4.5%	-7.3%

in the post acquisition period evaluated. However, the net affect is a reduction in operating cash flows as illustrated in Table 2.6 below.

2.4.4 Cash Flow Statement Timeline

To understand the cash flow implications of LBO transactions we present summary cash flow statements in Table 2.6. Table 2.6 presents a reduced sample of 64 LBOs that have complete financial statements for up to and including the period +4. Cash flow from operations decreases 46% after the LBO from $111 million to an average of $60 million over periods +1 to +4, mainly as a result of the increased interest expense. Given that these firms' assets can only generate a certain level of cash flow, the firms experience a forced reduction in capital expenditures. Cash flow associated with investment decreases 42% after the LBO from an average of $84 million in periods -2 and -1 to an average of $49 million over periods +1 to +4. Kaplan (1989), Smith (1990) and Opler (1992) all document sizable reductions in capital expenditures after a buyout. This is an illustration of the forced release of excess free cash flow and the motivational benefits of debt described in Jensen (1986). Free cash

flow is cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital. Debt reduces the agency costs of free cash flow by reducing the cash flow available for spending at the discretion of managers. It is argued that the LBO capital structure combined with concentrated ownership and high-powered incentives reduces wasteful investment and is superior to the traditional public, diverse ownership form. Therefore, testing Jensen's thesis results in testing proxies for operating performance adjusted for capital structure.

Table 2.6: Cash Flow Statement while Controlled by Private Equity Fund

Table 2.6 reports average cash flow financial statement items for a subsample of firms in our sample. Summary statistics are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. The summary statistics are presented for a maximum of five years after acquisition by the private equity fund. Year t = 0 is the year the firm was acquired by the private equity fund.

Period	**t = -2**	**t = -1**	**t = 0**	**t = 1**	**t = 2**	**t = 3**	**t = 4**
Number of Firms	**64**	**64**	**64**	**64**	**64**	**64**	**64**
Cash Flow Statement							
Change in Cash Balance	10	21	(45)	(6)	9	3	(0)
Net Income	56	57	(11)	(21)	(10)	(36)	(50)
add Depreciation & Amortization	45	49	66	83	82	84	85
add decreases in Net Working Capital	(4)	8	(0)	47	(4)	(34)	15
add decreases in Deferred Charges	0	0	(10)	(1)	0	1	2
add increases in Taxes	4	6	104	7	(5)	(7)	1
Cash Flow from Operations	101	121	149	114	64	8	53
Cash Flow used for Investing	(90)	(78)	(922)	(62)	(74)	(34)	(25)
Cash Flow from Financing	(2)	(23)	728	(58)	19	29	(28)

2.4.5 First Exits from Private Equity Funds

Firms can exit the private equity fund via a subsequent IPO, bankruptcy, restructuring out of court,[45] sale to strategic buyer or sale to another financial buyer.[46] We limit our sample to deals announced between January 1980 and December 2006 in an attempt to reduce the number of firms in the sample that are still held by private equity funds. We then

[45]Out of court restructuring is defined specifically as a debt for equity conversion where the private equity funds' equity is essentially eliminated.

[46]Financial buyers would include other private equity funds, wealthy individuals or management.

use Factiva, Lexis-Nexis, Hoover's and other major news sources to follow the history of the firm and specifically determine how and when the company exited private equity ownership. This is a critical step in our analysis, as firms in our sample are removed from the analysis once the private equity fund has surrendered ownership of the firm.

A summary is provided in Table 2.7, both for the initial sample of 531 firms and the 138 firms with complete financial statements. Table 2.7 shows that of the 138 firms in our sample with complete financial statements, 21% of firms acquired by private equity funds file for bankruptcy and an additional 4% restructure out of court. The same analysis on the 531 LBOs finds that 21% file for bankruptcy or restructure out of court. These default rates are higher than the Standard & Poor's five year average cumulative default rate for speculative grade debt of 18.5%.[47] A high default rate for LBOs supports the position that the reduced reinvestment is detrimental to long-term operating performance and leaves firms more vulnerable to economy wide or industry specific shocks.[48]

Table 2.7 also indicates that firms that exit private equity ownership via IPO are more likely to be included in our sample as they are required to make public historical financial statements as part of the IPO process. Of the 138 firms with complete financial statements 39% IPO versus only 23% of the 531 LBOs identified in our initial search.

Table 2.7 also provides the average number of years that firms are controlled by private equity funds. The average holding period is approximately 5 years as expected given the private equity investment thesis of buy-improve-sell. The firms identified as still controlled by private equity have been held 10 years on average and deserve further investigation.

2.4.6 Industry and Year of Private Equity Fund Acquisitions

We provide an analysis of private equity acquisitions across industries and over time using the standard industry classification (SIC) system in Table 2.8. Approximately 80% of the firms acquired are in manufacturing, retail trade and service industries. Our sample of 138 firms appears to be reasonably similar to the overall distribution of firms identified by SDC Platinum database in both time and industry.

[47] Standard & Poor's 2011 Annual U.S. Corporate Default Study and Rating Transitions, Publication date 23-March-2012.

[48] Our results are similar to Andrade and Kaplan (1998) that find 23% of larger public-to-private transactions of the 1980's defaulted by 1995. Our results are also supported by a recent study by the *Wall Street Journal* that evaluates 77 firms acquired by private equity fund Bain Capital and finds that 17 (22%) filed for bankruptcy protection or were liquidated by the end of the eighth year. (Maremont, M. (2012 Monday January 9). Romney at Bain: Big Gains, Some Busts. *The Wall Street Journal*).

Table 2.7: Outcomes for Firms acquired by Private Equity Funds

Table 2.7 reports the methods utilized by private equity funds to monetize investments over our sample period 1:1980 - 12:2008. Bankruptcy and out of court restructuring would indicate a loss in equity invested by the private equity fund. The table also presents the average number of years that firms were held by private equity funds. Results for both the 531 firms identified in our analysis and for the subsample of 138 firms with complete financial statements are provided.

	Panel A	**531 Sample**		**Panel B**	**138 Sample**	
Type of Exit	**# of Deals**	**% Of Deals**	**Years Held**	**# of Deals**	**% Of Deals**	**Years Held**
IPO	124	23%	4.0	53	39%	4.6
Strategic Buyer	132	25%	5.2	29	21%	4.6
Financial Buyer	50	9%	5.0	11	8%	5.3
Bankruptcy	99	19%	5.2	29	21%	4.7
Restructuring	10	2%	4.4	6	4%	4.9
Still Private	115	22%	11.5	10	7%	10.8
Open	1	0%				
	531	100%		138	100%	

2.5 Empirical Results

2.5.1 Methodology

This section evaluates operating performance variables during the two full years pre-acquisition and during the holding period, up to five years post-acquisition. Year 0 is the first year where the acquisition is recorded in the financial statements. As firms exit the private equity funds, they exit our sample. The analysis presents variables in two ways: (1) in levels, and (2) the percentage changes in the first five full years after the buyout (periods + 1, + 2, + 3, + 4, and + 5) compared to the first full year before the buyout (period - 1).

In order to identify the effect of an LBO on subsequent performance, we use the following approach. We are interested in the development of the a firms $RNOA$ after the LBO:

$$E[RNOA_{t,LBO=1}|LBOCan = 1] - E[RNOA_{t,LBO=0}|LBOCan = 1] \tag{2.3}$$

for t=1 to 5 and t=0 being the time of the LBO. $LBOCan$ are LBO candidates, the sample firms subject to a LBO. In other words, we are interested in the average treatment effect on the treated, or the difference between the performance after the LBO and the performance had the firms not been subject to a LBO. This can be rewritten as.

Table 2.8: Private Equity Acquisition Activity Across Industries and Over Time

Table 2.8 reports the Standard Industrial Classification (SIC) of firms acquired by private equity funds over our sample period. Deals announced in 2006 may have been completed in 2008. The table presents results for the 531 firms identified in our initial search for public to private LBOs and for the subsample of 138 public to private LBOs with complete financial statements (F/S). Only 508 of the 531 firms have SIC codes due to incomplete hand collection.

Industry	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2008	Total	Complete F/S
Manufacturing	35	86	7	35	33	25	44%	38%
Retail Trade	7	43	2	8	12	18	18%	25%
Construction	2	3	0	0	0	1	1%	1%
Electric, Gas, and Sanitary Services	3	12	0	8	6	9	7%	9%
Agriculture, Forestry, and Fishing	0	0	0	0	2	0	0%	1%
Finance, Insurance, and Real Estate	1	3	2	5	4	14	6%	1%
Services	2	15	5	26	16	27	18%	17%
Wholesale Trade	1	4	2	3	7	5	4%	6%
Public Administration	1	1	0	1	0	0	1%	0%
Mining	1	1	0	1	3	0	1%	1%
Public to Private LBOs	53	168	18	87	83	99	508	
	10%	33%	4%	17%	16%	19%	100%	
LBOs with complete F/S	4	56	3	36	24	15		138
	3%	41%	2%	26%	17%	11%		100%

$$
\begin{aligned}
&E[RNOA_{t,LBO=1}|LBOCan=1] - E[RNOA_{t,LBO=0}|LBOCan=1] = \\
&E[RNOA_{t,LBO=1}|LBOCan=1] - E[RNOA_{t,LBO=0}|LBOCan=0] \\
&- E[RNOA_{t,LBO=0}|LBOCan=1] - E[RNOA_{t,LBO=0}|LBOCan=0]
\end{aligned} \tag{2.4}
$$

The first term after the equal sign is the observed difference between firms in the sample that have been subject to an LBO and the performance of the firm has not been subject to an LBO. The second term in brackets is the sample selection bias. It is essentially the difference in performance between LBO candidates and non-LBO candidates over time that is not attributable to the LBO treatment. In our main tests we simply compare LBO performance to the industry median over time. By doing so we effectively assume that LBO candidates are not significantly different from other firms in their industry. In our sensitivity section we test this assumption, however, by constructing a matched control sample and comparing

the difference in performance between the LBO and the matched sample over time.

A second problem we face in our empirical analysis is the occurrence of quasi-voluntary attrition. We can only collect data for firms still filing data with the SEC as they have listed debt. Our sample reduces in size the further out into the future we try to collect the data. This is a potential problem if the attrition is related to performance. There are a few possible reasons why this might be so. As long as performance is negatively related to attrition this is working against our tests. We would effectively retain the more profitable LBOs. However, the case where we would retain only the less profitable LBOs would bias our estimates downwards. More profitable firms, for instance, might be able to refinance their debt sooner to get rid of costly disclosures or are sold off again at a faster rate. To test whether performance can predict the rate of attrition in our sample, we estimate a Cox proportional hazard model of the form:

$$\begin{aligned} \lambda(Prds_i|X) &= \lambda_0(Prds_i)\exp(\beta' X) \\ &= \lambda_0(Prds_i)\exp(\beta_1 OpInc_{i,before} + \beta_2 OpInc_{i,after} + \beta_3 Lev_{i,after}) \end{aligned} \tag{2.5}$$

where *prds* is the number of post-LBO periods the firm is in the sample. *OpInc* is operating income and *Lev* is leverage measured as net financial obligations to equity. The results of Model (2.5) are presented in Table 2.9 and show no significant relation between performance and leverage with the rate of attrition from our sample.[49]

In order to evaluate the statistical significance of pre- and post-acquisition operating performance adjusted for economy wide and industry effects, we present industry adjusted figures. The industry adjustment uses firms in the same four-digit SIC code as the acquired firm. Comparisons are made at the three-digit level and the two-digit level when fewer than three industry matches are found. The industry file is the merged[50] COMPUSTAT and CRSP databases were limited to firms that trade on the NYSE, AMEX and NASDAQ stock exchanges. The 138 sample firms are also excluded from the industry file when calculating the industry variable to subtract.

To abstract from outliers that dominate the means in the small samples we focus on medians. The results for Wilcoxon signed rank tests are used to test for significance of the median values. All significance levels are based on two-tailed tests. This approach is conservative and implicitly assumes a null hypothesis that post-acquisition variables equal pre-acquisition variables.

[49] As an additional robustness test we conduct a two-stage Heckmann approach. Untabulated results yield an insignificant inverse mills ratio when included in a regression of industry adjusted RNOA on year dummies and the inverse Mills ratio.

[50] Merged using 8 digit CUSIP to PERMNO. Observations where the balance sheet does not balance or where the calculation of net income does not equal reported net income are excluded.

Table 2.9: Cox Proportional Hazard Model of Early Exit

The model tests whether operating income (measured as sales minus cogs minus SG&A scaled by lagged assets before and after the LBO and leverage from the LBO) explain how fast a firm exits from our sample. A standard Cox proportional hazard model is applied. Tests of the global null hypothesis cannot be rejected with a likelihood ratio of 3.267 and a p-value of 0.35.

Parameter	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
opinc_after	−2.420	1.675	2.088	0.149	0.089
opinc_before	0.455	1.410	0.104	0.747	1.577
lev_after	0.002	0.002	0.738	0.390	1.002

2.5.2 Evaluation of Post-Buyout RNOA

For our main test of operating profitability, we apply a standard textbook approach used in financial analysis as advocated by Nissim and Penman (2001) and decompose ROE into RNOA, our main measure of operating profitability. We further decompose RNOA into operating margin and net operating asset turnover.[51]

Table 2.10 provides the details of our ROE decomposition. Looking at the development of the whole decomposition over the event time line provides interesting insights. RNOA experiences a sizable drop (from 10.2% to 4.1% at the LBO date) from which the firms seem to be slow to recover, eventually reaching 5.6% in period 5. The industry adjusted time line shows this drop is relative to industry profitability. While the firms are not significantly more or less profitable before the LBO, their operating profitability is significantly worse than the industry standard afterward. In a perfectly competitive market firms should only be able to earn their cost of capital. A firm's WACC is therefore a good benchmark for a firm's RNOA if the balance sheet captures all assets appropriately. Pre-LBO a sample firm's RNOA was on average 10%, not significantly different than the industry median. Reasonable estimates for a WACC should be in the 7% to 10% range. However the LBO depresses RNOA to something around 6%; this seems too low to be the result of productive intangible assets which haven't been on the books so far. A study of operating margin and operating turnover suggests that this decrease is significant when compared to the industry. The decline in operating turnover, from 2.37 in period -1 to 1.65 in period 3, implies that firms use more invested capital after the LBO to generate a dollar of sales. This makes sense considering that in most cases a premium has been paid by the private equity fund to buy the firm. This premium is additional capital invested in the firm and is now reflected in net operating assets via the intangible asset goodwill. The subsequent use of the additional capital invested is correspondingly reflected in goodwill amortization. In fact, comparing

[51] See Appendix B (Chapter 4.2) for decomposition details.

Table 2.10 with the components of tangible RNOA in Table 2.11 suggests the premium is the main driver for the decline in operating performance.

Apart from the results on operating profitability, Table 2.10 also highlights the impact on borrowing costs. Net borrowing costs go up significantly after the buyout, from a median 6.6% in period -1 to over 7.2% in the post-acquisition period. This corresponds to a consistent premium of an additional 1.3%-2.2% in interest, compared to peers, reflecting the additional risk associated with a highly leveraged capital structure. Leverage turns negative, albeit not statistically significantly so. This is because a large amount of firm in our sample has negative equity at the point (See Table 2.4). The industry-adjusted leverage shows that leverage increases by order of magnitudes of what the industry median is. If LBO targets operated with a suboptimal capital structure before the LBO, so does most of its industry too.

Table 2.11 depicts the development of RNOA and its drivers over time while excluding intangibles and goodwill amortization. The measure is called return on net operating tangible assets (RNOA Tangible).[52] Here we do not find any evidence of improvements in operating profitability on tangible assets. The profitability of tangible net operating assets stays in line with the industry. Neither operating margin nor tangible operating efficiency shows signs of a sustainable improvement. These results are robust to tests of subsamples of LBOs completed in the 1980s and those completed after and to tests of LBOs by industry (results not presented). There are 60 LBOs from 1980 - 1989 in our sample and 78 LBOs from 1990 - 2006.

These tests are a cleaner test – free of leverage effects and adjusting for accounting issues – of operational improvements in target firms than what was previously used in the literature.

2.5.3 Additional Tests

2.5.4 Development of RNOA compared to a Control Group

With a method similar to Boucly et al. (2011), we compare operating profitability directly to a control group. We select firms in the same 2-digit sic code during the year before the LBO, number of employees in a $+/-50\%$ of the LBO firms number of employees and an RNOA not smaller than the target's RNOA minus 5% and not higher than the target's RNOA plus 5%. We then match the time line of these firms and each control group's median RNOA and tangible RNOA from the respective target firm. The last lines in Tables 2.10 and 2.11 show the adjusted RNOA and tangible RNOA measures over time. The results are qualitatively similar to the the industry adjusted results.

[52] See Appendix B (Chapter 4.2) for adjustment details.

2.5.5 Evaluation of Previously Tested Proxies

To put the preceding results into perspective, we now turn to analyzing other performance measures comparable to those previously presented in the literature.

Focusing on Table 2.12, Panel A, EBITDA to sales for the sample of LBO firms is significantly above the industry pre- and post-acquisition through period +3, after which the variable is not statistically different from the industry. *Operating Income* to sales for the sample of LBO firms is significantly above the industry pre- and post-acquisition through period +1, after which the variable is not statistically different from the industry. We believe the increased difference in the two variables is due to the accounting treatment of restructuring initiatives. Given the trend declines using the EBITDA measure and persistent for only one year using the *Operating Income* measure, we conclude that LBOs do not exhibit post-buyout operating performance improvements compared to industry peers.

We also present the percentage changes in the variables presented in Table 2.12, Panel B. Although the industry adjusted percentage changes in both variable is significantly positive from period -1 to +1, the latter periods are neither significant nor positive.

Table 2.13, Panel A, presents EBITDA to tangible assets and *Operating Income* to tangible assets for the sample of LBO firms. Again, these variables are presented for comparison with prior literature. Both measures are significantly above the industry pre- and post-acquisition through period +3 after which only the variable EBITDA to tangible assets is statistically different from the industry. Again, we believe the increased difference in the two variables post-acquisition is due to the fact that costs associated with improvement initiatives are only captured in *Operating Income*. In Panel B, we present the percentage changes and industry adjusted percentage changes for both variables. We do not find any evidence of improvements in these measures, as they stay in line with the industry. It is of interest to note that we did test EBITDA to adjusted total assets, as in Kaplan (1989) and Guo, Hotchkiss, and Song (2011) where the value of total assets pre acquisition is increased by the goodwill on the balance sheet post-acquisition, and find significant improvements in the percentage change over the 5 years post-acquisition evaluated.

2.5.6 Controlling for Exit Types

To further investigate operating performance, we present the same event study using previously tested proxies and controlling for firms exiting the sample in Table 2.14. The subsample of 63 firms held for 4 years exhibits operating performance significantly above the industry in the pre-acquisition period and performance declines in the post-acquisition period. We also evaluate operating performance controlling for how firms exit private equity ownership. Table 2.15 presents results for firms that file for bankruptcy or restructure outside the bankruptcy court. These firms exhibit operating performance significantly above their industry peers in the pre-acquisition period and then exhibit a rapid deterioration in

operating performance in the post-acquisition period. Table 2.16 presents results for firms that return to public ownership via an IPO. For these outcomes, we find that firms exhibit a short-term increase in operating performance compared to industry peers.

2.6 Conclusion

Previous literature has a mostly positive attitude towards the operating abilities of private equity funds. It is suggested that private equity, with its concentrated ownership and high powered incentives, creates value through managerial incentives and by forcing the release of excess free cash flows. In this study we point out that previous literature has hitherto used noisy measures of operating profitability which are unable to cleanly isolate true improvements in operating profitability of the targets. Furthermore, various accounting issues significantly complicate inference. We collect comprehensive financial statements for a sample of 138 public U.S. firms that were acquired by private equity funds in leveraged buyouts between 1980 and 2008 and tackle this question again using a measure of operating performance adjusted for capital structure. Second, the complete financial statements enable us to examine the accounting issues that are caused by the LBO transaction and which complicate measurement significantly.

We present the technical accounting issues associated with leveraged buyouts and illustrate the importance of variable selection when evaluating private equity investing. In contrast with the existing literature, we find that firms acquired by private equity funds do not exhibit operating performance improvements compared with peers when evaluated after the buyout. Moreover, LBOs exhibit a significant decline in operating performance when measured up to five years post-acquisition. In addition to operations, we evaluate outcomes for firms acquired by private equity funds. In an expanded sample of 531 large public to private leveraged buyouts we find that 109 (21%) subsequently declare bankruptcy or were restructured outside the bankruptcy court while held by private equity funds. While it may be true that private equity funds are savvy investors and produce sizable returns for investors, the stagnant operating profitability over the five years post-buyout in conjunction with the high bankruptcy rate suggests that, on average, private equity funds do not add value in the form of operating performance improvements.

Table 2.10: Operating Profitability Timeline using RNOA

Table 2.10 reports median values in performance measures and these same performance measures industry adjusted. Performance measures are provided for the two full years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match. The construction of the variables is explained in Appendix B (Chapter 4.2).

	Variables	t=-2		t=-1		t=0		t=1		t=2		t=3		t=4		t=5	
	N=	138		138		138		138		114		87		64		44	
A.	ROE	11,8%	***	11,8%	***	-1,5%		-0,3%		1,4%		0,7%		1,7%		5,6%	
	Industry adjusted	0,3%		-1,0%		-13,1%	***	-12,9%	***	-11,5%	***	-12,7%	***	-8,2%		-5,5%	
B.	RNOA	10,5%	***	10,2%	***	4,1%	***	5,4%	***	6,1%	***	5,5%	***	5,8%	***	5,6%	*
	Industry adjusted	0,5%	***	0,0%	***	-6,8%	***	-5,2%	***	-4,6%	***	-3,3%	***	-3,4%	***	-3,1%	***
C.	Operating Margin	4,6%	***	5,2%	***	2,4%	***	3,8%	***	3,7%	***	3,6%	***	3,5%	***	3,0%	*
	Industry adjusted	0,0%		0,0%		-2,1%	***	-0,6%	*	-0,6%		-1,0%	**	-0,5%		-1,4%	
D.	Operating Turnover	2,50	***	2,37	***	1,58	***	1,23	***	1,47	***	1,49	***	1,79	***	1,35	***
	Industry adjusted	0,13		0,02		-0,60	***	-0,78	***	-0,65	***	-0,61	***	-0,42	***	-0,43	**
E.	Leverage	0,68	***	0,64	***	1,90	***	2,22	***	1,91	***	0,68		-1,47		-1,82	*
	Industry adjusted	0,14	***	0,06	**	1,53	***	1,59	**	1,57	***	0,26		-1,26		-2,44	**
F.	Spread	2,6%	***	3,0%	***	-3,9%	***	-2,7%	***	-1,9%	***	-1,2%	***	-1,2%	**	-0,6%	
	Industry adjusted	0,7%		0,0%		-6,9%	***	-5,3%	***	-5,9%	***	-4,2%	***	-4,0%	***	-4,1%	***
G.	Net Borrowing Costs	6,8%	***	6,6%	***	7,4%	***	7,9%	***	7,9%	***	7,5%	***	7,2%	***	7,3%	***
	Industry adjusted	0,2%		0,1%		1,3%	***	1,7%	***	1,4%	***	1,9%	***	2,1%	***	2,1%	***
	RNOA Control group adjusted	-1,2%		-0,2%		-6,3%	***	-5,6%	***	-3,5%	**	-4,4%		-2,2%		-8,9%	

Table 2.11: Operating Profitability Timeline using RNOA & Tangible Assets

Table 2.11 reports median values in performance measures and these same performance measures industry adjusted. Performance measures are provided for the two full years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match. The construction of the variables is explained in Appendix B (Chapter 4.2).

	Variables	t=-2		t=-1		t=0		t=1		t=2		t=3		t=4		t=5	
	N=	138		138		138		138		114		87		64		44	
B.	RNOA (Tangible)	12,9%	***	13,6%	***	6,1%	***	11,7%	***	10,9%	***	11,5%	***	10,2%	**	11,3%	
	Industry adjusted	-0,1%		-0,3%		-6,8%	***	-2,8%		-0,7%		-2,3%		-1,7%		-5,2%	*
C.	Operating Margin (Tangible)	4,6%	***	5,2%	***	2,4%	***	3,9%	***	3,7%	***	3,6%	***	3,5%	***	3,0%	*
	Industry adjusted	-0,4%		-0,1%		-2,2%	***	-1,0%	**	-0,8%		-0,7%	*	-1,3%	*	-1,6%	*
D.	Operating Turnover (Tangible)	3,07	***	3,11	***	2,90	***	2,57	***	2,93	***	3,32	***	2,90	***	2,87	***
	Industry adjusted	0,13		0,24	**	-0,02		-0,01		0,08	**	0,38	**	0,09		0,14	
	RNOA (Tangible) Control group adjusted	-0,7%		-0,5%		-4,8%	***	-0,4%		1,7%		2,2%		0,6%		-0,125	**

Table 2.12: Operating Performance Timeline using Profitability Measures

Table 2.12 reports median values in performance measures and these same performance measures industry adjusted. Panel A shows performance measures are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Panel B shows changes over time. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match. Operating Income equals net income plus interest, taxes, and depreciation & amortization.

	N =	137		137		137		137		113		85		63	43
	Period	**t=-2**		**t=-1**		**t=0**		**t=1**		**t=2**		**t=3**		**t=4**	**t=5**
	Panel A														
A.	EBITDA/Sales	11.3%		12.3%		12.1%		12.2%		11.5%		10.9%		10.0%	8.9%
	Industry adjusted	1.1%	***	1.1%	***	0.9%	**	1.6%	***	1.0%	**	0.8%	**	0.7%	-0.8%
B.	Operating Income/Sales	11.8%		12.4%		8.4%		12.8%		10.4%		10.8%		8.7%	8.1%
	Industry adjusted	0.3%		0.6%	*	-1.1%	**	1.0%	***	0.7%		0.4%		0.4%	-0.8%
	From year i to year j							**-1 : +1**		**-1 : +2**		**-1 : +3**		**-1 : +4**	**-1 : +5**
	Panel B														
C.	EBITDA/Sales							0.5%		-3.1%		-5.4%		-9.7%	-10.6%
	Industry adjusted, % change							7.1%	***	3.1%		0.1%		-6.9%	-5.4%
D.	Operating Income/Sales							-0.2%		-7.0%		-8.8%		-22.0%	-26.8%
	Industry adjusted, % change							8.5%	**	-0.2%		4.5%		-13.6%	-6.0%

Table 2.13: Operating Performance Timeline using Asset Efficiency Measures

Table 2.13 reports median values in performance measures and these same performance measures industry adjusted. Panel A shows performance measures are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Panel B shows changes over time. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match.

	N =	137	137	137	137	113	85	63	43
	Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**	**t=5**
	Panel A								
A.	EBITDA/Tan. Assets	17.6%	18.6%	17.2%	18.7%	18.5%	19.2%	20.5%	19.9%
	Industry adjusted	1.7% ***	3.2% ***	1.3% **	2.4% ***	3.3% ***	3.1% ***	4.5% ***	5.7% ***
B.	Op. Income/Tangible Assets	17.8%	18.6%	13.0%	19.0%	18.2%	17.9%	19.0%	17.4%
	Industry adjusted	1.4% ***	3.8% ***	-3.0% ***	2.4% ***	2.2% ***	2.8% ***	1.8%	5.2%
	From year i to year j				**-1 : +1**	**-1 : +2**	**-1 : +3**	**-1 : +4**	**-1 : +5**
	Panel B								
C.	EBITDA/Tangible Assets				-0.5%	0.5%	-5.5%	1.1%	6.3%
	Industry adjusted, % change				4.2%	5.2%	1.5%	11.6%	6.8%
D.	Op. Income/Tangible Assets				-5.6%	-6.0%	-5.0%	-7.9%	-2.8%
	Industry adjusted, % change				3.5%	-1.9%	3.3%	1.2%	-1.1%

Table 2.14: Operating Performance Timeline Controlling for Exits

Table 2.14 reports median values in performance measures and these same performance measures industry adjusted for a subsample of firms that were held by private equity funds for 4 years. Panel A shows performance measures are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Panel B shows changes over time. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match.

	N =	63	63	63	63	63	63	63
	Panel A							
	Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**
A.	Operating Income/Sales	11.9%	12.1%	9.0%	11.2%	9.2%	10.2%	8.7%
	Industry adjusted	1.4% *	1.4% **	-1.0%	1.6% ***	1.0% *	0.4%	0.4%
B.	Operating Income/Tangible Assets	18.4%	19.6%	13.1%	19.6%	18.9%	18.3%	19.0%
	Industry adjusted	2.7% ***	4.0% ***	-2.9%	3.5% ***	3.1% ***	3.0% **	1.8%
	Panel B							
	From year i to year j				**-1 : +1**	**-1 : +2**	**-1 : +3**	**-1 : +4**
C.	Op. Income/Sales, % change				-0.8%	-12.9%	-8.8%	-22.0%
	Industry adjusted, % change				10.6%	-5.8%	0.8%	-13.6%
D.	Op. Income/Tangible Assets, % change				-6.8%	-9.2%	-4.6%	-7.9%
	Industry adjusted, % change				6.1%	2.4%	10.2%	1.2%

Table 2.15: Operating Performance Timeline for Firms with Bankruptcy Exits

Table 2.15 reports median values in performance measures and these same performance measures industry adjusted for a subsample of firms that file for bankruptcy. Panel A shows performance measures are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Panel B shows changes over time. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match.

	N =	35	35	35	35	26	16	12	7
	Panel A								
	Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**	**t=5**
A.	Operating Income/Sales	11.9%	12.1%	7.1%	11.1%	6.6%	10.9%	5.7%	7.8%
	Industry adjusted	0.1%	1.4% *	-1.3%	-0.7%	-1.8%	-0.8%	-3.1% *	-0.2%
B.	Op. Inc./Tangible Assets	17.6%	18.4%	11.8%	14.4%	10.8%	14.4%	9.4%	14.2%
	Industry adjusted	1.2%	4.3% *	-4.9% **	-1.0%	-5.2% *	-2.0%	-2.7%	0.6%
	Panel B								
	From year i to year j				**-1 : +1**	**-1 : +2**	**-1 : +3**	**-1 : +4**	**-1 : +5**
C.	Op. Inc./Sales, % change				-7.3%	-35.6%	-17.0%	-70.4%	-30.4%
	Industry adjusted, % change				-2.9%	-31.8% ***	-10.2%	-61.4% ***	-30.4% **
D.	Op. Inc./Tan. Assets, % change				-20.8%	-55.3%	-30.8%	-74.0%	-44.1%
	Industry adjusted, % change				-14.0%	-44.3% ***	-8.2%	-63.3% ***	-31.0% **

Table 2.16: Operating Performance Timeline for Firms with IPO Exits

Table 2.16 reports median values in performance measures and these same performance measures industry adjusted for a subsample of firms that exit private equity control via IPO. Panel A shows performance measures are provided for two years prior to acquisition by the private equity fund and until the firm exits the private equity fund. Values are presented for a maximum of five years after acquisition. Panel B shows changes over time. Industry adjusted subtracts the median for firms in the same 4 digit SIC code. Significance levels of medians are based on a two-tailed Wilcoxon rank test. ***, **, and * denote levels that are significantly different from zero at the 1%, 5%, and 10% level, respectively. N equals the number of firms in our sample with an industry match.

	N =	52	52	52	52	45	34	24	14
	Panel A								
	Period	**t=-2**	**t=-1**	**t=0**	**t=1**	**t=2**	**t=3**	**t=4**	**t=5**
A.	Op. Income/Sales	11.9%	11.6%	8.5%	13.4%	11.9%	10.6%	8.6%	5.8%
	Industry adjusted	0.2%	1.6%	-0.6%	1.8% ***	0.6%	0.4%	0.7%	-4.2%
B.	Op. Inc./Tangible Assets	17.8%	18.2%	14.6%	20.3%	20.8%	20.1%	19.7%	10.6%
	Industry adjusted	0.7% *	2.3% ***	-3.2% *	3.5% ***	2.9% ***	2.9% ***	6.2% **	1.3%
	Panel B								
	From year i to year j				**-1 : +1**	**-1 : +2**	**-1 : +3**	**-1 : +4**	**-1 : +5**
C.	Op. Inc./Sales, % Δ				6.2%	3.6%	-3.1%	-13.6%	-8.8%
	Industry adjusted, % Δ				13.4% ***	6.7%	11.7% *	6.0%	18.3%
D.	Op. Inc./Tan. Assets, % Δ				11.4%	11.5%	3.0%	1.2%	3.5%
	Industry adjusted, % Δ				16.3% ***	19.1% **	16.3% *	21.7% **	10.6%

3 Chapter 3
Are Distressed Firms Mispriced?

3.1 Introduction

Researchers have been developing default and bankruptcy prediction models since the seminal work of Altman (1968). Given the ability to rank firms based on various financial distress risk measures, the literature has identified breakdowns in the risk return relationship. Specifically, portfolios of the most distressed firms deliver abnormally low returns. Dichev (1998) documents this asset pricing puzzle in the relationship between stock returns and distress risk using the Ohlson (1980) O-score and the Altman (1968) Z-score. Griffin and Lemmon (2002) use the same distress measures and argue that the phenomenon is driven by the poor performance of firms with low book-to-market ratios and high distress risk.

Vassalou and Xing (2004) use the Black and Scholes (1973) and Merton (1974) option pricing framework to calculate the distance to default and show that the subsequent abnormally low returns of distressed firms is specific to small value stocks. Da and Gao (2005) argue that the Vassalou and Xing (2004) result is attributable to the illiquidity of these small stocks and related market microstructure effects. If there was any doubt as to the existence of this asset pricing puzzle, Campbell, Hilscher, and Szilagyi (2008) – using a hazard rate model – present an impressive breakdown in the risk return relationship.[53]

In this paper we present a continuous time exchange economy where we model firms using the endogenous default model of Leland (1994). We simulate the path of 1000 distressed and 1000 non-distressed firms and evaluate the return distributions. It is clear that firms in distress do not have a Normal return distribution. Leland (1999) describes the impact of buying and selling skewness in a portfolio insurance framework on a key proxy for portfolio management performance, alpha. For instance, a portfolio manager who holds the market portfolio and buys put options on the market is in essence buying skewness. This portfolio manager will report negative alpha as the CAPM will not price the skewness purchased. As a result of the systematic mismeasurement of alpha in the presence of higher order moments, Leland (1999) proposes the use of the Rubinstein (1976) model. In this model, where consumption has a high volatility like stock returns, we do not need high risk aversion to explain the equity premium. However, under constant relative risk aversion (CRRA) utility, the modified *beta* derived would capture investors' preference for all higher order moments. We propose testing portfolios of distressed firms using the CAPM model and the Rubinstein (1976) modified CAPM with the hypothesis that the breakdown in the risk return relationship is the result of a systematic mispricing of the portfolios because the underlying return distribution is positively skewed.

[53]To quantify the mispricing, Campbell et al. (2008) present an alpha of negative 10 percent on an annual basis with annual portfolio formation in deciles using the CAPM.

The remainder of the paper is organized as follows. In Section 3.2 we develop our model and decompose *beta*. In Section 3.3 we describe the empirical methodology to test the modified *beta*. In Section 3.4 we describe the construction of the dataset and the four default measures tested. In Section 3.5 we present return properties of equity portfolios formed using the default measures. In Section 3.6 we conclude.

3.2 Model Development

3.2.1 Continuous Time Exchange Economy

We define the Stochastic Discount Factor (SDF) as follows:

$$\Lambda_t = e^{-\rho t} u'(c_t)$$

Assuming CRRA utility and applying Ito's lemma, the SDF can be written as follows:

$$\frac{d\Lambda_t}{\Lambda_t} = -\rho dt + c_t \frac{u''(c_t)dc_t}{u'(c_t)c_t} + \frac{1}{2} c_t^2 \frac{u'''(c_t)dc_t^2}{u'(c_t)c_t^2} \tag{3.1}$$

The coefficient of relative risk aversion under CRRA is defined as follows:

$$\gamma = -c_t \frac{u''(c_t)}{u'(c_t)}$$

We assume that consumption growth is independently and identically distributed (iid) at each moment in time. This assumption allows us to represent the law of motion (LOM) of consumption growth as a Geometric Brownian Motion (GBM) defined as follows:

$$\frac{dc_t}{c_t} = \mu_c dt + \sigma_c dz \tag{3.2}$$

where z is a standard Brownian motion, and μ_c and σ_c are mean and volatility of consumption growth, respectively.

Substituting the LOM for consumption growth into equation (3.1) we can rewrite our SDF as follows:

$$\frac{d\Lambda_t}{\Lambda_t} = -(\rho + \gamma\mu_c - \frac{1}{2}\gamma(\gamma+1)\sigma_c^2)dt - \gamma\sigma_c dz$$

Given that the expectation at time t ($\mathbb{E}_t[.]$) of the SDF is equal to the risk free rate, it is convenient to present the SDF as follows:

$$\frac{d\Lambda_t}{\Lambda_t} = -rdt - \gamma\sigma_c dz \tag{3.3}$$

$$\mathbb{E}_t\left[\frac{d\Lambda_t}{\Lambda_t}\right] = -rdt$$

Where the risk free rate, $r = \rho + \gamma\mu_c - \frac{1}{2}\gamma(\gamma+1)\sigma_c^2$, the market price of risk is equal to $\gamma\sigma_c$, z is a standard Brownian motion, and μ_c and σ_c are mean and volatility of consumption growth, respectively.

3.2.2 Firm i's Cash Flow Generation Process

Firm i has assets in place that generate after tax cash flow δ_t available to all claim holders. Let the firm's cash flow generation process follow a GBM.[54]

$$\frac{d\delta_t}{\delta_t} = \mu_\delta dt + \sigma_\delta dz$$

where z is a standard Brownian motion, and μ_δ and σ_δ are mean and volatility of cash flows, respectively. Assuming the same z creates a link between consumption and firm value in our economy.

To simplify our analysis it is convenient to express the firm's cash flow generation process under the risk neutral measure as follows:[55]

$$\frac{d\delta_t}{\delta_t} = \mu dt + \sigma_\delta dz^Q \qquad \text{where } \mu = \mu_\delta - \sigma_c\sigma_\delta\gamma \tag{3.4}$$

where z is a standard Brownian motion under the risk neutral measure, and μ and σ_δ are mean and volatility, respectively.

3.2.3 Equity Value

3.2.4 Equity Value without Debt and Infinite Life

First we define the value of a firm with no debt and zero probability of default as $A(\delta_t)$. The value of $A(\delta_t)$ can be expressed as follows:

$$\Lambda_t A_t = \mathbb{E}_t\left[\int_t^\infty \delta_s\Lambda_s ds\right]$$

The change of measure to risk neutral pricing indicated by $\mathbb{E}^Q$ simplifies the analysis.[56]

$$A_t = \mathbb{E}_t^Q\left[\int_t^\infty e^{-r(s-t)}\delta_s ds\right] = \frac{\delta_t}{r-\mu}$$

[54]We could incorporate a firm specific shock by introducing a second standard Brownian motion in our definition of firm cash flows, however, our *beta* decomposition is not influenced by this additional term.

[55]See Appendix A (Chapter 5.1): Solving for δ_t under the risk neutral measure.

[56]See Appendix B (Chapter 5.2): Solving for A_t.

The LOM of a firm with no debt and zero probability of default follows a GBM defined as follows:

$$\frac{dA_t}{A_t} = \mu dt + \sigma_\delta dz^Q \tag{3.5}$$

where z is a standard Brownian motion under the risk neutral measure, and μ and σ_δ are the instantaneous return and volatility, respectively.

3.2.5 Equity Value with Debt and Finite Life

We define the value of a equity as $\mathcal{E}(A_t)$. To derive the value of equity we follow Leland (1994) with the following notation:

- Console Debt that pays coupon $C > 0$.
- Tax-rate θ.
- Equity holders are getting paid, $\delta_t - C(1-\theta)$ (or equivalently $A_t(r-\mu) - C(1-\theta)$ at time t).
- Bankruptcy occurs when the asset value reaches A_B. The recovery value is $(1-\alpha)A_B$ and goes to debt holders. The bankruptcy cost is αA_B.
- Stopping time, $\tau(A_B) \equiv \inf\{t : A_t \leq A_B\}$, is a random variable w.r.t. filtration $\mathcal{F}$.

The firm's management will choose to default when the value of the unlevered, infinitely lived assets reach an endogenously predetermined level A_B, where the subscript B implies default or bankruptcy. The value of equity can be represented as follows:

$$\Lambda_t \mathcal{E}(A_t) = \sup_{\tilde{\tau} \in \mathcal{F}} \mathbb{E}_t \left[\int_t^{\tilde{\tau}} (A_s(r-\mu) - C(1-\theta))\Lambda_s ds \right]$$

Letting τ^* be the optimal stopping time, we solve for the following value of equity,[57] when $A_t > A_B$:

$$\mathcal{E}(A_t) = \left[A_t - \frac{C(1-\theta)}{r} \right] - \left(\frac{A_t}{A_B} \right)^{-\nu} \left[A_B - \frac{C(1-\theta)}{r} \right] \tag{3.6}$$

with $\nu = \frac{m + \sqrt{m^2 + 2r\sigma_\delta^2}}{\sigma_\delta^2}$; $m = \mu - \sigma_\delta^2/2$; and $A_B = \frac{C(1-\theta)\nu}{r(1+\nu)}$

[57] See Appendix C (Chapter 5.3): Solving for $\mathcal{E}(\delta_t)$.

3.2.6 Solving for Law of Motion of Equity

Unfortunately, the dynamics of $d\mathcal{E}_t$ does not constitute a GBM. However, we can solve for the LOM for equity by applying Ito's lemma to equation (3.6).[58] The result is presented below.

$$\frac{d\mathcal{E}}{\mathcal{E}} = \mu_{\mathcal{E}} dt + \sigma_{\mathcal{E}} dz^Q \tag{3.7}$$

where

$$\mu_{\mathcal{E}} = \frac{\mu A_t + \mu\nu\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - \frac{C(1-\theta)}{r}] - \frac{\nu(\nu+1)}{2}\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - \frac{C(1-\theta)}{r}]\sigma_\delta^2}{\mathcal{E}}$$

$$\sigma_{\mathcal{E}} = \frac{\sigma_\delta A_t + \sigma_\delta\nu\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - \frac{C(1-\theta)}{r}]}{\mathcal{E}}$$

Given the LOM of equity we can simulate the path of equity values for distressed and non-distressed (healthy) firms. Figure 3.1, Panel A presents the simulated path for healthy firms. We model distressed firms as firms with a higher coupon payment. The higher leverage increases the probability that the firm will reach A_B, a predetermined level, where management will file for bankruptcy.

For all firms we assume that the tax rate is 30% ($\theta = 0.3$) and the value of the firm lost in the event bankruptcy occurs is 50% ($\alpha = 0.5$). For healthy firms we assume a coupon payment of 3, which implies a debt to equity ration of 1.16. For distressed firms we assume a coupon payment of 5, which implies a debt to equity ratio of 2.67. Panel B presents the distribution of returns. The healthy firms have a distribution that resembles a Normal distribution

Figure 3.2, Panel A presents the simulated path for distressed firms and Panel B presents the distribution of returns. The distressed firms have a positively skewed distribution.

3.2.7 *beta* Decomposition

We can solve for the equity *beta* of our model using the LOM for equity and the SDF from our CRRA continuous time exchange economy:[59]

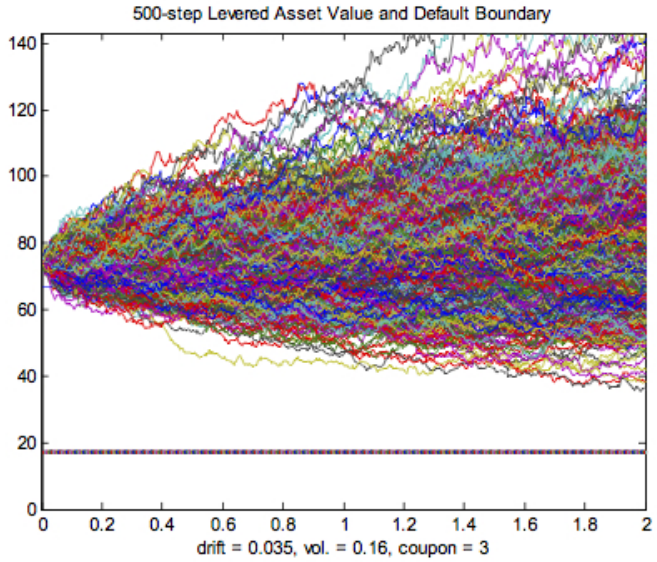
$$\beta_{\mathcal{E}} = \frac{cov\left[\frac{d\mathcal{E}_t}{\mathcal{E}_t}, \frac{d\Lambda_t}{\Lambda_t}\right]}{var\left[\frac{d\Lambda_t}{\Lambda_t}\right]}$$

[58] See Appendix D (Chapter 5.4): Solving for LOM of $\mathcal{E}(\delta_t)$.

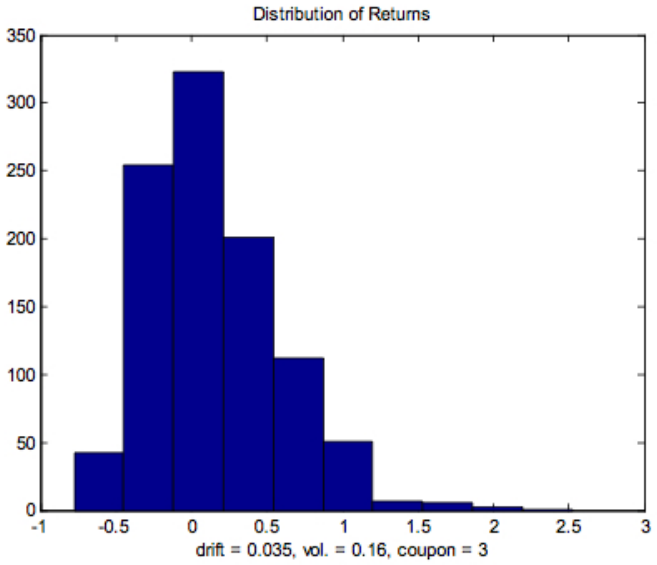
[59] To be technically correct in calculating *beta* it is necessary to have both equity and the SDF in the same measure. Here we have the SDF in the physical measure and the equity LOM in the risk neutral measure. However, when changing measure only the drift term changes and our calculation of *beta* only depends on the volatility terms. Thus the change of measure is implied but not presented.

Figure 3.1: Simulated Equity Value for Healthy Firms

We simulate the path of 1000 healthy firms. Healthy firms are distinguished from distressed firms by their lower coupon payment. For all firms we assume a tax rate of 30% and 50% of the firm's value will be lost in the bankruptcy process ($\alpha = 0.5$). A_B can be identified in the figure as the solid line. Panel B presents the distribution of returns. The healthy firms have a distribution that resembles a Normal distribution.



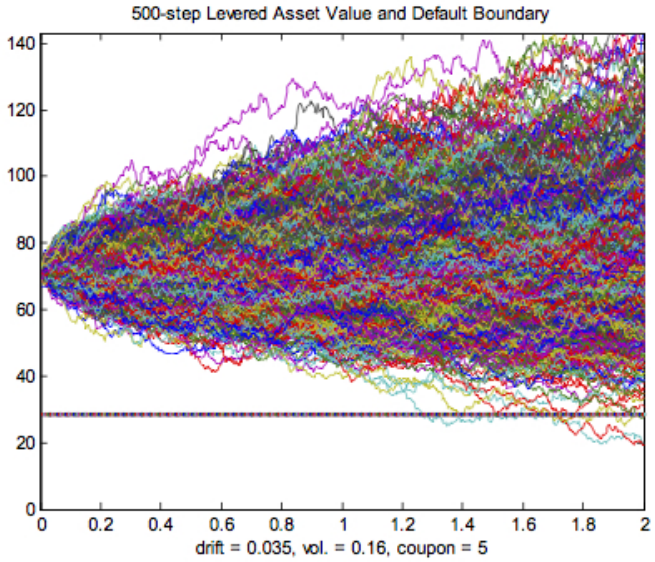
Panel A



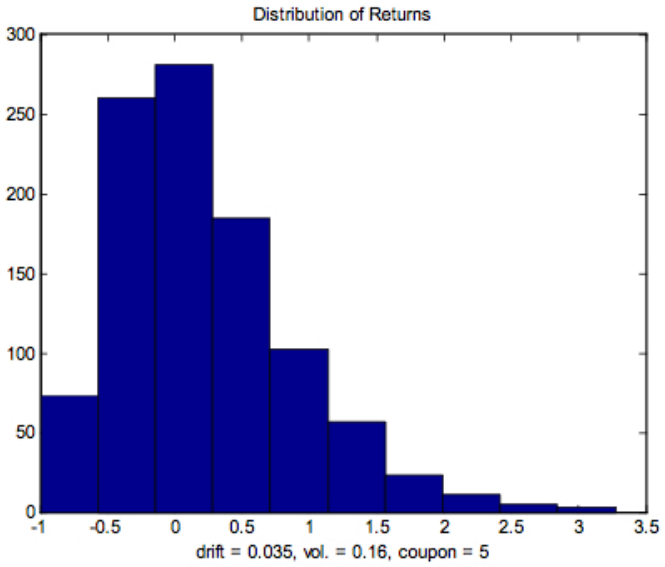
Panel B

Figure 3.2: Simulated Equity Value for Distressed Firms

We simulate the path of 1000 distressed firms. Distressed firms are distinguished from healthy firms by their higher coupon payment. For all firms we assume a tax rate of 30% and 50% of the firm's value will be lost in the bankruptcy process ($\alpha = 0.5$). A_B can be identified in the figure as the solid line. Panel B presents the distribution of returns. The distressed firms have a positively skewed distribution.



Panel A



Panel B

$$\beta_{\mathcal{E}} = \underbrace{\frac{\sigma_\delta A_t}{\mathcal{E}_t \gamma \sigma_c}}_{[Leverage\ component]} + \underbrace{\frac{\sigma_\delta \nu \left(\frac{A_t}{A_B}\right)^{-\nu} [A_B - \frac{C(1-\theta)}{r}]}{\mathcal{E}_t \gamma \sigma_c}}_{[Proximity\ to\ default\ component]} \tag{3.8}$$

In this model we can think of *beta* as a leverage component containing $\frac{A_t}{\mathcal{E}}$ and an adjustment factor associated with a firm's proximity to default component.

3.2.8 Characteristics of the Equity *beta*

In this section we evaluate *beta* at various levels of γ. It is well documented that the CAPM can be derived assuming log utility (a special case of CRRA utility with $\gamma = 1$). Although this is not the traditional CAPM tested empirically, it does have the necessary characteristic that consumption moves one-to-one with wealth. This direct substitution generates a model in which consumption volatility has a standard deviation equal to that of the market. Thus, this modified CAPM does not need high risk aversion to explain the equity premium premium puzzle.

Figure 3.3 presents the difference between firm i's equity *beta* and asset *beta* while varying the level of cash flow generated. We have fixed the coupon so low levels of cash flow represent distressed states of the world. We plot *beta difference* for three levels of *gamma* ($\gamma = 1$ is the top plot). The plot illustrates that for the CAPM model ($\gamma = 1$), the *beta difference* increases more rapidly than the *beta difference* for a model that allows higher levels of γ. The plot also illustrates that the *beta difference* increases as firm i becomes more distressed. Thus, in distressed states of the world, the CAPM model will generate a higher equity *beta*. This higher equity *beta* under the CAPM will correspond with a higher risk adjusted expected return for firm i. Thus under these assumptions we expect the CAPM to generate negative alphas.

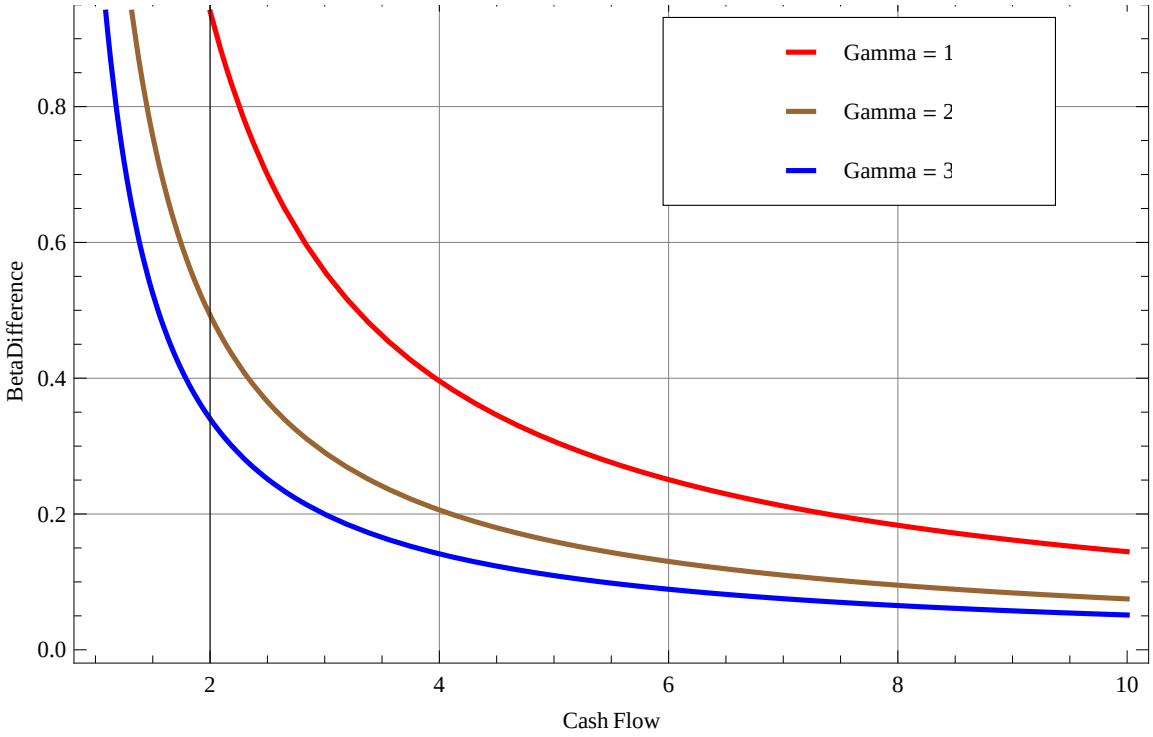
Figure 3.4 presents equity value when changing the level of the coupon payment required on the console bond issued by firm i. We have fixed the cash flow generated by the assets in place so high levels of coupon payments represent distressed states of the world. The plot illustrates that for the CAPM model ($\gamma = 1$, is the top plot), the equity value increases more rapidly than the equity value of the model developed in this paper. Thus in distressed states of the world, firm i will have a greater value under the CAPM. This elevated firm value will result in lower subsequent portfolio returns under the CAPM.

3.3 Testing Empirically

Our model clearly illustrates that portfolios of firms sorted by a distress measure will violate the underlying CAPM assumption that portfolio returns have Normal distributions.

Figure 3.3: Equity *beta* less Asset *beta* for Firm i

We model the difference between firm i's equity *beta* and asset *beta* when changing the level of cash flow generated. We have fixed the coupon so low levels of cash flow represent distressed states of the world. The plot illustrates that for the CAPM model ($\gamma = 1$, the top plot), the equity *beta* increases more rapidly than the equity *beta* of the model with higher levels of γ. We use the following values to solve for *beta* difference: $C = 1, \theta = 0.35, \alpha = 0.3, \mu = 0.02, \sigma_\delta = 0.05, \mu_c = 0.02, \sigma_c = 0.02, \rho = 0.1$



Thus we propose following Rubinstein (1976)[60] to address the systematic mismeasurement of these portfolio under the CAPM. Using the basic asset pricing equation under CRRA utility with the assumptions that the return on the market portfolio is iid, markets are perfect and that the growth rate of per capita consumption follows a random walk, Rubinstein (1976) derives the following CAPM like expression:

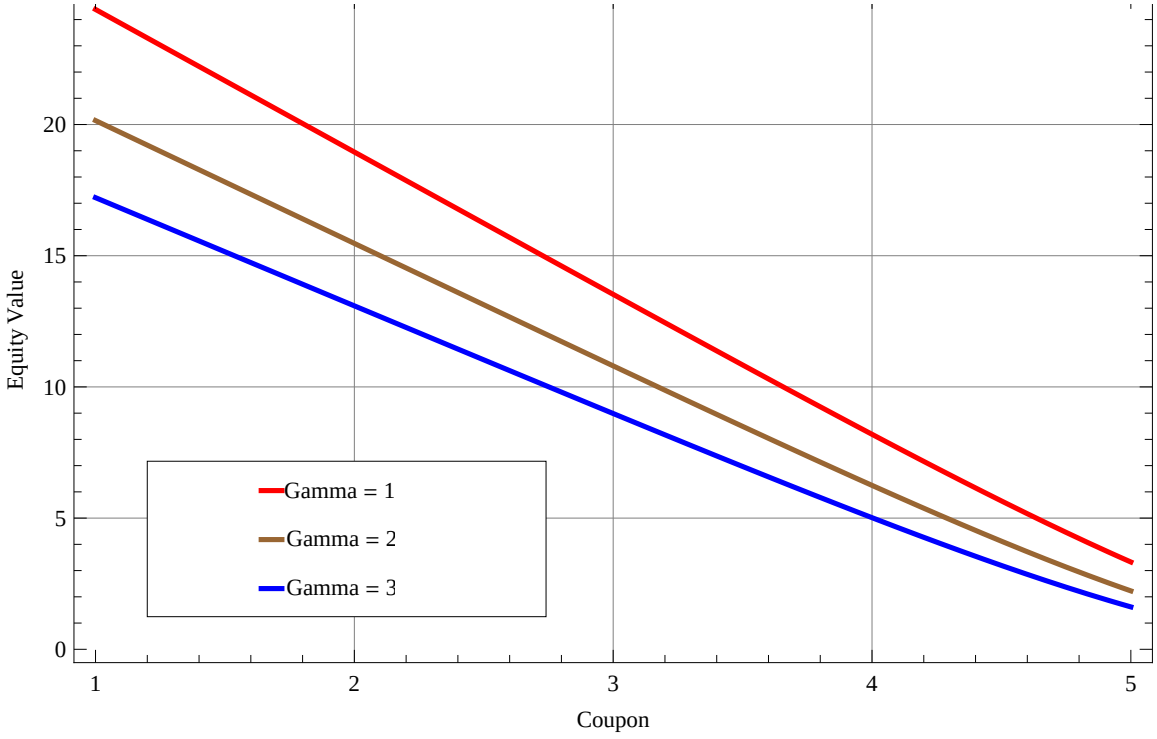
$$\mathbb{E}(r_p) = r_f + B_p[E(r_m) - r_f] \quad \text{where } B_p = \frac{cov[r_p, (1+r_m)^{-\gamma}]}{cov[r_m, (1+r_m)^{-\gamma}]} \tag{3.9}$$

where γ is the coefficient of relative risk aversion of the average investor. The data required to test this model empirically is the same that is required to test the traditional CAPM.

[60] See Appendix E (Chapter 5.5): Solving for the Modified *beta*.

Figure 3.4: Leverage's effect on Equity Value

We model equity value when changing the leverage ratio by changing the coupon payment. We have fixed firm i's cash flow so high coupon payments represent distressed states of the world. The plot illustrates that for the CAPM model ($\gamma = 1$, the top plot), the equity value increases more rapidly as firm i approaches distress than the equity value of the model with higher levels of γ. We use the following values in equation (3.6) for equity: $\delta = 3, \theta = 0.35, \alpha = 0.3, \mu_\delta = 0.02, \sigma_\delta = 0.05, \mu_c = 0.02, \sigma_c = 0.02, \rho = 0.1$



Specific to our application, we have only made assumptions about r_{market}, where r_p can come from any non-symmetrical distribution.

3.4 Data Description

The sample consists of domestic exchange-traded stocks[61] available simultaneously on the Center for Research in Security Prices (CRSP) monthly dataset, inclusive of delisting returns, and COMPUSTAT for the period 1981:1 to 2010:12[62] and two 15 year subsamples. To

[61]Specifically, we use COMPUSTAT exchange codes for the NYSE, NYSE AMEX, NASDAQ-NMS stock markets, NASDAQ OMX BX, Midwest Exchange (Chicago), NYSE Arca, and the Philadelphia Exchange.

[62]We link the datasets using firm level 8 digit CUSIP. COMPUSTAT is set for PROSRC = D (Domestic - US and Canadian companies), CONSOL = C (consolidated financial statements) and DATAFMT = STD

simulate accurate information arrival, we assume that the COMPUSTAT data are available three months after the date stated.[63] For example, month-end December 2000 COMPUSTAT accounting data will be available month-end March 2001 and thus matched with month-end March 2001 CRSP market data. To limit the influence of extreme outliers, the top and bottom 5 percent of variables used in the calculation of the respective distress measures, book to market ratios and monthly returns are set at the 5th and 95th percentiles, respectively.

Each month from January 1981 through December 2010, we sort stocks according to their respective distress measures. We then form 10 portfolios of stocks that fall into the different deciles of the risk distribution and present value weighted portfolio returns, value weighted portfolio book to market ratios, and value weighted portfolio relative size (log of equity market value).

3.4.1 Sample and Variable Selection for the Hazard Rate Model

We use the model developed by Campbell et al. (2008)[64] and calculate default probability at the individual firm level using quarterly accounting data from COMPUSTAT merged with monthly and daily equity market data from CRSP. We exclude any firms with a negative book to market ratio or stocks that have a price less than or equal to \$1. The reported default probability is the likelihood of default at time t + 12 given survival until t + 11. Thus, it cannot be interpreted in the same fashion as the Moody's KMV distance to default measure also presented in this paper.

The explanatory variables constructed are net income to market value of total assets (NIMTA). We average NIMTA and use $\text{NIMTAAVG}_{t-1,t-12} = \frac{1-\phi^3}{1-\phi^{12}}(\text{NIMTA}_{t-1,t-3} + \cdots + \phi^9\text{NIMTA}_{t-9,t-12})$, where $\phi = 2^{-\frac{1}{3}}$, implying that the weight is halved each quarter.[65] Total liabilities to market value of total assets (TLMTA), cash and short-term assets to the market value of total assets (CASHMTA), market-to-book ratio (MB), monthly log excess return on each firm's equity relative to the S&P500 index (EXRET). We average log $(1+r_{i,t})$ - log $(1+r_{S\&P500,t})$ and use $\text{EXRETAVG}_{t-1,t-12} = \frac{1-\phi}{1-\phi^{12}}(\text{EXRET}_{t-1}+\cdots+\phi^{11}\text{EXRET}_{t-12})$, where again $\phi = 2^{-\frac{1}{3}}$. A proxy for the standard deviation of each firms daily stock return over the past three months (SIGMA),[66] the relative size of each firm measured as the log ratio of its

(standardized).

[63] Dichev (1998) assumes a six month lag and Campbell et al. (2008) assume a two month lag.

[64] We test the Campbell et al. (2008) 12 month model: $DP_t = \frac{1}{1+exp(-\alpha_j-\beta_j x_{i,t})}$, using:

$$\frac{1}{1+exp(-9.16-20.26NIMTAAVG+1.42TLMTA-7.13EXRETAVG+1.41SIGMA-.045RSIZE-2.13CASHMTA+.075MB-.058PRICE)}$$

[65] We do not force the average NIMTA to be consecutive quarters. Enforcing consecutive quarters creates a substantial reduction in the sample of firms with complete information.

[66] SIGMA is calculated as an annualized 3-month rolling sample standard deviation centered around zero in lieu of the mean: $\text{SIGMA}_{i,t-1,t-3} = \left(252 * \frac{1}{N-1}\sum_{k\in(t-1,t-2,t-3)} r_{i,k}^2\right)^{\frac{1}{2}}$. Values of SIGMA calculated with less than 50 daily observations are deleted.

market capitalization to that of the S&P500 index (RSIZE), and finally, each firm's log price per share, truncated above at $15 (PRICE).

Table 3.1, Panel A provides summary statistics for the properties of the explanatory variables used to calculate the distance to default. Panel A describes the distribution of the variables with complete information available with each observation weighted equally. We can clearly see the effect of the recent recession on the variables presented in the 1996:1 - 2010:12 subsample.

Panel B provides summary statistics for the 10 value weighted portfolios. The portfolio returns do not illustrate a breakdown in the risk return relationship. We expand our sample as in Campbell et al. (2008) to include over the counter (OTC) traded stocks and see a clear breakdown in the risk return relationship.[67] Table 3.2, Panel B presents portfolio information inclusive of OTC traded stocks for the full sample period. It is clear that the risk return relationship is driven by the inclusion of OTC stocks. Interestingly, both exchange and OTC traded stocks illustrate a size relationship, while only the exchange traded portfolios exhibit the value versus growth relationship.

[67]The COMPUSTAT CRSP universe of merged stocks also includes some erroneously classified private companies (exchange code = 0), erroneously classified non-traded stocks (exchange code = 1), a limited number of LBO firms (exchange code = 3), a nominal number of Canadian firms that trade on the Toronto exchange (exchange code = 7), and unlisted evaluated equity (exchange code = 20).

Table 3.1: Summary Statistics for Campbell et al. Portfolios

Panel A includes the following variables (with various adjustments described in the data description section): net income to market value of total assets (NIMTA), total liabilities to market value of total assets (TLMTA), cash and short-term assets to the market value of total assets (CASHMTA), market-to-book ratio (MB), monthly log excess return on each firm's equity relative to the S&P 500 Index (EXRET), the standard deviation of each firm's daily stock return over the past three months (SIGMA), the relative size of each firm measured as the log ratio of its market capitalization to that of the S&P 500 Index (RSIZE), and finally, each firm's log price per share, truncated above at 15 (PRICE) for the full sample period 1981:1 - 2010:12 and for two sub-periods. In Panel B we sort all stocks based on their default measure in basis points and divide them into 10 portfolios based on percentile cutoffs. For each portfolio we include value weighted observations for the default measure in basis points, monthly returns, annualized returns, log of the market value of equity (in millions), and the book value of equity over the market value of equity.

Panel A		NIMTA	TLMTA	EXRET	RSIZE	SIGMA	CASHMTA	MB	PRICE
Sample: Full	Mean	0.002	0.419	-0.002	-9.941	0.487	0.084	2.379	2.307
	STD	0.046	0.274	0.135	1.924	0.262	0.094	1.923	0.628
81:1-95:12	Mean	0.005	0.427	-0.003	-9.544	0.442	0.074	2.073	2.324
	STD	0.033	0.258	0.114	1.857	0.231	0.080	1.534	0.602
96:1-10:12	Mean	0.000	0.414	-0.001	-10.181	0.515	0.091	2.580	2.298
	STD	0.053	0.283	0.146	1.925	0.278	0.104	2.171	0.643

Panel B									Most Distressed
Portfolio	1	2	3	4	5	6	7	8	9	10
Monthly Portfolio Default Measure, basis points										
Sample: Full	1.78	2.36	2.87	3.41	4.04	4.83	5.85	7.35	10.15	19.36
81:1 - 95:12	1.67	2.18	2.63	3.09	3.61	4.27	5.09	6.27	8.51	15.82
96:1 - 10:12	1.90	2.54	3.11	3.74	4.49	5.43	6.64	8.49	11.84	22.70
Monthly Portfolio Returns										
Sample: Full	0.0103	0.0094	0.0106	0.0108	0.0106	0.0115	0.0105	0.0117	0.0094	0.0082
81:1 - 95:12	0.0125	0.0122	0.0105	0.0133	0.0127	0.0142	0.0127	0.0147	0.0123	0.0093
96:1 - 10:12	0.0088	0.0068	0.0093	0.0093	0.0087	0.0076	0.0091	0.0101	0.0046	0.0077
Annualized Portfolio Returns, %										
Sample: Full	13.08	11.84	13.55	13.73	13.45	14.67	13.41	14.95	11.93	10.25
81:1 - 95:12	16.05	15.65	13.32	17.22	16.31	18.46	16.38	19.20	15.78	11.69
96:1 - 10:12	11.09	8.48	11.78	11.77	11.00	9.57	11.50	12.84	5.69	9.60
Monthly Portfolio Log of Market Value, in $MM										
Sample: Full	9.798	9.501	9.155	8.878	8.752	8.630	8.293	7.780	7.183	6.486
81:1 - 95:12	8.992	8.728	8.396	8.124	7.958	7.680	7.356	6.965	6.429	5.513
96:1 - 10:12	10.601	10.275	9.908	9.680	9.538	9.614	9.235	8.516	8.051	7.508
Monthly Portfolio Book to Market Ratio										
Sample: Full	0.371	0.393	0.458	0.531	0.586	0.645	0.709	0.760	0.809	0.894
81:1 - 95:12	0.419	0.474	0.558	0.656	0.712	0.788	0.857	0.913	0.950	1.017
96:1 - 10:12	0.325	0.314	0.361	0.406	0.460	0.496	0.555	0.609	0.659	0.777

Table 3.2: Summary Statistics for Campbell et al. Portfolios by Exchange

Panel A includes the following variables (with various adjustments described in the data description section): net income to market value of total assets (NIMTA), total liabilities to market value of total Assets (TLMTA), cash and short-term assets to the market value of total assets (CASHMTA), market-to-book ratio (MB), monthly log excess return on each firm's equity relative to the S&P 500 Index (EXRET), the standard deviation of each firm's daily stock return over the past three months (SIGMA), the relative size of each firm measured as the log ratio of its market capitalization to that of the S&P 500 Index (RSIZE), and finally, each firm's log price per share, truncated above at 15 (PRICE) for the sample period 1981:1 - 2010:12. In Panel B we sort all stocks based on their default measure in basis points and divide them into 10 portfolios based on percentile cutoffs. For each portfolio we include value weighted observations for the default measure in basis points, monthly returns, annualized returns, log of the market value of equity (in millions), and the book value of equity over the market value of equity. The portfolios in Panel B are presented for all firms in the sample and then subgroups formed based on the exchange on which the stocks trade.

Panel A		NIMTA	TLMTA	EXRET	RSIZE	SIGMA	CASHMTA	MB	PRICE
ALL	Mean	0.000	0.423	-0.004	-10.240	0.525	0.087	2.387	2.194
	STD	0.053	0.276	0.145	1.991	0.294	0.099	2.032	0.712
OTC	Mean	-0.010	0.444	-0.018	-11.760	0.725	0.100	2.481	1.621
	STD	0.078	0.287	0.188	1.586	0.396	0.122	2.711	0.827
Exchange	Mean	0.002	0.419	-0.002	-9.941	0.487	0.084	2.379	2.307
	STD	0.046	0.274	0.135	1.924	0.262	0.094	1.923	0.628

Panel B									Most Distressed	
Portfolios	1	2	3	4	5	6	7	8	9	10
Monthly Portfolio Default Measure, basis points										
ALL	1.81	2.44	3.00	3.64	4.39	5.34	6.64	8.71	12.97	28.18
OTC	2.16	3.66	5.23	7.27	9.63	13.05	17.90	26.50	42.16	114.83
Exchange	1.78	2.36	2.87	3.41	4.04	4.83	5.85	7.35	10.15	19.36
Monthly Portfolio Returns										
ALL	0.0102	0.0099	0.0103	0.0100	0.0109	0.0106	0.0112	0.0083	0.0050	0.0013
OTC	0.0080	0.0093	0.0025	-0.0068	-0.0111	-0.0161	-0.0202	-0.0276	-0.0294	-0.0434
Exchange	0.0103	0.0094	0.0106	0.0108	0.0106	0.0115	0.0105	0.0117	0.0094	0.0082
Annualized Portfolio Returns, %										
ALL	13.01	12.49	13.08	12.69	13.94	13.44	14.26	10.43	6.11	1.55
OTC	10.04	11.71	3.09	(7.81)	(12.55)	(17.72)	(21.73)	(28.54)	(30.07)	(41.32)
Exchange	13.08	11.84	13.55	13.73	13.45	14.67	13.41	14.95	11.93	10.25
Monthly Portfolio Log of Market Value, in $MM										
ALL	9.768	9.443	9.075	8.814	8.642	8.460	8.009	7.450	6.837	5.972
OTC	7.864	7.584	7.455	6.977	6.252	5.625	5.106	4.795	4.421	3.917
Exchange	9.798	9.501	9.155	8.878	8.752	8.630	8.293	7.780	7.183	6.486
Monthly Portfolio Book to Market Ratio										
ALL	0.386	0.404	0.477	0.553	0.608	0.677	0.731	0.777	0.828	0.950
OTC	0.959	0.782	0.755	0.788	0.836	0.895	0.955	0.998	1.101	1.139
Exchange	0.371	0.393	0.458	0.531	0.586	0.645	0.709	0.760	0.809	0.894

3.4.2 Sample and Variable Selection for the Merton Model

We follow the approach developed in Vassalou and Xing (2004) and Bharath and Shumway (2004) to calculate the distance to default. Inputs to the Merton model include the volatility of stock returns, σ_E, the face value of debt, F, the risk free rate,[68] and the time period, T. The volatility of stock returns is the annualized standard deviation of returns and is estimated using the prior year's daily stock returns from the daily CRSP dataset.[69] The market value of each firm's equity is calculated from the monthly CRSP dataset. Following Vassalou and Xing (2004), we take F to be debt in current liabilities plus one half of long term debt from the quarterly COMPUSTAT dataset. Using these values and the numerical approach described in Bharath and Shumway (2004) we calculate KMV-Merton distance to default.

Table 3.3, Panel A describes the distribution of the variables used to calculate distance to default with complete information available with each observation weighted equally. We delete any all equity firms from our sample. We can clearly see the effect of the recent recession on the variables presented in the 1996:1 - 2010:12 subsample.

Panel B provides summary statistics for the 10 value weighted portfolios. The portfolio returns do not exhibit a breakdown in the risk return relationship. The size relationship is not as pronounced when compared with other default measures tested. The portfolios clearly present a value versus growth stock relationship.

Both the Z-score and O-score were developed for industrial firms. Thus for these models, we impose that all firms in the sample are industrial, defined as COMPUSTAT Standard Industrial Classification (SIC) codes 1 to 3999 and 5000 to 5999.

In order to calculate the Z-score[70] and O-score[71] at the individual firm level we use annual accounting data from COMPUSTAT to construct the necessary variables: working capital to total assets (WCAPTA), retained earnings to total assets (RETA), earnings before interest and taxes to total assets (EBITTA), market value of equity to total liabilities (MVETL), sales to total assets (SALETA), total liabilities to total assets (TLTA), current liabilities to current assets (CLCA), net income to total assets (NITA) and funds from operations[72] to

[68] Specifically we use the 1-Year Treasury Constant Maturity Rate obtained from the Board of Governors of the Federal Reserve system available at http://research.stlouisfed.org/fred/data/irates/gs1.

[69] Values calculated with less than 50 daily observations are deleted.

[70] Altman's (1968) model is: Z = 1.2 (working capital/total assets) + 1.4 (retained earnings/ total assets) + 3.3 (earnings before interest and taxes/total assets) + 0.6 (market value of equity/book value of total liabilities) + (sales/total assets).

[71] Ohlson's (1980) model 1 is: 0 = -1.32 - 0.407 log (total assets/GNP price-level index) + 6.03 (total liabilities/total assets) - 1.43 (working capital/total assets) + 0.076 (current liabilities/current assets) - 1.72 (1 if total liabilities > total assets, otherwise 0) - 2.37 (net income/total assets) - 1.83 (funds from operations/total liabilities) + 0.285 (1 if net loss for last two years, otherwise 0) - 0.521 (net income$_t$ - net income$_{t-1}$)/(| net income$_t$ | + | net income$_{t-1}$ |). We use this model without adjusting for the GNP price-level index because the tests in this study employ monthly cross sections, within which the index is the same.

[72] Defined as COMPUSTAT Income before extraordinary items plus depreciation and amortization.

total liabilities (FUNDTL).

Table 3.3: Summary Statistics for KMV-Merton Portfolios

Panel A includes the probability of default calculated using the KMV-Merton model for the full sample period 1981:1 - 2010:12 and for two sub-periods. In Panel B we sort all stocks based on their probability of default and divide them into 10 portfolios based on percentile cutoffs. For each portfolio we include value weighted observations for the default measure in basis points, monthly returns, annualized returns, log of the market value of equity (in millions), and the book value of equity over the market value of equity.

Panel A	Prob. of Default	
Sample: Full	Mean	0.029
	STD	0.113
Sample 1981:1 - 1995:12	Mean	0.026
	STD	0.102
Sample 1996:1 - 2010:12	Mean	0.032
	STD	0.118

Panel B									Most Distressed	
Portfolios	1	2	3	4	5	6	7	8	9	10
Monthly Portfolio KMV-Merton Probability of Default, basis points										
Full	0.000	0.000	0.001	0.014	0.069	0.207	0.506	1.186	3.094	15.034
81:1-95:12	0.000	0.000	0.000	0.000	0.000	0.005	0.050	0.327	1.653	11.798
96:1-10:12	0.000	0.000	0.002	0.027	0.138	0.408	0.962	2.044	4.536	18.271
Monthly Portfolio Returns										
Full	0.008	0.010	0.010	0.009	0.010	0.010	0.010	0.012	0.011	0.014
81:1-95:12	0.012	0.011	0.012	0.012	0.011	0.012	0.013	0.015	0.011	0.015
96:1-10:12	0.005	0.009	0.008	0.007	0.009	0.008	0.007	0.008	0.011	0.013
Annualized Portfolio Returns, %										
Full	10.50	12.49	12.56	11.82	12.45	13.01	12.80	14.73	13.76	18.07
81:1-95:12	15.10	14.25	14.88	14.92	13.54	15.90	16.99	19.44	13.65	19.82
96:1-10:12	6.07	10.75	10.28	8.80	11.38	10.18	8.74	10.19	13.88	16.34
Monthly Portfolio Log of Market Value, in $MM										
Full	9.305	9.586	9.265	8.897	8.634	8.478	8.385	8.290	8.122	7.927
81:1-95:12	8.010	8.938	8.711	8.227	7.933	7.732	7.591	7.492	7.188	6.850
96:1-10:12	10.601	10.235	9.818	9.568	9.335	9.225	9.180	9.087	9.055	9.004
Monthly Portfolio Book to Market Ratio										
Full	0.361	0.370	0.451	0.498	0.549	0.588	0.635	0.687	0.778	0.917
81:1-95:12	0.457	0.437	0.525	0.571	0.631	0.675	0.732	0.787	0.881	1.035
96:1-10:12	0.264	0.304	0.377	0.425	0.466	0.501	0.539	0.586	0.675	0.798

Table 3.4: Summary Statistics for Z-Score Portfolios

Panel A includes the following variables: working capital over total assets (WCAPTA), retained earnings over total assets (RETA), earnings before interest and taxes over total assets (EBITTA), market value of equity over total liabilities (MVETL) and sales over total assets (SALETA) for the full sample period 1981:1 - 2010:12 and for two sub-periods. In Panel B we sort all stocks based on their calculated Z-score and divide them into 10 portfolios based on percentile cutoffs. For each portfolio we include value weighted observations for Z-score, monthly returns, annualized returns, log of the market value of equity (in millions), and the book value of equity over the market value of equity.

Panel A	Variables	WCAPTA	RETA	EBITTA	MVETL	SALETA
Sample: Full	Mean	0.318	0.068	0.063	5.988	1.186
	STD	0.214	0.544	0.126	8.565	0.673
Sample 1981:1 - 1995:12	Mean	0.324	0.211	0.087	4.749	1.323
	STD	0.197	0.314	0.098	6.545	0.664
Sample 1996:1 - 2010:12	Mean	0.314	-0.071	0.042	7.022	1.078
	STD	0.226	0.753	0.149	10.101	0.663

Panel B	Most Distressed									
Portfolios	1	2	3	4	5	6	7	8	9	10
Monthly Portfolio Z-score										
Full	1.182	2.011	2.563	3.048	3.551	4.156	4.969	6.303	9.214	17.112
81:1-95:12	1.502	2.237	2.750	3.201	3.643	4.195	4.881	5.962	8.208	14.330
96:1-10:12	0.766	1.769	2.364	2.886	3.452	4.105	5.054	6.639	10.262	20.014
Monthly Portfolio Returns										
Full	0.0121	0.0123	0.0111	0.0116	0.0096	0.0110	0.0102	0.0103	0.0089	0.0081
81:1-95:12	0.0093	0.0114	0.0126	0.0130	0.0097	0.0130	0.0125	0.0120	0.0120	0.0106
96:1-10:12	0.0145	0.0130	0.0098	0.0106	0.0098	0.0091	0.0080	0.0084	0.0061	0.0059
Annualized Portfolio Returns, %										
Full	15.58	15.73	14.16	14.90	12.15	14.09	12.90	13.15	11.28	10.16
81:1-95:12	11.70	14.63	16.18	16.81	12.23	16.73	16.14	15.36	15.41	13.45
96:1-10:12	18.91	16.72	12.42	13.51	12.46	11.52	10.01	10.62	7.59	7.27
Monthly Portfolio Log of Market Value, in $MM										
Full	7.550	8.497	8.776	9.345	9.089	8.940	9.175	9.557	9.408	8.292
81:1-95:12	7.242	8.098	8.364	9.012	8.310	8.072	8.119	8.644	8.371	7.003
96:1-10:12	7.829	8.879	9.171	9.678	9.816	9.820	10.219	10.463	10.422	9.573
Monthly Portfolio Book to Market Ratio										
Full	0.942	0.782	0.666	0.547	0.455	0.391	0.332	0.267	0.217	0.174
81:1-95:12	0.975	0.832	0.720	0.624	0.536	0.463	0.396	0.323	0.250	0.197
96:1-10:12	0.922	0.752	0.635	0.481	0.379	0.319	0.269	0.209	0.184	0.153

Table 3.5: Summary Statistics for O-score Portfolios

Panel A includes the following variables: log of total assets log(TA), total liabilities over total assets (TLTA), working capital over total assets (WCAPTA), current liabilities over current assets (CLCA), net income over total assets (NITA) and funds from operation over total liabilities (FUNDTL) for the full sample period 1981:1 - 2010:12 and for two sub-periods. In Panel B we sort all stocks based on their calculated O-score and divide them into 10 portfolios based on percentile cutoffs. For each portfolio we include value weighted observations for O-score, monthly returns, annualized returns, log of the market value of equity (in millions), and the book value of equity over the market value of equity.

Panel A	Variable	log (TA)	TLTA	WCAPTA	CLCA	NITA	FUNDTL
Sample: Full	Mean	5.329	0.443	0.316	0.486	0.019	0.166
	STD	1.890	0.197	0.213	0.264	0.118	0.444
Sample: 1981:1 - 1995:12	Mean	4.801	0.458	0.323	0.478	0.041	0.242
	STD	1.799	0.183	0.197	0.235	0.083	0.282
Sample: 1996:1 - 2010:12	Mean	5.741	0.432	0.311	0.493	0.000	0.093
	STD	1.886	0.206	0.226	0.287	0.147	0.599

Panel B									Most Distressed	
Portfolios	1	2	3	4	5	6	7	8	9	10
Monthly Portfolio O-score										
Full	-5.429	-3.638	-2.866	-2.279	-1.771	-1.294	-0.780	-0.182	0.701	4.313
81:1-95:12	-5.009	-3.384	-2.673	-2.128	-1.646	-1.181	-0.717	-0.156	0.591	3.010
96:1-10:12	-5.848	-3.891	-3.059	-2.430	-1.895	-1.407	-0.844	-0.208	0.812	5.616
Monthly Portfolio Returns										
Full	0.0101	0.0094	0.0096	0.0119	0.0116	0.0108	0.0118	0.0110	0.0114	0.0092
81:1-95:12	0.0106	0.0113	0.0119	0.0139	0.0121	0.0127	0.0136	0.0122	0.0116	0.0084
96:1-10:12	0.0096	0.0074	0.0073	0.0098	0.0111	0.0088	0.0100	0.0099	0.0113	0.0100
Annualized Portfolio Returns, %										
Full	12.82	11.83	12.12	15.24	14.80	13.71	15.12	14.09	14.63	11.64
81:1-95:12	13.44	14.45	15.25	18.07	15.49	16.39	17.63	15.71	14.81	10.56
96:1-10:12	12.21	9.26	9.08	12.47	14.11	11.10	12.66	12.50	14.45	12.73
Monthly Portfolio Log of Market Value, in $MM										
Full	9.621	9.804	9.575	9.098	8.657	8.243	7.916	7.492	6.787	5.582
81:1-95:12	8.763	8.934	8.714	8.310	7.756	7.397	7.126	6.573	5.899	4.728
96:1-10:12	10.478	10.674	10.435	9.886	9.558	9.090	8.706	8.410	7.675	6.437
Monthly Portfolio Book to Market Ratio										
Full	0.315	0.433	0.465	0.463	0.479	0.476	0.475	0.466	0.455	0.352
81:1-95:12	0.367	0.529	0.570	0.561	0.589	0.569	0.579	0.604	0.599	0.442
96:1-10:12	0.266	0.342	0.363	0.369	0.370	0.384	0.368	0.325	0.303	0.260

3.4.3 Sample and Variable Selection for Accounting Models

Tables 3.4 and 3.5 provide summary statistics for the properties of the explanatory variables for Z-score and O-score, respectively. Panel A describes the distribution of the variables with complete information available and each observation weighted equally. We can clearly see the effect of the recent recession on the variables presented in the 1996:1 - 2010:12 subsample.

Table 3.4, Panel B provides summary statistics at the value weighted portfolio level for the default measure, the monthly and annualized return, the relative size of firms in the portfolio and the book to market ratio. The Z-score portfolios do not illustrate a breakdown in the risk return relationship. A relative size relationship does not appear. There is, however, a very pronounced value versus growth stock relationship in the portfolios.

The O-Score portfolio returns presented in Table 3.5, Panel B also do not exhibit a breakdown in the risk return relationship. The relative size relationship is more pronounced with this accounting model. The O-Score portfolios also clearly present a value versus growth stock relationship.

3.5 Results

We use the CAPM and the Rubinstein (1976) model to price value weighted excess returns of portfolios sorted by various default measures. Given that we are unable to document a breakdown in the risk return relationship for the Z-score, O-score or KMV-Merton model, we do not expect or find a material difference in the two approaches. Tables 3.6, 3.7 and 3.8 present regression results for the Z-score, O-score and KMV-Merton model, respectively. We note that return distributions of distressed stocks are more positively skewed than S&P 500 return distributions.[73] As γ is used in the modified CAPM, we note that our data sample generates a γ in the 1.5-4 range. As in Friend and Blume (1975), γ in the 3-5 range is expected when we substitute the volatility of the S&P 500 for the volatility of consumption.

With the Z-score, O-score and KMV-Merton model we are unable to generate statistically significant alphas under the CAPM or modified CAPM. The *beta* and modified *beta* are similar and there is no clear pattern between their values and the skewness of the portfolios being priced. Given the lack of statistically significant alphas in conjunction with the lack of positive skewness in the return distributions, we conclude that these portfolios do not warrant the use of the modified CAPM.

Next, we test the CAPM and the modified CAPM to price portfolios of both exchange and OTC traded stocks formed using a hazard rate model and present results in Table 3.9. The regression results show that there is no breakdown in the risk return relationship for exchange traded stocks. Only the OTC traded stocks exhibit a statistically significant breakdown in

[73] We evaluate excess return defined as the return over the risk free rate of interest from the Ken French website: monthly Fama/French Factors.

the risk return relationship, defined as the presence of statistically significant negative alphas. Interestingly, the portfolio of the most distressed OTC stocks has a negatively skewed return distribution rather than the positively skewed return distribution seen in our simulations. The lack of positive skewness in the return distribution leads us to conjecture that the failure of the modified CAPM to price OTC traded stock portfolios is due to the negative alphas being driven by microstructure effects.

3.6 Conclusion

This paper makes two contributions to the literature on financially distressed firms. First, we identify the stocks driving the breakdown in the risk return relationship for portfolios of firms sorted by various default measures. We define this breakdown in the risk return relationship specifically as the presence of statically significant negative alphas on value weighted portfolios of the most distressed firms. We find that the inclusion of OTC traded stocks is driving the breakdown result presented in Campbell, Hilscher, and Szilagyi (2008). Using their hazard rate model specifications to sort firms into portfolios, we show that only the OTC stocks experience a breakdown in the risk return relationship. Reducing our sample to portfolios of only exchange traded stocks sorted by various default measures, we do not find a breakdown in the risk return relationship. The period tested is 1981:1 - 2010:12 and two 15 year subsamples. The four default measures tested are the Z-score, O-score, the KMV-Merton model and the Campbell et al. (2008) hazard rate model.

Second, we show that portfolios of only exchange traded stocks sorted by the various default measures do not exhibit return distributions that warrant the use of the Rubinstein (1976) model. The preference for skewness in the distribution of returns that will be priced by the CRRA model cannot be tested given the lack of positive skewness in portfolios of the most distressed stocks. In fact, even the OTC traded stock portfolio returns have negative skewness rather than the positive skewness expected based on our simulations of equity value near bankruptcy in an endogenous default model. We conclude that the portfolios selected to test the CRRA model do not have the necessary distribution characteristics to make the comparison meaningful. Further, we conjecture that the results associated with the OTC portfolios are driven by microstructure effects.

Table 3.6: Returns on Z-score Portfolios

We sort all stocks on Z-score and sort them into 10 portfolios based on percentile cutoffs. In the table below we show results from regressions of value weighted excess returns on a constant and the market excess return. Panel A shows CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the full sample period, 1981:1 - 2010:12. Panels B and C show CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the sample period 1981:1 - 1995:12 and 1996:1 - 2010:12, respectively. Skewness of the excess return and gamma are also presented.

	Most Distressed										S&P
Portfolios	1	2	3	4	5	6	7	8	9	10	500
Panel A: Full 1981 - 2010											
alpha	0.0015	0.0028	0.0017	0.0023	0.0006	0.0019	0.0014	0.0014	-0.0007	-0.0030	
alpha, annual,%	1.87	3.37	2.04	2.79	0.76	2.31	1.65	1.66	-0.85	-3.51	
T-stats	(0.72)	(1.68)	(1.18)	(1.89)	(0.53)	(1.81)	(1.25)	(1.14)	(0.51)	(1.43)	
Modified alpha	0.0015	0.0028	0.0016	0.0023	0.0006	0.0019	0.0014	0.0014	-0.0007	-0.0029	
T-stats	(0.72)	(1.69)	(1.15)	(1.90)	(0.53)	(1.80)	(1.26)	(1.18)	(0.52)	(1.43)	
beta	1.206	0.999	0.985	0.973	0.903	0.934	0.870	0.903	1.031	1.297	
Modified beta	1.209	1.000	0.995	0.973	0.903	0.938	0.870	0.896	1.031	1.291	
Skewness	-0.327	-0.327	-0.847	-0.553	-0.643	-0.671	-0.534	-0.349	-0.415	-0.664	-0.778
gamma	2.44										
Panel B: 1981 - 1995											
alpha	-0.0032	0.0001	0.0008	0.0014	-0.0023	0.0010	0.0009	-0.0003	-0.0004	-0.0025	
alpha, annual,%	-3.74	0.11	0.91	1.67	-2.67	1.26	1.06	-0.33	-0.46	-2.99	
T-stats	(1.40)	(0.05)	(0.51)	(1.15)	(1.87)	(0.80)	(0.60)	(0.21)	(0.22)	(1.13)	
Modified alpha	-0.0032	0.0001	0.0007	0.0014	-0.0023	0.0011	0.0008	-0.0003	-0.0004	-0.0025	
T-stats	(1.44)	(0.04)	(0.46)	(1.19)	(1.94)	(0.83)	(0.55)	(0.20)	(0.20)	(1.14)	
beta	1.106	0.926	1.004	0.977	1.021	1.023	0.980	1.076	1.101	1.217	
Modified beta	1.117	0.930	1.018	0.970	1.030	1.020	0.994	1.073	1.096	1.218	
Skewness	-0.583	-0.476	-0.689	-0.565	-0.889	-0.571	-0.767	-0.499	-0.378	-0.551	-0.792
gamma	3.28										
Panel C: 1996 - 2010											
alpha	0.0059	0.0055	0.0027	0.0036	0.0035	0.0026	0.0016	0.0023	-0.0010	-0.0030	
alpha, annual,%	7.34	6.82	3.30	4.41	4.28	3.16	1.95	2.78	-1.17	-3.52	
T-stats	(1.66)	(2.01)	(1.09)	(1.74)	(1.80)	(1.56)	(0.99)	(1.24)	(0.47)	(0.86)	
Modified alpha	0.0059	0.0055	0.0027	0.0036	0.0035	0.0026	0.0016	0.0023	-0.0010	-0.0029	
T-stats	(1.66)	(2.01)	(1.07)	(1.74)	(1.80)	(1.56)	(1.00)	(1.25)	(0.48)	(0.85)	
beta	1.311	1.058	0.978	0.961	0.812	0.856	0.821	0.776	0.979	1.360	
Modified beta	1.312	1.060	0.991	0.964	0.814	0.859	0.820	0.772	0.980	1.352	
Skewness	-0.270	-0.307	-1.100	-0.503	-0.494	-0.547	-0.545	-0.136	-0.496	-0.596	-0.749
gamma	1.83										

Table 3.7: Returns on O-score Portfolios

We sort all stocks on O-score and sort them into 10 portfolios based on percentile cutoffs. In the table below we show results from regressions of value weighted excess returns on a constant and the market excess return. Panel A shows CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the full sample period, 1981:1 - 2010:12. Panels B and C show CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the sample period 1981:1 - 1995:12 and 1996:1 - 2010:12, respectively. Skewness of the excess return and gamma are also presented.

									Most Distressed		S&P
Portfolios	1	2	3	4	5	6	7	8	9	10	500
Panel A: Full 1981 - 2010											
alpha	-0.0001	0.0001	0.0006	0.0026	0.0021	0.0014	0.0022	0.0014	0.0008	-0.0030	
alpha, annual,%	-0.09	0.16	0.73	3.21	2.58	1.65	2.68	1.65	0.93	-3.56	
T-stats	(0.04)	(0.13)	(0.67)	(2.97)	(2.10)	(1.23)	(1.81)	(0.98)	(0.47)	(0.99)	
Modified alpha	0.0000	0.0001	0.0006	0.0026	0.0021	0.0013	0.0022	0.0013	0.0008	-0.0030	
T-stats	(0.02)	(0.14)	(0.69)	(2.98)	(2.09)	(1.22)	(1.79)	(0.95)	(0.46)	(1.00)	
beta	1.130	0.951	0.903	0.955	0.990	0.983	1.020	1.036	1.222	1.515	
Modified beta	1.121	0.949	0.900	0.958	0.995	0.987	1.027	1.046	1.224	1.512	
Skewness	-0.419	-0.598	-0.495	-0.730	-0.740	-0.773	-0.810	-0.817	-0.612	0.057	-0.778
gamma	2.44										
Panel B: 1981 - 1995											
alpha	-0.0012	-0.0005	0.0000	0.0019	-0.0001	0.0004	0.0014	-0.0004	-0.0016	-0.0055	
alpha, annual,%	-1.49	-0.55	-0.04	2.36	-0.07	0.45	1.64	-0.51	-1.91	-6.44	
T-stats	(0.76)	(0.37)	(0.04)	(2.01)	(0.05)	(0.31)	(0.88)	(0.24)	(0.77)	(1.66)	
Modified alpha	-0.0012	-0.0004	0.0000	0.0019	-0.0001	0.0003	0.0013	-0.0005	-0.0018	-0.0057	
T-stats	(0.77)	(0.33)	(0.02)	(2.02)	(0.14)	(0.29)	(0.82)	(0.31)	(0.85)	(1.71)	
beta	1.003	0.997	1.024	1.033	1.056	1.093	1.078	1.144	1.231	1.354	
Modified beta	1.003	0.988	1.015	1.035	1.071	1.098	1.094	1.163	1.256	1.374	
Skewness	-0.387	-0.544	-0.452	-0.681	-1.003	-0.801	-1.024	-0.953	-1.022	-0.325	-0.792
gamma	3.28										
Panel C: 1996 - 2010											
alpha	0.0014	0.0006	0.0009	0.0031	0.0041	0.0021	0.0029	0.0029	0.0031	-0.0001	
alpha, annual,%	1.72	0.72	1.12	3.81	5.07	2.51	3.54	3.49	3.81	-0.10	
T-stats	(0.47)	(0.39)	(0.65)	(2.16)	(2.46)	(1.15)	(1.55)	(1.37)	(1.23)	(0.02)	
Modified alpha	0.0015	0.0006	0.0009	0.0031	0.0041	0.0020	0.0029	0.0028	0.0031	0.0000	
T-stats	(0.48)	(0.38)	(0.66)	(2.15)	(2.46)	(1.14)	(1.54)	(1.36)	(1.24)	(0.01)	
beta	1.225	0.917	0.814	0.898	0.942	0.901	0.977	0.957	1.216	1.638	
Modified beta	1.214	0.920	0.814	0.902	0.945	0.906	0.981	0.964	1.211	1.628	
Skewness	-0.424	-0.633	-0.543	-0.768	-0.546	-0.746	-0.634	-0.688	-0.359	0.145	-0.749
gamma	1.83										

Table 3.8: Returns on KMV-Merton Portfolios

We sort all stocks using the KMV-Merton model and sort them into 10 portfolios based on percentile cutoffs. In the table below we show results from regressions of value weighted excess returns on a constant and the market excess return. Panel A shows CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the full sample period, 1981:1 - 2010:12. Panels B and C show CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the sample period 1981:1 - 1995:12 and 1996:1 - 2010:12, respectively. Skewness of the excess return and gamma are also presented.

									Most Distressed		S&P
Portfolios	1	2	3	4	5	6	7	8	9	10	500
Panel A: Full 1981 - 2010											
alpha	-0.0007	0.0011	0.0010	0.0002	0.0003	0.0006	0.0000	0.0013	0.0004	0.0025	
alpha, annual,%	-0.89	1.30	1.15	0.25	0.32	0.77	0.00	1.54	0.49	3.07	
T-stats	(0.71)	(1.20)	(1.09)	(0.22)	(0.25)	(0.62)	(0.00)	(0.87)	(0.23)	(1.09)	
Modified alpha	-0.0008	0.0011	0.0009	0.0002	0.0003	0.0007	0.0000	0.0013	0.0004	0.0026	
T-stats	(0.79)	(1.22)	(1.09)	(0.21)	(0.25)	(0.64)	(0.03)	(0.89)	(0.25)	(1.12)	
beta	0.927	0.865	0.899	0.935	1.013	1.021	1.112	1.142	1.171	1.362	
Modified beta	0.942	0.864	0.900	0.938	1.014	1.017	1.119	1.139	1.167	1.353	
Skewness	-1.352	-0.513	-0.611	-0.691	-0.685	-0.652	-0.698	-0.349	-0.277	0.148	-0.778
gamma	2.44										
Panel B: 1981 - 1995											
alpha	-0.0008	-0.0003	0.0001	0.0001	-0.0014	0.0005	0.0009	0.0027	-0.0014	0.0022	
alpha, annual,%	-0.95	-0.39	0.15	0.16	-1.66	0.65	1.09	3.25	-1.61	2.71	
T-stats	(0.63)	(0.26)	(0.10)	(0.11)	(0.98)	(0.41)	(0.64)	(1.50)	(0.69)	(0.93)	
Modified alpha	-0.0011	-0.0003	0.0002	0.0002	-0.0014	0.0007	0.0009	0.0027	-0.0014	0.0023	
T-stats	(0.86)	(0.26)	(0.14)	(0.14)	(1.00)	(0.54)	(0.64)	(1.56)	(0.71)	(0.98)	
beta	1.132	0.951	0.952	0.955	1.039	1.008	1.078	1.075	1.046	1.192	
Modified beta	1.179	0.951	0.946	0.948	1.041	0.979	1.079	1.063	1.050	1.177	
Skewness	-1.816	-0.531	-0.427	-0.384	-0.826	-0.169	-0.596	-0.265	-0.500	-0.049	-0.792
gamma	3.28										
Panel C: 1996 - 2010											
alpha	-0.0012	0.0023	0.0016	0.0002	0.0019	0.0008	-0.0008	0.0001	0.0025	0.0033	
alpha, annual,%	-1.47	2.74	1.99	0.28	2.25	0.94	-0.97	0.06	3.02	3.97	
T-stats	(0.85)	(1.85)	(1.33)	(0.17)	(1.14)	(0.48)	(0.44)	(0.02)	(0.89)	(0.83)	
Modified alpha	-0.0012	0.0023	0.0016	0.0002	0.0018	0.0007	-0.0008	0.0001	0.0025	0.0033	
T-stats	(0.86)	(1.85)	(1.32)	(0.14)	(1.13)	(0.46)	(0.46)	(0.02)	(0.90)	(0.84)	
beta	0.774	0.802	0.859	0.920	0.994	1.030	1.137	1.192	1.265	1.490	
Modified beta	0.774	0.802	0.865	0.928	0.997	1.039	1.145	1.190	1.260	1.484	
Skewness	-0.583	-0.493	-0.772	-0.903	-0.586	-0.918	-0.711	-0.345	-0.217	0.190	-0.749
gamma	1.83										

Table 3.9: Returns on Campbell et al. Portfolios by Exchange

We sort all stocks using the Campbell et al. 12 month hazard rate model and sort them into 10 portfolios based on percentile cutoffs. In the table below we show results from regressions of value weighted excess returns on a constant and the market excess return. Panel A shows CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over the full sample period, 1981:1 - 2010:12. Panels B and C show CAPM alphas and betas, modified CAPM alphas and betas, as well as corresponding t-stats below over subgroups formed based on the exchange on which the stocks trade. Skewness of the excess return and gamma are also presented.

									Most Distressed		S&P
Portfolios	1	2	3	4	5	6	7	8	9	10	500
Panel A: 1981:1-2010:12 All Traded											
alpha	0.0015	0.0010	0.0012	0.0007	0.0012	0.0004	0.0005	-0.0031	-0.0078	-0.0117	
alpha, annual,%	1.85	1.24	1.39	0.84	1.41	0.46	0.58	-3.70	-8.96	-13.21	
T-stats	(1.57)	(1.35)	(1.69)	(1.08)	(1.58)	(0.36)	(0.33)	(1.67)	(3.14)	(3.40)	
Modified alpha	0.0016	0.0010	0.0012	0.0007	0.0011	0.0004	0.0005	-0.0031	-0.0077	-0.0117	
T-stats	(1.62)	(1.37)	(1.71)	(1.11)	(1.56)	(0.34)	(0.34)	(1.67)	(3.13)	(3.41)	
beta	0.854	0.875	0.935	0.965	1.051	1.130	1.225	1.366	1.614	1.664	
Modified beta	0.848	0.875	0.933	0.963	1.056	1.135	1.224	1.362	1.599	1.658	
Skewness	-0.412	-0.646	-0.779	-0.656	-0.863	-0.701	-0.870	-0.643	-0.421	0.128	-0.743
gamma	2.73										
Panel B: OTC Traded											
alpha	0.0011	-0.0046	-0.0040	-0.0071	-0.0128	-0.0227	-0.0244	-0.0312	-0.0326	-0.0518	
alpha, annual,%	1.34	-5.33	-4.75	-8.20	-14.32	-24.09	-25.66	-31.64	-32.80	-47.19	
T-stats	(0.53)	(2.06)	(1.70)	(2.34)	(3.80)	(5.83)	(6.41)	(6.48)	(6.18)	(9.84)	
Modified alpha	0.0011	-0.0047	-0.0042	-0.0071	-0.0129	-0.0228	-0.0247	-0.0314	-0.0327	-0.0520	
T-stats	(0.51)	(2.16)	(1.76)	(2.36)	(3.86)	(5.90)	(6.53)	(6.58)	(6.25)	(9.95)	
beta	0.981	1.018	1.059	1.203	1.316	1.461	1.542	1.356	1.499	1.611	
Modified beta	0.990	1.048	1.078	1.206	1.334	1.475	1.585	1.390	1.514	1.644	
Skewness	-0.305	-0.603	-0.597	-1.163	-0.676	-0.819	-0.735	-1.171	0.473	-0.203	-0.743
gamma	2.73										
Panel C: Exchange Traded											
alpha	0.0018	0.0006	0.0008	0.0016	0.0011	0.0022	0.0005	0.0008	-0.0033	-0.0058	
alpha, annual,%	2.22	0.72	1.00	1.93	1.27	2.67	0.58	0.93	-3.93	-6.72	
T-stats	(1.48)	(0.64)	(0.92)	(2.03)	(1.32)	(1.90)	(0.35)	(0.40)	(1.37)	(1.68)	
Modified alpha	0.0019	0.0006	0.0009	0.0016	0.0011	0.0022	0.0005	0.0008	-0.0033	-0.0058	
T-stats	(1.52)	(0.65)	(0.97)	(2.04)	(1.39)	(1.91)	(0.35)	(0.40)	(1.38)	(1.70)	
beta	0.879	0.887	0.915	0.944	1.005	1.052	1.129	1.250	1.466	1.544	
Modified beta	0.872	0.888	0.908	0.945	0.997	1.053	1.130	1.250	1.465	1.548	
Skewness	-0.302	-0.660	-0.538	-0.711	-0.478	-0.651	-0.736	-0.857	-0.605	0.167	-0.743
gamma	2.73										

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4 Appendix for Chapter 2

4.1 Appendix A: Accounting for Acquisitions

Table 4.1: Accounting For Acquisitions

For the 138 deals identified we reviewed filings from the SEC Edgar database and microfiche records for deals prior to 1996 to determine the acquisition accounting method; recapitalization or purchase accounting. In instances where filings were not available, a detailed review of the COMPUSTAT financial statements was used to determine the type of accounting used for the acquisition. In Panel A we present complete financial statements for the 32 firms that use recapitalization accounting. In Panel B, we present complete financial statements for the 106 firms that use purchase accounting.

	Panel A: Recap		**Panel B: Purchase**	
($ in millions)	**Year Prior**	**Year of Acq.**	**Year Prior**	**Year of Acq.**
Cash & Equivalents	42	23	80	51
Receivables	68	59	163	146
Inventories	58	58	176	185
Prepaid Expenses	1	1	8	10
Current Assets - Other	19	18	32	98
Current Assets - Total	187	159	459	489
Plant, Property & Equip	187	179	760	812
Investments at Equity	6	6	15	15
Investments and Advances	8	7	18	26
Intangibles	147	159	366	1,190
Deferred Charges	2	10	12	27
Assets - Other	14	25	90	147
TOTAL ASSETS	551	546	1,720	2,707
Accounts Payable	34	37	114	116
Notes Payable	7	4	37	33
Accrued Expenses	24	32	105	130
Taxes Payable	2	2	11	14
Debt Due In One Year	6	10	34	78
Other Current Liabilities	15	16	50	58
Total Current Liabilities	86	101	350	429
Long Term Debt	189	512	569	1,641
Deferred Taxes	22	6	93	194
Investment Tax Credit	-	-	1	0
Liabilities - Other	25	27	78	137
Noncontrolling Interest	3	1	35	38
TOTAL LIABILITIES	325	648	1,125	2,441
SHAREHOLDERS' EQUITY	226	(102)	595	266
LIABILITIES AND EQUITY	551	546	1,720	2,707

4.2 Appendix B: Advanced DuPont Composition and Variable Definitions

The advanced DuPont model presented below is specifically designed to decompose return on equity (ROE) into its operating part and the additional effect of financial leverage. RNOA (Return on Net Operating Assets) is our measure of profitability. We define operating profitability as the profitability of the firm's underlying business.

$$\text{ROE} = RNOA + \underbrace{(RNOA - Net\ Borrowing\ Costs)}_{[Spread]} * \underbrace{\frac{NFO}{Common\ Equity}}_{[Leverage]}$$

The presentation below is based on the income statement (Table 2) and balance sheet (Table A.1) format presented within this paper. Average balance sheet items are used to calculate ratios.

(COA) Current Operating Assets = Total Current Assets - Cash Equivalents

(NCOA) Non-Current Operating Assets = Total Assets - Total Current Assets - Investments & Advances[74]

(OA) Operating Assets = Current Operating Assets + Non-Current Operating Assets

(COL) Current Operating Liabilities = Total Current Liabilities - Debt Due In One Year - Notes Payable

(NCOL) Non-current Operating Liabilities = Total Liabilities - Total Current Liabilities - Long Term Debt

(OL) Operating Liabilities = Current Operating Liabilities + Non-Current Operating Liabilities

(NOA) Net Operating Assets = OA - OL

(NFO) Net Financial Obligations = Debt Due In One Year + Note Payable + Long Term Debt + Preferred Equity + Non-control Interest - Cash Equivalents - Investments & Advancements

(NOI) Net Operating Income = Net Income + Interest Expense * (1-Marginal Tax Rate) + Preferred Dividend + Minority Interest

(NBC) Net Borrowing Costs = (Interest Expense * (1-Marginal Tax Rate) + Preferred Dividend + Minority Interest) / NFO

(MTX) Marginal Tax Rate = 1-Net Income/(Net Income+Tax Expense)

[74]Investments at Equity is included in NOA.

(LEV) Leverage = NFO / Common Equity

(OMargin) Operating Margin = NOI / Sales

(OTurn) Operating Turnover = Sales / NOA

(Spread) Spread between RNOA and Borrowing Cost = RNOA - NBC

(RNOA) Return on Net Operating Assets = NOI / NOA

(ROE) Return on Equity = Net Income / Common Equity

ROE Decomposition = RNOA + Spread * LEV

RNOA-Tangible = (NOI + Amortization Expense * (1-MTX) + Goodwill Impairments after Tax)/(NOA - Intangible Assets)

We also detail an adjustment to the tax rate that deviates from the preferred method. Because taxes are a relevant aspect of the analysis, we multiply our operating income measures by (1-marginal tax rate). In order to focus on the current performance of the firm's operations, we abstract from the actual book income taxes and instead use the same tax rates that are used by Nissim and Penman (2001). This also insures a greater comparability of our measures across firms.

5 Appendix for Chapter 3

5.1 Appendix A: Solving for δ_t under the Risk Neutral Measure

Solving for the firm's cash flow process under the risk neutral measure:

We assume (1) that the firm has no debt; and (2) that the probability of default is zero. Given these assumptions we can calculate the value of this claim which is equivalent to an all equity firm with infinite life. Let $A(\delta_t) \equiv A_t$ be the market value of this claim.

$$\Lambda_t A_t = \mathbb{E}_t\Big[\int_t^\infty \delta_s \Lambda_s ds\Big]$$

Let $\delta_s \Lambda_s = y_s$ and solve for $\frac{dy}{y}$ using ito's lemma.

$$\frac{dy}{y} = -(r - \mu_\delta + \sigma_\delta \sigma_c \gamma)dt + (\sigma_\delta - \gamma\sigma_c)dz = -\mu_y dt + \sigma_y dz$$

Then $\forall s \geq t$

$$y_s = y_t exp\big\{\big(-\mu_y - \frac{1}{2}\sigma_y^2\big)(s-t) + \sigma_y(z_s - z_t)\big\} \tag{5.1}$$

and in expectation

$$\mathbb{E}_t[y_s] = y_t e^{-\mu_y(s-t)} \tag{5.2}$$

substitute in for $\mathbb{E}_t[y_s]$, making the assumption that $r > \sigma_\delta \sigma_c \gamma - \mu_\delta$ to ensure that μ_y is positive.

$$\Lambda_t A_t = y_t \int_t^\infty e^{-\mu_y(s-t)} ds$$

$$\Lambda_t A_t = \frac{y_t}{\mu_y} = \frac{\Lambda_t \delta_t}{\mu_y}$$

$$A_t = \frac{\delta_t}{\mu_y} \quad \text{where } \mu_y = r - \mu_\delta + \sigma_\delta \sigma_c \gamma$$

Applying Ito's lemma to A_t, we see that dA_t is the following GBM

$$\frac{dA_t}{A_t} = \frac{d\delta_t}{\delta_t} = \mu_\delta dt + \sigma_\delta dz \tag{5.3}$$

To solve for the return process:

$$\frac{dA_t + \delta_t dt}{A_t} = \frac{dA_t + A_t \mu_y dt}{A_t} = \frac{dA_t}{A_t} + \mu_y dt = \mu_\delta dt + \sigma_\delta dz + \mu_y dt \tag{5.4}$$

Substitute in for μ_y

$$\frac{dA_t + \delta_t dt}{A_t} = (r + \sigma_\delta \sigma_c \gamma)dt + \sigma_\delta dz \tag{5.5}$$

This implies $dz^Q = \sigma_c \gamma dt + dz$ as the drift of the traded asset must equal r under the risk neutral measure by the Girsanov Theorem. Here we are making the assumption that the unlevered asset is traded.

$$\frac{dA_t + \delta_t dt}{A_t} = rdt + \sigma_\delta dz^Q \tag{5.6}$$

Applying the same change of measure to the firm's cash flow process results in the following LOM under the risk neutral measure.

$$\frac{d\delta_t}{\delta_t} = \mu dt + \sigma_\delta dz^Q \qquad \text{where } \mu = \mu_\delta - \sigma_c \sigma_\delta \gamma \tag{5.7}$$

Then $\forall s \geq t$

$$\delta_s = \delta_t e^{\left\{\left(\mu - \frac{1}{2}\sigma_\delta^2\right)(s-t) + \sigma_\delta(z_s - z_t)\right\}} \tag{5.8}$$

and in expectation.

$$\mathbb{E}_t^Q[\delta_s] = \delta_t e^{\mu(s-t)} \tag{5.9}$$

5.2 Appendix B: Solving for $\mathbf{A}_t$

Solving for the value of an all equity firm with infinite life. Define Z_t as follows:

$$Z_t \equiv \ln \delta_t \qquad \text{(apply Ito's lemma to } Z_t\text{)}$$

$$dZ(t, \delta_t) = \frac{\partial Z}{\partial t}dt + \frac{\partial Z}{\partial \delta}d\delta + \frac{1}{2}\frac{\partial^2 Z}{\partial \delta^2}d\delta^2$$

$$dZ = \frac{1}{\delta}d\delta + \frac{1}{2}\left[- \frac{1}{\delta^2}\right]d\delta^2 \qquad \text{(substitute in value of } \frac{d\delta}{\delta} = \mu dt + \sigma_\delta dz\text{)}$$

$$dZ = \frac{1}{\delta}(\mu\delta dt + \sigma_\delta \delta dz) + \frac{1}{2}\left(- \frac{1}{\delta^2}\right)(\sigma_\delta^2 \delta^2 dt)$$

$$dZ = \left(\mu - \frac{1}{2}\sigma_\delta^2\right)dt + \sigma_\delta dz \qquad \text{(integrate)}$$

$$Z_s = Z_t + \left(\mu - \frac{1}{2}\sigma_\delta^2\right)(s-t) + \sigma_\delta(z_s - z_t)$$

$$\ln \delta_s = \ln \delta_t + \left(\mu - \frac{1}{2}\sigma_\delta^2\right)(s-t) + \sigma_\delta(z_s - z_t)$$

$$\delta_s = \delta_t e^{\left(\mu - \frac{1}{2}\sigma_\delta^2\right)(s-t) + \sigma_\delta(z_s - z_t)}$$

$$\mathbb{E}_t^Q[\delta_s] = \delta_t \mathbb{E}_t^Q\left[e^{\left(\mu-\frac{1}{2}\sigma_\delta^2\right)(s-t)+\sigma_\delta(z_s-z_t)}\right]$$

The combination of the lognormal distribution for the firm's cash flows (GBM) and power utility assumptions allows for an analytical solution. We also assume that $r > \mu$.

$$\mathbb{E}_t^Q[\delta_s] = \delta_t e^{\left(\mu-\frac{1}{2}\sigma_\delta^2\right)(s-t)+\frac{1}{2}var\left[\left(\mu-\frac{1}{2}\sigma_\delta^2\right)(s-t)+\sigma_\delta(z_s-z_t)\right]}$$

$$\mathbb{E}_t^Q[\delta_s] = \delta_t e^{\mu(s-t)}$$

$$A_t = \mathbb{E}_t^Q\left[\int_t^\infty e^{-r(s-t)}\delta_s ds\right] = \int_t^\infty e^{-r(s-t)}\mathbb{E}_t^Q[\delta_s]ds \ = \frac{\delta_t}{r-\mu}$$

5.3 Appendix C: Solving for $\mathcal{E}(\delta_t)$

Solution to a General Claim

In general, any claim must satisfy the partial differential equation

$$rF = \mu\delta F_\delta + \frac{1}{2}\sigma^2\delta^2 F_{\delta\delta} + F_t + CF$$

where CF is intertemporal cash flow. Due to the issuance of the perpetual debt in this model, all claims are time independent. As a result, the partial differential equation reduces to an ordinary differential equation ("ODE"). If we set F $\equiv \mathcal{E}(\delta_t)$ then the ODE can be written as follows:

$$r\mathcal{E} = \mu\delta\mathcal{E}_\delta + \frac{1}{2}\sigma^2\delta^2\mathcal{E}_{\delta\delta} + CF \tag{5.10}$$

General Solution to Equity's Claim in our Model

We know that the cash flow accruing to equity holders over each interval dt in our model is $[\delta - C(1-\theta)]$. In addition to this cash flow, equity holders expect appreciation in the value of equity over the interval dt, or equivalently $\mathbb{E}[d\mathcal{E}]$. Thus under risk neutral pricing, for $\delta_t > \delta_B$, we have that the value of equity satisfies the following equation:

$$r\mathcal{E}(\delta_t)dt = \mathbb{E}^Q[d\mathcal{E}]dt + [\delta - C(1-\theta)]dt \tag{5.11}$$

We can solve for $\mathbb{E}^Q[d\mathcal{E}]$ by using Ito's lemma and taking expectations[75]. Thus for $\delta_t > \delta_B$, we have that the value of equity satisfies the following equation

$$\underbrace{r\mathcal{E}(\delta_t)dt}_{[Return\ on\ Equity]} = \underbrace{(\mu\delta\mathcal{E}_\delta + \frac{1}{2}\sigma^2\delta^2\mathcal{E}_{\delta\delta})dt}_{[\mathbb{E}^Q(d\mathcal{E})\ is\ the\ appreciation\ of\ Equity]} + \underbrace{(\delta - C(1-\theta))dt}_{[Cash\ flow\ to\ Equity]} \tag{5.12}$$

[75] Using Ito's formula to solve for $d\mathcal{E}(\delta_t)$,

$$d\mathcal{E}(\delta_t) = \mathcal{E}_t dt + \mathcal{E}_\delta d\delta + \frac{1}{2}\mathcal{E}_{\delta\delta}d\delta^2$$

The general solution to this ODE is:

$$\mathcal{E}(\delta_t)_{GS} = L_1\delta^{-\xi_-} + L_2\delta^{-\xi_+} \tag{5.13}$$

The general solution does not account for intertemporal cash flows. These are accounted for in the particular solution. The particular solution for the ODE is[76]:

$$\mathcal{E}(\delta_t)_P = \frac{\delta_t}{r-\mu} - \frac{C(1-\theta)}{r}$$

giving us a solution for $\mathcal{E}(\delta_t)$ of

$$\mathcal{E}(\delta_t) = L_1\delta_t^{-\xi_-} + L_2\delta_t^{-\xi_+} + \frac{\delta_t}{r-\mu} - \frac{C(1-\theta)}{r} \tag{5.15}$$

Solution to Equity's Claim in our Model

Main Result: Optimal default-triggering level δ_B and equity level $\mathcal{E}(\delta_t)$ are jointly determined by the following ODE and conditions:

$$\begin{cases} \frac{1}{2}\sigma^2\delta^2\mathcal{E}''(\delta) + \mu\delta\mathcal{E}'(\delta) - r\mathcal{E}(\delta) + \delta - C(1-\theta) = 0, \text{ for } \delta_t \geq \delta_B \\ \mathcal{E}(\delta) = 0, \text{ for } \delta_t \leq \delta_B \\ \mathcal{E}'(\delta) \text{ is bounded} \\ \mathcal{E}(\delta_B) = 0 \ \text{ (boundary condition)} \\ \mathcal{E}'(\delta_B) = 0 \ \text{ (smooth pasting)} \end{cases}$$

$$d\mathcal{E}(\delta_t) = (0)dt + \mathcal{E}_\delta d\delta + \frac{1}{2}\mathcal{E}_{\delta\delta}d\delta^2$$

$$d\mathcal{E}(\delta_t) = \mathcal{E}_\delta(\mu\delta dt + \sigma\delta dz^Q) + \frac{1}{2}\mathcal{E}_{\delta\delta}(\sigma^2\delta^2 dt)$$

$$d\mathcal{E}(\delta_t) = (\mu\delta\mathcal{E}_\delta + \frac{1}{2}\sigma^2\delta^2\mathcal{E}_{\delta\delta})dt + \sigma\delta\mathcal{E}_\delta dz^Q$$

$$\mathbb{E}[d\mathcal{E}(\delta_t)] = (\mu\delta\mathcal{E}_\delta + \frac{1}{2}\sigma^2\delta^2\mathcal{E}_{\delta\delta})dt$$

Where $\frac{d\delta}{\delta} = \mu dt + \sigma dz^Q$; Notation: $\mathcal{E}_t = \frac{\partial\mathcal{E}}{dt}$; $\mathcal{E}_\delta = \frac{\partial\mathcal{E}}{d\delta}$; $\mathcal{E}_{\delta\delta} = \frac{\partial^2\mathcal{E}}{d\delta^2}$

[76]The particular solution $\frac{\delta_t}{r-\mu} - \frac{C(1-\theta)}{r}$ comes from the fact that $\mathcal{E}(\delta_t)$ must hold when $\delta_t \to \infty$. Given that ξ_- is negative, then we need $L_1 = 0$ because $\delta_t^{-\xi_-}$ explodes as $\delta_t \to \infty$.

To see this recall,

$$\mathcal{E}(\delta_t) \leq \frac{\delta_t}{r-\mu} + \frac{C(1-\theta)}{r} \qquad \forall\delta_t > \delta_B \tag{5.14}$$

Intuition: Equation (5.14) holds with equality for a residual claim that cannot default. Debt introduces a default-option, which leads to the inequality. As $\delta_t \to \infty$, the asset value is so high that default never happens, so all coupon payments will be made.

Beginning with equation (5.15): given that ξ_- is negative, then we need $L_1 = 0$ because $\delta_t^{-\xi_-}$ explodes as $\delta_t \to \infty$.

To see this recall,

$$\mathcal{E}(\delta_t) \leq \frac{\delta_t}{r-\mu} + \frac{C(1-\theta)}{r} \qquad \forall \delta_t > \delta_B$$

Thus our ODE reduces to

$$\mathcal{E}(\delta_t) = L_2 \delta_t^{-\xi_+} + \frac{\delta_t}{r-\mu} - \frac{C(1-\theta)}{r} \tag{5.16}$$

To solve for L_2, use boundary condition $\mathcal{E}(\delta_B) = 0$

$$0 = L_2 \delta_B^{-\xi_+} + \frac{\delta_B}{r-\mu} - \frac{C(1-\theta)}{r}$$

$$\implies L_2 = \left[\frac{C(1-\theta)}{r} - \frac{\delta_B}{(r-\mu)}\right] \frac{1}{\delta_B^{-\xi_+}}$$

Substituting L_2 back into equation (5.16) with a little manipulation:

$$\mathcal{E}(\delta_t) = \left[\frac{\delta_t}{(r-\mu)} - \frac{C(1-\theta)}{r}\right] - \left(\frac{\delta_t}{\delta_B}\right)^{-\xi_+} \left[\frac{\delta_B}{(r-\mu)} - \frac{C(1-\theta)}{r}\right] \tag{5.17}$$

To solve for ξ_+ and ξ_- take first and second derivative of $\mathcal{E}$ in eq(5.16) *with respect to* δ :

$$\mathcal{E}' = -\xi_+ L_2 \delta_t^{-\xi_+ - 1} + \frac{1}{r-\mu} \tag{5.18}$$

$$\mathcal{E}'' = (-\xi_+ - 1)(-\xi_+) L_2 \delta_t^{-\xi_+ - 2} = \xi_+(\xi_+ + 1) L_2 \delta_t^{-\xi_+ - 2} \tag{5.19}$$

Substituting equations (5.16), (5.18) and (5.19) into (5.10):

$$r\left[L_2 \delta_t^{-\xi_+} + \frac{\delta_t}{r-\mu} + \frac{C(1-\theta)}{r}\right] = \mu\delta_t\left[-\xi_+ L_2 \delta_t^{-\xi_+ - 1} + \frac{1}{r-\mu}\right] + \frac{1}{2}\sigma^2\delta_t^2\left[\xi_+(\xi_+ + 1) L_2 \delta_t^{-\xi_+ - 2}\right] + CF$$

where CF $\equiv \frac{\delta_t}{r-\mu} - C(1-\theta)$. This reduces to:

$$r L_2 \delta_t^{-\xi_+} = \mu\left[L_2 \xi_+ \delta_t^{\xi_+}\right] + \frac{1}{2}\sigma^2\left[L_2 \xi_+(\xi_+ - 1)\delta_t^{\xi_+}\right]$$

Canceling $L_2 \delta_t^{-\xi_+}$

$$0 = \frac{1}{2}\sigma^2 \xi(\xi - 1) + \mu\xi - r$$

where

$$\xi_- = \frac{m - \sqrt{m^2 + 2r\sigma^2}}{\sigma^2} \quad \text{the negative root}$$

$$\xi_+ = \frac{m + \sqrt{m^2 + 2r\sigma^2}}{\sigma^2} \quad \text{the positive root}$$

with $m = \mu - \sigma^2/2$. Let $\nu \equiv \xi_+$ for ease of notation in the body of the paper.

Now we can solve for δ_B, the value for which management will declare bankruptcy, using the smooth pasting condition, $\mathcal{E}'(\delta_B) = 0$. Taking the derivative of equation (5.17) and evaluating it at δ_B gives the following solution:

$$\delta_B = \frac{C(1-\theta)(r-\mu)\xi_+}{r(1+\xi_+)} \implies \qquad A_B = \frac{C(1-\theta)\xi_+}{r(1+\xi_+)}$$

5.4 Appendix D: Solving for the LOM of $\mathcal{E}(\delta_t)$

$$d\mathcal{E}(A_t) = \frac{\partial \mathcal{E}}{\partial t}dt + \frac{\partial \mathcal{E}}{\partial A}dA + \frac{1}{2}\frac{\partial \mathcal{E}^2}{\partial^2 A}dA^2 \tag{5.20}$$

where

$$\mathcal{E}(A_t) = [A_t - k_1] - \left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1] \qquad \text{and } k_1 = \frac{(1-\theta)c}{r}$$

$$\frac{\partial \mathcal{E}}{\partial t} = 0$$

$$\frac{\partial \mathcal{E}}{\partial A} = 1 + \nu\left(\frac{A_t}{A_B}\right)^{-\nu}\left(\frac{1}{A_t}\right)\left[A_B - k_1\right]$$

$$\frac{\partial^2 \mathcal{E}}{\partial A^2} = -\nu(\nu+1)\left(\frac{A_t}{A_B}\right)^{-\nu}\left(\frac{1}{A_t^2}\right)\left[A_B - k_1\right]$$

$$dA = \mu A dt + \sigma_\delta A dz^Q$$

$$dA^2 = \sigma_\delta^2 A^2 dt$$

Substituting the above into equation (5.20) we have:

$$d\mathcal{E} = \left(1 + \frac{\nu}{A_t}\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1]\right)(\mu A_t dt + \sigma_\delta A_t dz^Q) - \frac{\nu(\nu+1)}{2A_t^2}\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1](\sigma_\delta^2 A_t^2 dt)$$

$$d\mathcal{E} = \left(\mu A_t + \mu\nu\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1] - \frac{\nu(\nu+1)}{2}\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1]\sigma_\delta^2\right)dt$$

$$+\left(\sigma_\delta A_t + \sigma_\delta \nu\left(\frac{A_t}{A_B}\right)^{-\nu}[A_B - k_1]\right)dz^Q$$

5.5 Appendix E: Solving for the Modified *beta*

Rubinstein (1976) assumes: (1) The returns on the market portfolio are iid at each moment in time; and (2) markets are perfect. Rubinstein (1976), Brennan (1979), and He and Leland (1993) showed that if the return on the market portfolio is iid and markets are perfect, the representative agent must have a power utility function.

Hakansson (1971) and Rubinstein (974b) have shown that for investors with CRRA utility, their average propensity to consume wealth (c_t) at any date is independent of his wealth (W_t). Thus, $\tilde{C}_t = \tilde{k}_t \tilde{W}_t$ where $\tilde{k}_t$ is a random variable.

Under Logarithmic utility, a special case of CRRA utility where the coefficient of relative risk aversion, γ, is equal to one, we can derive consumption as a constant fraction of wealth, $\tilde{C}_t = k\tilde{W}_t$. This constant fraction of wealth relationship holds for any value of γ under the assumption that the growth rate of per capita consumption follows a random walk Rubinstein (974b)).

Using these assumptions and starting with the *Law of One Price*,

$$P_0 = \sum_{t=1}^{\infty} \sum_{s(t)} pc[s(t)] D[s(t)]$$

where D represents future dividends which is dependent on the state of the world s(t), pc is a set random variables that is the same for all assets and also dependent on the state of the world, s(t), and $\pi[s(t)]$ is the probability that state s occurs.

$$P_0 = \sum_{t=1}^{\infty} \sum_{s(t)} \pi[s(t)] \left(\frac{pc[s(t)]}{\pi[s(t)]} \right) D[s(t)]$$

$$P_0 = \sum_{t=1}^{\infty} \sum_{s(t)} \pi[s(t)] m[s(t)] D[s(t)]$$

$$P_0 = \sum_{t=1}^{\infty} \mathbb{E}\big[m_t D_t\big]$$

If we look at a discrete time interval $0 \rightarrow t$, and define the payoff, $\tilde{x}_t$, as $\tilde{x}_t = P_0(1 + \tilde{r}_p)$ where the random variable $\tilde{r}_p$ is the net return on the portfolio over the time period inclusive of dividends.

$$P_0 = \mathbb{E}\big[m_t x_t\big]$$

Alternatively, we can write the basic pricing equation in terms of returns and excess returns.

$$1 = \mathbb{E}\big[m_t R_t\big]$$

$$0 = \mathbb{E}\big[m_t (R_t - R_t^f)\big]$$

To represent c_t as a function of the return on the market portfolio under the assumption of CRRA utility, Rubinstein (1976) uses the budget constraint in an exchange economy where the risk free rate is in zero net supply and the representative agent only holds the market in equilibrium and the fact that $\tilde{c}_t = k_t \tilde{W}_t$.

Under CRRA,

$$M_{t+1} = \beta \left(\frac{c_{t+1}}{c_t} \right)^{-\gamma}$$

where M is the stochastic discount factor, and β is the subjective discount factor, our measure of impatience. The representative agent has the following budget constraint:

$$\tilde{W}_t = (W_{t-1} - c_{t-1})(1 + \tilde{r}^m_{t-1,t}), \text{ then } \tilde{c}_t = (W_{t-1} - c_{t-1})k_t(1 + \tilde{r}^m_{t-1,t}) \text{ and}$$

$$\tilde{c}_t = (W_{t-2} - c_{t-2})(1 - k_{t-1})k_t(1 + \tilde{r}^m_{t-2,t-1})(1 + \tilde{r}^m_{t-1,t}) \text{ and working backwards}$$

$$\tilde{c}_t = [W_0(1 - k_0)(1 - k_1) \dots (1 - k_{t-1})k_t](1 + \tilde{r}^m_t)$$

Alternatively,

$$\tilde{c}_{t+1} = [(W_{t-1} - c_{t-1})(1 - k_t)(k_{t+1})](1 + \tilde{r}^m_{t-1,t})(1 + \tilde{r}^m_{t,t+1})$$

$$\tilde{c}_t = [(W_{t-1} - c_{t-1})k_t](1 + \tilde{r}^m_{t-1,t})$$

Solve for M_{t+1} in terms of the return on the market portfolio:

$$M_{t+1} = \beta \left(\frac{c_{t+1}}{c_t} \right)^{-\gamma} = \beta \left((1 + r^m_{t,t+1}) \frac{(1 - k_t)k_{t+1}}{k_t} \right)^{-\gamma}$$

Thus,

$$M_{t+1} = \beta \left(R^{mkt}_{t+1} \frac{(1 - k_t)k_{t+1}}{k_t} \right)^{-\gamma}$$

Expanding the basic asset pricing equation for excess returns:

$$\mathbb{E}_t[M_{t+1}]\mathbb{E}_t[R^p_{t+1} - R^f_{t+1}] + cov(M_{t+1}, R^p_{t+1} - R^f_{t+1}) = 0$$

$$\mathbb{E}_t[R^p_{t+1} - R^f_{t+1}] = -\frac{cov(M_{t+1}, R^p_{t+1} - R^f_{t+1})}{\mathbb{E}_t[M_{t+1}]} \tag{5.21}$$

To derive a CAPM like expression under this CRRA model, we solve equation (5.21) for the price of the market portfolio and portfolio p.

For the market:

$$r_f = \mathbb{E}[(r_{M_t})] + cov((r_{M_t}, (1 + r_{M_t})^{-\gamma})/\mathbb{E}[(1 + r_{M_t})^{-\gamma}] \tag{5.22}$$

$$\mathbb{E}[(1+r_{M_t})^{-\gamma}] = \frac{cov(r_{M_t},(1+r_{M_t})^{-\gamma})}{\mathbb{E}[r_{M_t}]-r_f} \tag{5.23}$$

For the portfolio:

$$r_f = \mathbb{E}[(r_p)] + cov((r_p,(1+r_{M_t})^{-\gamma})/\mathbb{E}[(1+r_{M_t})^{-\gamma}] \tag{5.24}$$

$$\mathbb{E}[(1+r_{M_t})^{-\gamma}] = \frac{cov(r_p,(1+r_{M_t})^{-\gamma})}{\mathbb{E}[r_p]-r_f} \tag{5.25}$$

Equating the two:

$$\frac{cov(r_{M_t},(1+r_{M_t})^{-\gamma})}{\mathbb{E}[r_{M_t}]-r_f} = \frac{cov(r_p,(1+r_{M_t})^{-\gamma})}{\mathbb{E}[r_p]-r_f} \tag{5.26}$$

$$\mathbb{E}(r_p) = r_f + \frac{cov[r_p,(1+r_{M_t})^{-\gamma}]}{cov[r_{M_t},(1+r_{M_t})^{-\gamma}]}[E(r_{M_t})-r_f]$$

$$\mathbb{E}(r_p) = r_f + B_p[E(r_{M_t})-r_f]$$

where

$$B_p = \frac{cov[r_p,(1+r_{M_t})^{-\gamma}]}{cov[r_{M_t},(1+r_{M_t})^{-\gamma}]}$$

Note we have only made assumptions about r_{markrt}, r_p can come from any non-symmetrical distribution.

Solving for γ

$$1+r_f = \mathbb{E}[(1+r_p)] + \frac{cov((1+r_p,(1+r_{M_t})^{-\gamma})}{\mathbb{E}[(1+r_{M_t})^{-\gamma}]}$$

$$1+r_f = \frac{\mathbb{E}[(1+r_p)]\mathbb{E}[(1+r_{M_t})^{-\gamma}] + cov((1+r_p,(1+r_{M_t})^{-\gamma})}{\mathbb{E}[(1+r_{M_t})^{-\gamma}]}$$

If we substitute r_M for r_p and expand the covariance term:

$$1+r_f = \frac{\mathbb{E}[(1+r_{M_t})^{1-\gamma}]}{\mathbb{E}[(1+r_{M_t})^{-\gamma}]}$$

Given assumption (1) that the market return is iid, in the limit as time periods become infinitesimal in duration, $(1+r_{market}) \equiv 1+r_M$ are distributed log normal. Then $(1+r_{M_t})^{1-\gamma}$ and $(1+r_{M_t})^{-\gamma}$ are also log normal.

$$1+r_f = \frac{exp[(1-\gamma)\mathbb{E}(\ln(1+r_{M_t}) + \frac{1}{2}(1-\gamma)^2 var(\ln(1+r_{M_t}))]}{exp[-\gamma\mathbb{E}(\ln(1+r_{M_t}) + \frac{1}{2}\gamma^2 var(\ln(1+r_{M_t}))]} \tag{5.27}$$

Taking logarithms:

$$\gamma = \frac{\ln[\mathbb{E}(1+r_{M_t})] - \ln(1+r_f)}{var[\ln(1+r_{M_t})]}$$

where γ is the coefficient of relative risk aversion of the average investor in a CRRA model.