The effects of buybacks on corporate investment

Abstract

Using a comprehensive panel data set with a total of 92,901 US firm-year observations over the period 1984-2014, I show that the decision to repurchase company stock is driven by the existence of several firm characteristics. Logit regressions indicate that the use of buybacks is positively related to profitability, operational cash flows, large cash reserves, conservative levels of debt and low growth opportunities. The use of repurchases has consequences for corporate investment, as measured by R&D expenditures, capital expenditures and employment. The empirical evidence supports the notion that companies are trading off investment for share repurchases, since repurchasing firms lower their future capital expenditures, R&D and decrease their number of employees. The negative relationship holds after controlling for growth opportunities, profitability and firm size and is present in the majority of the six investigated industries. This paper contributes to the growing academic debate about the use of repurchases and its possible consequences for the real economy.

Erasmus University Rotterdam
Erasmus School of Economics
MSc. Financial Economics
Master thesis
J.C. van Eijk
Studentnumber 361930
Date final version: 31 August 2017
Supervisor: S. (Sjoerd) van den Hauwe
Second assessor: M.S.D. (Mintra) Dwarkasing

Table of contents

List of figures and tables

1. Introduction

1.1 Topic

Before the 1980s, it was exceptional for managers to announce a corporate repurchases program, a program in which a company buys back its own shares from the marketplace. Dividends were the undoubtedly dominant form of distributing cash to shareholders. Since then, stock repurchases have become an increasingly important form of payout and add substantially to total shareholder distributions, even with dividends on the rise. The rise of the buybacks in the United States can be partially attributed to the passing of a SEC ruling in 1982, which provided companies doing buybacks protection against lawsuits for stock manipulation. Nowadays repurchases are the dominant form of payout and so widespread that some companies are the biggest demanders of their own stock. This triggered me to study the relationship between the usage of buybacks and corporate investment.

The move towards buybacks is evident in the 1990s and continues roughly until the financial crisis hits. In peak year 2007, the aggregate amount in buybacks is significantly higher than the amount of dividend payouts. The financial crisis of 2008 resulted in a sharp decline in buybacks, whereas dividends fell to a lesser extent. Recent data on buybacks illustrate that managers show an increasing propensity to repurchase again, which demonstrates that the buyback surge has far from ended yet.

The increasing occurrence of buybacks triggered a lot of questions. Many financial researchers have been studying the rationale for doing buybacks and searched for answers to the question why the payout policy of many firms has changed severely over the past decades. This body of research has shown that many firms repurchase stock to take advantage of potential undervaluation and to distribute excess capital. Apart from that, it has been shown that in many countries, buy-back programs are a more tax-efficient way of returning money to shareholders than dividends. In a survey among financial executives, potential undervaluation, increasing earnings per share and offsetting dilution are the most commonly occurring motives for buybacks. Another reason to announce a stock repurchase program can be that investors regard this as evidence that a company believes its shares are undervalued. This often results in a (temporary) positive stock price movement.

Repurchases are considered to be a more flexible means of payout than dividends. Shareholders see dividends as a regular stream of income and have a strong disregard for dividend declines. An announcement to decline or stop repurchases however, has only a limited effect on the share price, because the nature of buybacks is temporary. The flexibility of repurchases is a clear advantage for companies with volatile earnings. Additionally, repurchases can serve as a tool to alter the leverage ratio of a company, since repurchases reduce the amount of equity outstanding. Research has also shown that share repurchases increase the pay for performance sensitivity of employee compensation, which potentially leads to greater employee effort and higher stock prices.

On the other hand, skeptics have raised their concerns regarding the popularity of stock repurchases. The buyback habits have been criticized for being an earnings management device or a tool to drive up earnings per share without really enhancing company profits. Some firms use repurchases to compensate for earnings shortfalls so that they still meet analysts' EPS forecasts. Executives increase their firms' repurchases to offset the dilutive effect of securities such as employee stock options. Buybacks can therefore also be used to make management's stock options more valuable.

Another interesting point of criticism is that corporations shift resources away from value-enhancing investments such as research and development (R&D) and capital expenditures towards the expensive repurchases of company stocks. This frustrates policy makers, who point out that the record low interest rates should be a great stimulant for investment. Lower investment potentially harms the global economy and reduces employment, innovation and overall prosperity. By reducing corporate investment, the buybacks might also harm the long term profitability and competiveness of a firm. This triggered me to study the relationship between the usage of buybacks and corporate investment.

Buyback defenders often counter this view with the argument that investment rates have declined due to a shift from manufacturing to services and internet, which are inherently less capital-demanding (The economist 2014). This paper aims to contribute to the existing literature by studying how the increasing allocation to buybacks influences corporate spending on investment and human capital. Ultimately, this can be of major interest for economic policymakers, since investment and employment are two key factors in prosperity and economic development. The research question resolves around the motivations to use buybacks and investigates the relation between the usage of share repurchases and corporate investment.

1.2. Research question

What factors drive the decision to repurchase shares and what are the effects of corporate stock repurchases by companies in North-America on future corporate investment and employment for the years 1984-2014?

1.3. Findings and implications

Using annual data of NYSE, AMEX and NASDAQ constituents America for the years 1984-2014, empirical tests show that buybacks are strongly related to the existence of several firm characteristics. Logistic regression methodologies suggests that firms choose to repurchase shares when a range of conditions are met. I find a positive relationship between profitability (ROA), operational cash flow (CFO_r) and the use of buybacks. This makes economic sense, because buybacks are costly and preferably funded with intern ally generated cash. The evidence is also consistent with the agency costs theory, which posits that excess cash should be distributed to shareholders. Companies with large cash reserves show higher propensity to repurchase shares. The disciplining function of repurchases emerges in the negative relationship between leverage and the use of buybacks as well, as firms with conservative levels of debt are more inclined to repurchase shares.

To study the relationship between share repurchases and corporate investment, three investment outcome variables are considered. These are changes in capital expenditures, R&D expenses and employment. The empirical evidence supports the notion that companies are trading off investment for share repurchases. I find that repurchases are associated with a negative change in future capital expenditures, R&D and employment. The negative relation is observed over a one year period and over a three year period, which enables me to confirm the medium- to long-term presence of the effects as well. The negative relationship holds after controlling for growth opportunities, profitability and firm size.

In earlier literature, several attractive features of buybacks have been identified that can explain this trade off. Signaling- and market timing theories suggest that buybacks are a powerful tool to communicate stock undervaluation. It is well documented that the announcement of a buyback program causes a temporary stock price pop, which can explain the wide range use in all investigated industries. For long, the general tendency was that buybacks are an innocent and more flexible means of paying out excess cash than dividends. This paper contributes to the academic debate about the growing use of repurchases and its consequences. The allocation of corporate profits can temper overall economic prosperity, because the excessive use of buybacks is ultimately a form of disinvestment.

1.4. Structure

The paper proceeds as follows. In section 2, I provide an extensive review on earlier work on payout decisions, the motives for stock repurchases and the different methods for buying back shares. The criticism on buybacks and the relation with corporate investment is also discussed in more detail. The empirical analysis starts after discussing the literature. In section 3, I discuss the applied estimation methods extensively. First of all I investigate the motivations for doing a buyback by constructing a logit-model. This model allows me to distinguish several factors that influence the decision and probability to repurchase shares. Section 4 gives a description of the dataset. Then I proceed with the following step, where I empirically investigate the relation between stock buybacks on the one hand, and corporate investment, employment and profitability on the other hand. The research question resolves around this relation. The results are presented and discussed in section 5. Section 6 concludes and discusses the limitations and directions for future research.

2. Literature Review

2.1. The payout choice

Managers typically have two uses for company profits. Earnings can be kept inside of the company and used for investing in new or existing projects. In this way the company uses its profits to invest in the future and it chooses to expand or retain its business activities. Expanding the company in a profitable manner will lead to higher future profits and therefore an increasing share price. In some cases however, companies may feel that it is not wise to reinvest all earnings, for instance due to a lack of profitable investment opportunities. In this case it can be more efficient to return the excess profits to the shareholders in the form of payout.

Dividend have always been the dominant way for a company to return wealth to its shareholders. Although many theories have been put forward in the literature to explain the pervasive presence of dividends, they remain one of the puzzles in corporate finance (Allen, Bernardo & Welch 2000). The questions why corporations pay dividends and why investors pay attention to dividends are among the most frequently studied in corporate finance (Black 1976). Ignoring transaction costs and taxation, the choice between a common stock that pays a dividend or no dividend should theoretically be indifferent. The Modigliani-Miller theorem states that, under several assumptions, a dividend payment does not affect the value of a share or the return of an investor, because a higher dividend is compensated with lower capital appreciation and vice versa (Modigliani & Miller 1958 and 1961).

Lintner (1956) is one of the first people to conduct a comprehensive study on corporate dividend policies. Using data of 28 companies over the period 1947-1953, Lintner's model shows that there are two main determinants of corporate dividend decisions. The first parameter is the target payout ratio and the latter is the speed at which current dividends adjust to the target. The theory is developed upon two observations. According to Lintner, companies tend to set long-run target dividend ratios, dependent on the amount of positive projects or growth opportunities are available. Moreover, this dividend ratio is not changed until managers have faith that a new earnings level can be sustained. Lintner's work has served as a foundation for future research into the distribution of corporate income to shareholders.

Share repurchases were virtually non-existent until the 1980s. When a Securities and Exchange Commission (SEC) ruling in 1982 provided managers implementing open-market repurchases a legal safe harbor, the buyback phenomenon hit off. Nowadays they make up a bigger chunk of payout than dividends (Damadoran 2014). The remarkable surge of stock repurchase programs during the 1980s and 1990s is one of the most significant trends in corporate finance. The total value of all stock repurchased by US companies exceeded the amount paid out as cash dividends for the first time in 1998 (Grullon & Ikenberry 2000). According to aggregate data from Compustat, expenditures on share repurchase programs (relative to total earnings) increased from 4.8 percent in 1980 to 41.8 percent in 2000 (Grullon & Michaely 2002).

Prior research has shown that stock repurchases and dividends are used at different times from another (Jagannathan, Stephens & Weisback 2000). Grullon and Michaely (2002) show that share repurchases are funded with money that otherwise would have been used to increase dividends. There is an extensive literature on payout decisions and the choice between dividends and share repurchases in general. I review the reasons for the rise of the buyback phenomenon and discuss the incentives for both share buybacks and dividends. In this respect it is of vital importance to discuss the characteristics of companies who engage in share repurchases rather than dividends (or retained earnings) as well.

The choice of payout is a result of cash flow considerations. Both dividends and buybacks are used to distribute excess capital. This suggests that total payout increases with cash flow and realized earnings, which is an extension of Lintner's arguments. Jagannathan et al. (2000) reexamine Lintner's framework and come to the conclusion that stock repurchases are more pro-cyclical than dividends. Dividends increase more steadily over time and are paid by firms with higher operating cash flows, with a permanent character. Dividends are pervasive in that many companies have been paying regular cash dividends and are highly reluctant to lower dividend payments. In these cases, their investors may simply demand stable annual cash dividends, which is supported by the catering theory of dividends that is developed by Baker and Wurgler (2004). On the other hand, buybacks are used by firms with high temporary, non-operating cash flows. The flexibility argument for stock buybacks is confirmed by executives in a survey by Brav, Graham, Harvey, and Michaely (2005), and other academic papers. Skinner (2008) for example, finds that share repurchases have become increasingly sensitive to earnings.

Fama and French (2001) attribute the declining propensity to pay cash dividends to changing firm characteristics. First of all they find that the fraction of dividend payers has decreased from 66.5% of the listed firms in 1978 to 20.8% of firms in 1999. According to Fama and French, this decline can particularly be attributed to two reasons. Firstly, all types of companies show a declining propensity to pay dividends and secondly, the (financial) characteristics of listed companies have changed drastically over the course of the years. Many newly listed companies, such as tech stocks, have an asset base tilted towards intangible assets instead of fixed assets. Fed by these new listings, the population of public firms tilted more towards small firms. These companies are characterized by having lower profits and strong growth opportunities, characteristics of firms unlikely to pay dividends on a regular basis. DeAngelo, DeAngelo, and Skinner (2004) provide evidence that both dividends and earnings have become increasingly concentrated among a smaller group of American firms.

Another commonly suggested explanation for the increasing occurrence of buybacks is the market timing theory. According to this theory, managers use their knowledge of the firm to execute stock repurchases when they feel that the company's stock is undervalued. The positive market response and the ability to time the announcement of a buyback can be attributed to management's privileged information position regarding the companies' future earnings and growth opportunities. Compared to the management team, outside investors have a structural information disadvantage. The signaling

theory also builds on this principle. This theory assumes that managers opt for buybacks because they want to convince investors that they appraise the firms' value too conservatively. Another positive signal could be management's confidence that future commitments such as debt payments and capital investments can be covered without holding significant cash reserves. Yet, the news conveyed in the announcement of a buyback is not always taken as a positive signal. In fact, some managers are very reluctant to spend money on buyback programs because it may be regarded as a signal that no lucrative investment opportunities are ahead.

Earlier literature suggests that overall, the announcement of a buyback program is warmly welcomed by the market. The market timing theory is documented by Vermaelen (1981), Stephens & Weinbach (2000) and Dittmar (2000). When a company spends a lot of money buying back its own shares in an effort to exploit undervaluation, this implies that the market has discounted the shares too steeply. Asquith and Mullins (1986) indeed find that the market regards the announcement of a buyback program as a positive signal about the company's prospects. The market timing theory and the signaling theory predict positive abnormal stock performance surrounding the public announcement of a buyback program. The empirical prediction that managers utilize timing skills when doing buybacks is confirmed by Chan, Ikenberry and Lee (2007) and Brockman & Chung (2001). Ginglinger & Hamon (2007) find that French firms repurchase shares at a lower price than outsider investors. Dittmar and Field (2015) confirm this observation for US companies. In general, earlier research suggests that repurchases occur more frequently after a decline in the share price.

In an anonymous survey among financial executives, Brav, Graham, Harvey and Michaely (2005) find that share repurchases are initiated and/or accelerated when the company's stock price is low compared to recent historical standards. Although the warm reception from investors is an attractive feature of the buybacks, the survey answers do not provide convincing support for the signaling hypothesis. According to the market timing theory, managers will buy back shares when market valuations are low.

Another factor that will likely influence the choice between dividends and stock repurchases is taxation. Buybacks used to be a more tax-efficient vehicle to return money to shareholders than dividends in many jurisdictions. Before the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) reduced the maximum tax rates of dividends, the dividend taxes could be as high as 40% for retail investors, while the maximum long-term capital gains tax rate was 20%. The tax rate advantage of buybacks is something of the past in most countries around the world. In the United States for example, dividends and long-term capital gains are both taxed at 15% up to a certain income threshold (Blouin, Raedy & Shackelford 2011). An investor selling his stock will therefore have to pay (almost) the same tax rate on their gains from share repurchases as they would on the gains from dividends. There are however still some tax differences between dividend payments and buybacks.

One difference is that a dividend payment represents a definite taxable return, whereas a buyback represents a future return that is uncertain and on which the tax payment can be deferred until the investor

sells the shares. Corporate taxes can play a minor role as well. Corporate taxes may shrink marginally as a result of a share buyback, because its cost of capital falls from having less cash reserves and/or greater debt. The cost of capital is lower when a company uses some debt for financing, because interest payments are tax deductible while dividend payments are not. Additionally, since interest income is taxable, a company that holds large cash reserves puts investors at a tax disadvantage (Dobbs & Rehm 2005). Although tax systems vary per country, the differences in taxation are clearly less pronounced than they used to be in the 20th century.

David Zion of ISI, which is a research firm, indicates in an article in The Economist (2014) that American tax laws are not completely foolproof: "Buy-backs are weakening the balance-sheets even of the most cash-rich firms because of an oddity in American tax laws. Companies have to pay tax on foreign profits at the difference between America's rate of 35% and whatever they paid in the foreign country (often 20% or less)—but only if they bring the proceeds back to America. So, they hoard this cash offshore. Microsoft, General Electric, Google, Apple, Pfizer, Coca-Cola and Johnson & Johnson, among others, hold the majority of their cash overseas. Those firms in the S&P 500 that deign to disclose this have $650 billion of cash overseas, or two-thirds of their total".

A share repurchase affects a company's capital structure by reducing its cash holdings, and consequently its asset base. The cash expense simultaneously shrinks the shareholder's equity on the liabilities side. This means a company can change its capital structure by buying back outstanding equity. This process accelerates when a company issues debt to fund the buybacks. Therefore share repurchases can serve as a tool to increase the leverage ratio. Farre-Mensa, Michaely & Schmalz (2015) find that firms finance 32% of total aggregate payout in the capital markets, mainly through debt issues but also through equity. In an average year almost half of the firms engage in this payout-financing behavior, and it is widespread among both dividend-paying and repurchasing firms.

One could ask himself why a company would issue debt to buy back its own shares. The risk of a company essentially increases when equity is replaced with debt (and interest obligations). A leveraged buyback can be used to fend off hostile bidders by adding unwanted debt to the balance sheet, while at the same time it raises the share value (ideally). Another reason is that interest payments on debt are tax deductible, whereas dividends are not. Adding debt also reduces agency problems associated with substantial cash holdings.

It is evident that a share repurchase has a significant impact on the financial statements by reducing the outstanding shares. A by-effect is that many per-share measures of performance get an upgrade. Many commonly used metrics such as return on assets (ROA), return on equity (ROE) and earnings per share (EPS) increase because buybacks reduce the asset- and equity value on the balance sheet. These are used as the denominator value in the calculation. A buyback also helps to improve valuation multiples that relate to EPS, such as the price to earnings ratio. These effects are just temporary, because the ratios will revert to normal as earnings or return are forfeited when cash is spend on repurchases. Yet, managers

may still be inclined to pursue buybacks to boost these performance metrics in certain cases (Hribar, Jenkins & Johnson 2006). Brav et al. (2005) report that three out of four CEOs, CFOs, and treasurers in their survey stated that increasing EPS is a (very) important consideration in their stock repurchase decisions. Almeida, Fos and Kronlund (2016) use a regression discontinuity design to show that the probability of doing an EPS-motivated share repurchase is sharply higher for those firms who otherwise would have just missed their forecasted EPS.

Research by Bens, Nagar & Wong (2003) already showed that stock repurchase decisions could be explained by the dilutive effect of employee stock option (ESO) plans on diluted EPS. More specifically, executives increase the level of stock repurchases when the dilutive effect of outstanding employee stock options (ESOs) on diluted EPS increases and when earnings are below the level required to achieve a desired EPS rate. These findings suggests that executives' repurchase decisions are driven by incentives to manage diluted but not basic EPS. Managers feel the urge to "manage" EPS because investors reward consistent earnings growth and have a strong aversion to lower than expected EPS.

Kahle (2002) specifically examined the relationship between stock repurchases and employee options. The growing use of stock options in corporate compensation policies in the 1990s coincided with the dramatic increase in repurchases. Executives in charge of payout policy started to possess a significant amount of exercisable stock options. Two hypotheses relating growth in stock options to the increasing popularity of buybacks are examined. The option-funding hypothesis predicts that repurchases are used to fund the exercise of stock options. The substitution hypothesis distinguishes between executive options and employee options. The substitution hypothesis posits that employee options provide incentives to repurchase shares in order to compensate any earnings dilution by option exercises. Executive options however create an incentive to decrease dividend payments, as dividends reduce the manager's option value.

Both hypotheses are found to be true. Consistent with the option-funding hypothesis, managers are more inclined to do buybacks when many options have recently been exercised and when the value of exercisable options (as a percentage of shares outstanding) is high. When options outstanding are divided into exercisable and unexercisable options, the repurchase decision is positively related to total options exercisable, but unrelated to total unexercisable options. Unexercisable executive options however, have a positive effect on the repurchase decision. This reveals that the managers of these firms are more likely to buy back shares if their managerial option value would be negatively affected by dividend payments.

Kahle (2002) concludes that the emerging use of executive stock option compensation contributes to the increased use of repurchases instead of dividends. Kato et al. (2005) provide evidence for the Japanese market that repurchases are used to finance option-based compensation plans. Cheng, Harford and Zhang (2015) find that a company is more likely to conduct a buyback when the CEO's bonus is directly tied to an EPS measure. This effect is even more clear-cut when the company would just miss the EPS

threshold for a bonus award. Bonus-driven buybacks are not successful for other stakeholders in that they do not exhibit positive long-run abnormal returns.

I discussed earlier in this literature review that stock repurchases are an attractive alternative for dividends, especially when a firm generates highly volatile annual net earnings and cash flows. Dividend payments occur at the end of the year and are typically regarded as a non-flexible means of payout, whereas repurchases do not follow an annual time path. Although earnings drive the level of total payout and repurchases, other considerations play a significant role in explaining the announcement and timing of repurchases.

Grullon & Michaely (2004) consider the two most commonly found economic motivations behind the decision to repurchase shares: the signaling hypothesis (Vermaelen, 1981) and the free-cash flow hypothesis (Jensen, 1986). The first theory suggests that the information content of the announcement of a share repurchase is used to signal good future prospects of the firm. The latter theory poses that repurchases are used to decrease the amount of free cash flow available to managers. This explanation builds on the idea that management must be disciplined to prevent any overinvestment as a result of excess cash holdings. This possibly leads to a higher firm value if investors are worried that the abundant cash would otherwise be misused on exotic takeovers or lavish new headquarters.

The signaling hypothesis predicts that repurchase announcements are used to convey management's positive expectation about future earnings. Yet, the empirical evidence presented by Grullon & Michaely (2004) indicates that repurchasing firms experience no improvement in future profitability at all. What is more, their findings on operating performance suggest that analysts revise a firm's earnings expectations downward after the announcement of a share repurchase program, a notion that is confirmed by Jagannathan & Stevens (2003). The findings in Grullon & Michaely's paper are more in line with Jensen's free-cash flow theory. Repurchasing firms reduce their level of capital expenditures and research and development expenses. On top of that, these firms significantly reduce their cash reserves.

The empirical findings presented by Grullon and Michaely (2004) indicate that firms are likely to increase cash payouts in response to a decline in profitable investment opportunities, in line with the free cash flow hypothesis from Jensen (1986). The free cash flow theory argues that managers are inclined to overinvest (in non-profitable projects) when cash is abundant but growth opportunities are scarce. This is the case when the internal cash generating capabilities of the firm flourish and when new profitable investment opportunities start to get scarce.

Grullon and Michaely (2004) suggest that repurchases may be associated with a firm's transition from a higher growth phase to a lower growth phase. The dynamic model of Berk, Green & Naik (1999) is used to explain this suggestion. In this model, the value of a firm is the sum of the value of assets in place and the value of growth options. Firms that perform well tend to be those that have discovered

particularly valuable investment opportunities. As these investment opportunities are exploited the asset base growths and the investment opportunity set becomes relatively smaller. This stage is what Grullon and Michaely (2004) call the transition phase. During and after the transition, the future cash flows of existing projects (assets already in place) determine a large part of the value of the firm, whereas the option value of uncertain future projects determines a smaller chunk of the total value. The transition comes with a lower reinvestment rate, declining risk and therefore a lower cost of capital. The positive market reaction to repurchase announcements is, according to Grullon and Michaely (2004), a logical response to the declining risk and a reward for the limitation of agency conflicts. The latter finding is backed by the observation that the market reaction to a repurchase is more positive when the firm is more likely to overinvest.

2.2. Stock repurchase methods

A firm that wishes to repurchase its own equity can choose between three primary methods: open-market repurchases, tender-offer repurchases and Dutch auction repurchases (Stephens & Weisbach 1998). Comment and Jarrell (1991) compare the three most common ways of repurchasing securities and find positive abnormal announcement returns for all three types of repurchase arrangements. The strongest positive reaction is found in fixed-price tender offers, followed by Dutch auctions and open-market repurchases. In general, existing literature suggests that the more expensive the repurchase method, the larger the (short run) increase in shareholder value (Vermaelen 2006). Although this may seem counterintuitive at first sight, it actually makes sense because the more expensive the repurchase, the more trustworthy the signal is taken by investors. During the hostile takeover wave in the 1980s, it was not uncommon that firms repurchased shares privately from large investors. This method has gradually disappeared in recent years and will not be discussed in the remainder of this paper.

2.2.1. Open market repurchases

The most straightforward way is to repurchase the shares in the open market. Hribar, Jenkins and Johnson (2006) state that open-market repurchases account for approximately 95% of all repurchases announced during the 1990s. In an open-market repurchase, the equity issuer assigns a broker to periodically purchase its own shares directly from the market at the market price. This method provides the most flexibility as the company maintains the option of deciding whether, when, and how much to repurchase. Moreover, the SEC guidelines for open market repurchases are quite tolerant (Cook et al. 2003). Managers are allowed to buy fewer or more shares than announced at first or may even renounce the decision to repurchase shares completely (Stephens & Weisbach 1998). No binding obligation is incurred when a firm announces an intention to repurchase shares in the open market.

The method to purchase shares on the open stock market is cost effective, because it requires no negotiations with single shareholders. Large scale open market stock repurchases may significantly boost the demand for shares and thus positively affect prices. Each open-market repurchase program is to be approved by the company's board. To avoid potential liability for insider trading in connection

with the repurchase program, the company must publicly disclose information regarding the open market repurchase program. The disclosure of the following information is mandatory: the estimated time period during which the purchases will be made, the maximum amount of shares proposed to be acquired, the maximum of funds to be expended, the objective of the repurchase program, any plan or proposal relating to the disposition of the shares to be purchased, and an indication of how the purchases will be executed (Skadden 2013). SEC ruling 10b-18 forbids the issuer to repurchases more than 25% of the average daily trading volume.

Billett & Xue (2007) find evidence that firms use open market repurchases to deter unwanted takeovers. Firms who face a high takeover probability significantly increase their repurchase activity. Open-market repurchases deter would-be acquirers by a drop in cash reserves, increased insider ownership and higher leverage. The inherent flexibility of open market repurchase programs allows the target to quickly respond to hostile bids. Lie (2005) finds that the stock price reaction to the announcement of an open market repurchase is positive. He also documents that actual repurchases, and not the announcement itself, foretell future operating performance improvements. Andriosopoulos, Andriosopoulos & Hoque (2013) show that disclosing explicit information about the intended buyback program can serve as a strong signal of a firm's intentions to complete the intended buyback program.

2.2.2. Tender-offer repurchases

In tender offers, the company contacts shareholders and makes an offer to buy back a portion or all of their shares at a certain price within a certain near-term date (Lazonick 2014). The tender offer stipulates both the number of shares the company wants to repurchase and the price (range) they are willing to pay. Only the shareholders who find the offer agreeable tender their shares to the company. The shareholders who participate will state the number of shares they want to tender along with the price they are willing to accept. Once all the offers have been received by the company it buys the shares at the lowest cost. Frequently, officers and directors are banned from participating in the tender offer. The tender offer price is often at a premium to the market price. If the number of shares tendered is below the number of shares sought, the firm may opt to extend the offer's expiration date. The announcement of a tender offer does, in contrast to an open market repurchase, have legal meaning.

Tender-offers are relatively rare compared with open-market repurchases. The main reason for this is that tender offers are more costly because individual shareholders need to be contacted and the price premium that is typically involved. Dann (1981) and Vermaelen (1981) motivated the use for premium self-tender offers with the information signaling hypothesis. The thought behind this is that the market knows that a tender offer is costlier than the other repurchase methods and that the signal contains more information and therefore is more trustworthy. Comment & Jarrell (1991) find that tender-offers tend to be for the largest number of shares and result in the highest excess announcement return of all types of stock repurchases.

Vermaelen (1984) and Dann, Masulis, & Mayers (1991) show significant increases in EPS in the years after fixed-price repurchases take place. Bagwell (1991) suggests that tender offers may be used as a mechanism to counter a takeover threat. Li & McNally (2004) use a conditional event study to compare tender offer repurchases with open market repurchases and find that firms are likely to choose tender offers when they have financial slack and large shareholders who closely monitor the management team. Louis & White (2007) dive into the reporting behavior of firms and find evidence suggesting that managers intentionally use fixed-price repurchase tender offers to signal undervaluation. This is in line with the earlier findings of Comment & Jarrell (1991).

D'mello & Schroff (2000) employ an earnings-based valuation model to illustrate that managers engage in buybacks when their assessment of the firm's value exceeds the market valuation. The (perceived) undervaluation is then linked to a manager's choice for tender offer repurchases. They find that 74% of the firms repurchasing via fixed-price tender offers are undervalued prior to the tender offer, compared to just 51% of a control sample of non-repurchasing firms. On top of that, they find that the tender premium is highly correlated with the degree of undervaluation, which confirms that managers possess superior information. Consistent with this notion is the observation that the tender premium is on average lower than the magnitude of undervaluation.

2.2.3. Dutch auction repurchases

The introduction of the Dutch auction share repurchase in 1981 allows firms an alternative to the fixed price tender offer when executing a tender offer share repurchase. A Dutch auction offer specifies a price range within which the shares will ultimately be purchased. Shareholders are invited to tender their stock, if they desire, at any price within the stated range. The purchase price is the lowest price that allows the firm to buy the number of shares sought in the offer, and the firm pays that price to all investors who tendered at or below that price (Bagwell 1992).

Dutch auctions can be more appealing to a corporation than a fixed-price tender offer for a couple of reasons. First, it is often a cheaper way to buy back a specific number of shares than a fixed-price offer, since the company essentially repurchases only from the most pessimistic investors. Second, the most pessimistic investors are often the ones who would be the first to accept a hostile takeover bid. The last advantage is that the repurchase price is not fixed in advance. Instead it moves with the general tendency of the stock market, which can serve as a hedge against stock market crashes.

2.3. Motivations for stock repurchases

The considerations that are bespoken earlier in this literature review are issues that a manager typically faces when he or she is confronted with a payout decision. Broadly speaking, a firm can either retain its earnings or return the money to existing shareholders in the form of dividends or through repurchases. From the extensive body of literature on financial payout we can take a couple of conclusions regarding the advantages and disadvantages of the use of stock repurchases. These considerations allow me to distill several hypotheses regarding the motivations for using buybacks. In this paragraph I formulate

several predictions, which are based on earlier literature. These predictions serve as the foundation of this research paper.

An appealing characteristic of buybacks is the flexibility to use them. Whereas dividends are annual, recurring and sticky, buybacks offer flexibility as a manager maintains the option of deciding whether, when, and how much to repurchase. This advantage is especially important for companies with volatile earning patterns. Both forms of payout require vast amounts of cash, which is preferably generated internally. Therefore my expectation is that repurchasing firms are likely to generate high earnings and/or (operating) cash flows. The market timing theory suggests that managers can time the market. From this I can imply that buybacks are more likely to occur after a decline in the share price. The information signaling hypothesis predicts that repurchase announcements are used to convey positive news about the prospects of the firm. From this I infer that the share price will increase in the period after the announcement of a buyback program. These considerations allow me to deduce predictions 1-4.

Share repurchases inevitably alter the composition of a company's balance sheet significantly. The cash reserves shrink because cash is used to pay for the repurchases. This directly results in lower asset- and equity value. Buybacks therefore are an attractive tool for companies who wish to increase leverage. This process is accelerated when a company opts for a leveraged buyback, which is a repurchase paid for with debt financing. This specific type of buyback additionally increases the value of debt and is frequently used by under-leveraged companies. Increasing a company's debt ratio can be desirable when management attempts to fend off a hostile takeover. Apart from that, the tax shields of interest payments can lower the corporate tax bill. The agency theory further posits that taking on debt disciplines management and reduces agency costs associated with substantial cash holdings. Predictions 5-6 hold concern to the thoughts above on the relationship between leverage and buybacks.

Most financial and/or operating performance metrics use one or more balance sheet posts in the computation. Doing a buyback (temporarily) improves several commonly used ratios such as return on assets (ROA), return on equity (ROE), and earnings per share (EPS). For this reason, buybacks are frequently criticized for simply being an earnings management tool, without really enhancing the company's profits or its fundamental value (Lazonick 2014). Moreover, earlier research suggests that the proceeds from repurchases are used to fund the execution of employee stock options. Apart from the funding argument, repurchases are likely to be the attractive form of payout for managers who hold compelling amounts of stock options. The point is that dividends dilute the company's value (and therefore the value of stock options) by the amount of the total payout. Predictions 7 connects the use of buybacks to the costs of stock option exercises.

Most firms are follow a life-cycle trajectory from origin to maturity that is associated with a shrinking investment opportunity set. Young firms with a smaller equity- and asset base will be more likely to invest in expansion and growth opportunities than older firms. Earnings will therefore be kept inside the

company and reinvested in existing or new projects, whereas larger firms are more likely to payout abundant earnings in the form of repurchases or dividends. On the contrary, one would expect larger information asymmetries in smaller firms because they are typically followed by fewer analysts. This might stimulate the use of buybacks to exploit from more frequent undervaluation. Nevertheless, hypotheses 8 and 9 posit that repurchases are more likely for mature firms with lower growth opportunities and a large equity base.

2.4. Hypotheses for the use of buybacks

An overview of the hypotheses is enclosed below and in Table 1 in the appendix.

1. Companies will do buybacks when they have high earnings
2. Companies will do buybacks when they have volatile earnings
3. Companies will do buybacks when they have higher operational cash flows
4. Companies will do buybacks after a share price decline
5. Companies will do buybacks when leverage is low
6. Companies will do buybacks when they are prone to high agency costs
7. Companies will do buybacks when the cost of stock option exercises is high
8. Companies will do buybacks when there are limited investment opportunities
9. Big and mature companies with a large asset base will do more buybacks than smaller companies

2.5. Criticism on buybacks

Now that I have discussed the reasons for engaging in buybacks I can proceed with the next and perhaps more interesting part of the paper. That is, the effects that the popularity of the buyback phenomenon has on economically important variables such as corporate investment, employment, profitability and other factors. A great deal of attention has been paid to the simultaneous occurrence of relatively weak corporate capital investment (especially at contracting points in the business cycle) and the historically elevated level of share buybacks.

Earlier in this literature review I have provided multiple reasons for the popularity of buybacks among managers and shareholders. Most executives are happy with the existence of a more flexible alternative for dividends. According to accepted theories in finance and strategic decision making, a manager follows the following thinking path. Ideally they expand their empire/business by investing cash or external capital in any projects likely to produce positive returns. At some point the management will feel that profitable projects dry out. Then they pay out a steadily growing dividend, which is often appreciated by more defensive investors such as pension funds and life insurance firms. If there is any remaining cash flow, they use this to buy shares. What could be more sensible? The existing literature suggests that shareholders believe that buybacks are a good way of returning cash, since the announcement of a new repurchase program is typically applauded with a significant abnormal return, especially in the case of cash-rich companies.

However, not everyone greets the buyback surge with enthusiasm. Some say that managers misuse the repurchase programs to inflate earnings levels and to achieve short-term performance targets such as EPS. If a buyback is EPS-motivated, its validity should be questioned right away. Contrary to popular wisdom, increasing EPS does not increase a company's fundamental value. Cash is spend to purchase the shares, and investors will adjust their valuations to reflect the reductions in both cash and shares accordingly. The result is that any effect on EPS will eventually be cancelled out. Another very tempting feature of pursuing a buyback is the frequently observed short term boost of the share price. It is very tantalizing for a CEO to lock in his bonus – often linked to EPS and share price – by announcing a repurchase program. Research by Almeida, Fos & Kronlund (2016) and Cheng, Harford & Zhang (2015) has shown that bonus-driven repurchases do not exhibit long-run abnormal returns.

Another flaw relates to the perverse incentives to pay out cash through buybacks. Both investors and managers can be obsessed by the temporary "pop" that a buy-back on average gives to a share price. Stock option plans can also corrupt manager's motives, as Jolls (1998) shows. By buying existing shares they can offset the costs incurred for creating new shares in their personal stock-option plans without any cash leaving the firm (The Economist 2014). In addition, managers have a tendency to think that their companies' shares are undervalued at all times - regardless of the price. Any shareholder skepticism when a buyback is announced would thus be well founded. The legitimacy of the market timing and information signaling arguments are therefore frequently questioned. Zhang (2005) for instance, finds that repurchasing firms do not seem to exhibit superior abnormal performance over long horizons when they make actual share repurchases.

So far I have not mentioned the main point of discontent relating to share repurchases, which is that firms are skimping on long-term investment opportunities and do not exploit any growth options. Porter (1991), famous for his theories on economics and business strategy, points out that the repurchases are a form of disinvestment and that its widespread use is deplorable for competitiveness and innovation in an economy. In a survey of fund managers in July 2014 by Bank of America Merrill Lynch, investors called for companies to invest more in capital spending for the seventh month in a row. A record high of 71 percent judged that companies were underinvesting (Bank of America Merrill Lynch 2014).

Many policymakers follow Porter's reasoning and fear that buybacks are conducted at the expense of new investments. These worries are fueled by the slow recovery from the financial crisis of 2008. The post-crisis policy of most central banks and authorities is aimed towards stimulating the economy and many costly initiatives have been employed accordingly. Consider for instance the monetary policy of quantitative easing (QE), of which its ultimate objective is to boost investment through lower interest rates. We observe however that companies spend a lot of cash on repurchase programs instead of expanding its production facilities or research and development teams, undermining a rapid recovery from the recession. A similar claim applies to employment. Why does the profitability of certain companies not translate to new job opportunities or higher wages?

Lazonick (2014) has been studying the influence of allocation decisions for a long time and uses an article in the Harvard Business Review to send a powerful message, which is that the allocation of corporate profits tempers overall economic prosperity. In the previously mentioned article he illustrates how payout policies are to blame for the stagnating economy. The 449 companies in the S&P 500 index that were publicly listed from 2003 through 2012 used 54% of their earnings to buy back their own stock, mostly through open-market repurchases. These companies further spent an additional 37% of their earnings on dividend payments. This means that less than 10% of earnings is reinvested in the company. Hanauer (2015) goes a step further and connects the increasing usage of repurchases with the rising income inequality. Before the buyback era, corporate profits used to flow through the broader economy in the form of increased investments in plants and equipment or higher wages. Lazonick posits that buybacks drain profits out of the real economy into a paper-asset bubble, inflating share prices while no tangible value is produced.

It is worrisome that the allocation of company profits to R&D investments and human capital seems to take a back seat (also see figure 1). For long the general tendency was that everyone stands to benefit from the buyback wave. But these days even shareholders, the presumed beneficiaries, tend to agree that the use of repurchases has escalated. The call for action against the large-scale extraction of capital from the corporate sector has grown to be of significant importance.

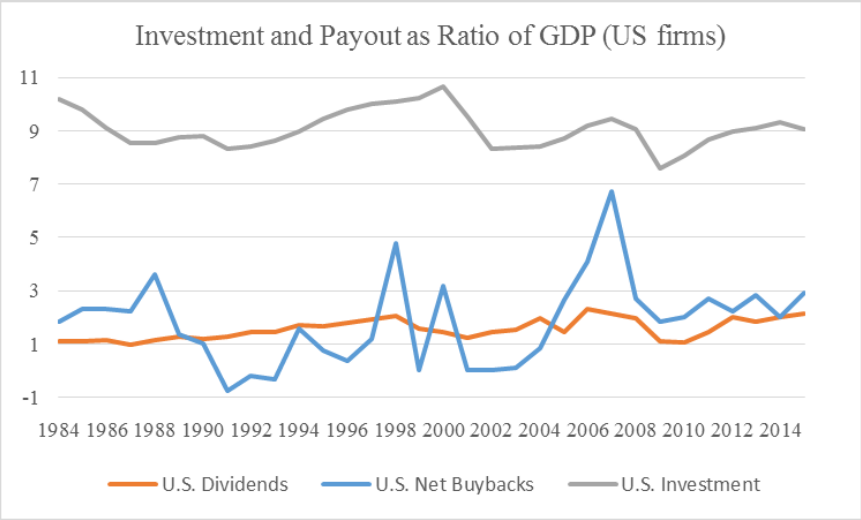


Figure 1: Investment and buybacks as ratio of GDP: United States from 1984-2014 (Source: Gruber & Kamin, 2017)

2.6. Relationship with payout, investment, employment and other factors

It is clear that resources that are used to payout dividends or buy back shares cannot be simultaneously used to increase a company's competitiveness through investments in productive competencies. Repurchases can be seen as a form of value extraction since cash essentially leaves the firm, whereas investments can be seen as a source of future value creation. The main goal of this study is to examine the relationship between the increasing usage of buybacks and factors that resemble and/or foster

economic growth and overall wealth. These indicators of wealth and growth can for instance be investment and employment and profitability.

I outlined earlier that repurchases are frequently blamed for deteriorating investment levels. Grullon & Michaely (2004) however, associate repurchases to firms who are in a transition from a higher growth phase to a lower growth phase. They argue that the observed negative correlation between stock repurchases and investment is driven by variation in growth opportunities and marginal investment opportunities. According to this theory, the existing assets of a firm generate levels of cash that cannot be satisfactory reinvested in new business opportunities. Hence, it is more efficient to use the excess cash to repurchase shares. Indeed, the relationship between buybacks and corporate investment has characteristics of a chicken-and-egg situation.

The rise of repurchases is also frequently justified as a necessary response to new challenges faced by manufacturing companies and changes in technology and competition. The economy in most developed (Western) countries has shifted from capital- and labor intensive industries towards higher-value-added work in high technology and services industries, to some degree triggered by more favorable manufacturing conditions in Asian (developing) countries. Gutierrez and Philippon (2016) show that corporate investment in the United States has fallen below levels justified by Tobin's Q, a measure of the prospective profitability of investment projects. There has been more research that links repurchases to weak investment. Lee, Shin, and Stultz (2016) find that even industries with high Tobin's Q tend to drain resources in heavy share repurchases, at the cost of investment spending.

Almeida, Fos & Kronlund (2016) have recently studied the real effects of EPS-motivated share repurchases. Their findings suggest that managers frequently trade off investments and employment for stock repurchases that allow them to meet analyst EPS forecasts. Such companies decrease employment, capital expenditures, and R&D in the years following increases in EPS-induced repurchases. Almeida et al build on an earlier study by Bens, Nagar & Wong (2003). Bens et al find that executives' repurchase decisions are driven by incentives to manage diluted EPS. Stock-based instruments nowadays make up the majority of the compensation of the executives of U.S. public companies. Bens et al (2003) illustrate that these executives increase the level of repurchases when the dilutive effect of outstanding employee stock options (ESOs) increases. Hribar, Jenkins & Johnson (2006) find that the market heavily discounts EPS-motivated repurchases. This is evidence that repurchases induced by management's personal interests leave the company worse off.

The most challenging part in this line of research is to establish a causal relation. It has already been shown that repurchases (or payout in general) are negatively correlated to investment. The premise underlying this relation is that any firm follows a life-cycle trajectory from origin to maturity that is associated with a shrinking investment opportunity set (Bulan & Subramanian 2009). Another interpretation on this point is that investment is actively reduced to finance repurchases and dividend payout. A big contribution to the existing literature would be to establish a causal effect of repurchases

on other firm policies, more specifically that the use of repurchases leads to lower investment, employment and profitability. For the main remainder of the research I hypothesize that buybacks temper corporate investment levels. The causal connection between equity buybacks, on the one hand, and capital expenditures and investment, on the other, is however difficult to establish. The next section will outline the methodologies applied in the research and explains how I cope with the causality issue. The first part deals with the factors influencing buyback behavior, while the second part of the paper focuses on the consequences of doing buybacks in terms of corporate investment.

3. Methodology

3.1. Measure for repurchases

To address the research question in a convincing manner, actual share repurchases must be identified accurately. Researchers that have studied buybacks have used several methods to compute the actual amount of repurchases. Banyi, Dyl & Kahle (2005) assess how accurately actual repurchases can be estimated using data from both CRSP and Compustat and find that Compustat purchases of common and preferred stock (adjusted for the change in preferred stock) are the most accurate measure of actual repurchases. Table 2 in the paper of Kahle et al. (2005) categorizes previous research papers according to the source of their repurchase data. It is evident that most researchers use either the "Changes in Treasury Stock from Compustat" or the "Purchases of common stock from Compustat" method.

In this paper I follow the methodology of Fama & French (2001), Skinner (2008) and Almeida et al (2015), who measure buybacks as net repurchases. Net repurchases are computed using Compustat data on the changes in treasury stock. This measure nets out associated stock issuances, removes the effect of share purchases for employee stock option programs, the funding of acquisitions and other corporate purposes. This is the most commonly used and most accurate measure for repurchases. I use the increase in common treasury stock (#226) if this variable is not zero or missing. If the variable treasury stock is equal to zero or not available, the company uses the 'retirement method' instead of the 'treasury stock method'. For those firms who use the 'retirement method' I measure repurchases as the difference between "Purchase of Common and Preferred Stock" (#115) and "Sale of Common and Preferred Stock" (#108) from the statement of cash flows. The firm is deleted from the sample if no data is available for both methods. It is preferable to use the first method, rather than net purchases, since the change in treasury stock nets out any associated issuances. If either of the two methods results in a negative value for repurchases, I set the amount to zero.

I also use a dummy variable for repurchases, with value 1 if net repurchases for firm i in year t are positive, otherwise the value is set to 0. The dummy variable is used to split up the entire sample in a subsample with repurchasing firm-years and non-repurchasing firm-years (see Table 10 in the data section for the results). Panel D shows the results from a mean comparison test. For an overview of all variables, please see Table 2 in the appendix.

It is important to have more information about the firms' repurchase activities than just net value of annual repurchases alone. The previous method is useful for calculating the dollar amount spent on (net) repurchases by a certain firm in a given year. The absolute amount is however not very useful for comparing multiple firms, because firms vary in size and have other distinct characteristics. Therefore a relative ratio for repurchase activities is computed as well. The relative size of a repurchase program is crucial for determining the impact on future investment, employment, payout, profitability and the other firm indicators. The ratio compares the value of net repurchases by a firm in year t to the value of assets at the end of last year. The completion of a buyback scheme typically takes longer than a year.

Therefore I am also specifically interested in the behavior and effects of firms who start repurchasing shares. To disentangle firms who occasionally use buybacks from the firms who make a habit of repurchases, I use a dummy variable for the start of a buyback program. The dummy variable has value 1 if the firm has positive net repurchases in this year and non-positive net repurchases in the previous year.

For dividend payments I use the total amount of dividend payments (other than stock dividends) during the year, an income statement item. Again a dummy variable is created, with value 1 if dividend payments for firm i in year t are positive, otherwise 0. The dividend payment during the year is subsequently scaled against the value of assets at the end of last year, which gives a relative ratio of dividends. The data for repurchases and dividends are combined to generate the variables total payout, dummy payout, and payout ratio (as of beginning total assets).

Table 3-6 provide descriptive statistics on repurchases and dividend payments (total sample, per year, per industry). From Table 3 it becomes clear that the mean values for repurchases and dividends are heavily influenced by some very high values, as the median value is lower than the mean. Table 4 provides annual payout data, which shows us that aggregate payout is increasing at a steady pace over time (positive trend) and is positively correlated with the market conjuncture. It is also clear that repurchases are more cyclical than dividends, which supports the notion that buybacks are a more flexible means of payout than dividends. This is preliminary evidence for hypothesis 1, which posits that repurchases are done by companies with volatile earnings- and cash flows patterns. The propensity to use repurchases as a means of payout exhibits a positive trend, whereas the propensity to use dividends is relative persistent (Also see figures 4-6 in the data section). The average (and aggregate) amount spent in a firm-year on repurchases and dividends increase during our sample period, which are reason to use time controls in the form of the variable “Period”, which splits up the entire sample in five periods.

Table 3: Payout statistics

Net repurchases are calculated as the increase in common treasury stock (Compustat item 226). If treasury stock is 0 or not available in the current and prior year, net repurchases are measured as the difference between stock purchases (item 115) and stock issuances (item 108) from the statement of cash flows. If either of these two amounts is negative, repurchases are set to 0. Data on repurchases are not always available. D_Rep is a dummy variable for repurchase activity, with value 1 if firm i repurchases shares in year t, otherwise 0. Rep_start is a dummy variable for the start of repurchase activity, with value 1 if D_rep is 1 in this year, and 0 in the previous year. Otherwise Rep_start is 0. Repurchase ratio is the amount spent on net share repurchases of firm i in year t, normalized by total end of the year assets of firm i in year t-1. Dividends are calculated as the total (non-stock) dividend payments during the year. Payout is the sum of dividends and repurchases.

	N	Mean	Min	p25	Median	p75	p95	Max	SD	Skewness	Kurtosis
D_rep	84491	0.350	0	0	0	1	1	1	0.48	0.63	1.39
D_Rep(start)	76859	0.117	0	0	0	0	1	1	0.32	2.39	6.71
Repurchases (net)	84491	63.18	0	0	0	0.88	177.80	44,270	551.25	29.55	1,437
Repurchase ratio (assets)	84486	0.014	0	0	0	0.004	0.078	5.483	0.05	27.80	2,025
D_div	84248	0.385	0	0	0	1	1	1	0.49	0.47	1.22
Dividends (net)	84248	67.87	0	0	0	4.323	204	67,644	516.65	39.67	3,924
Dividends ratio (assets)	84244	0.016	0	0	0	0.012	0.055	75.71	0.39	148	24,675
D_payout	84248	0.556	0	0	1	1	1	1	0.50	-0.23	1.05
Payout (net)	84491	130.85	0	0	0.19	14.12	429.00	69,303	907.46	23.53	999.33
Payout ratio (assets)	84243	0.027	0	0	0.00	0.026	0.118	63.53	0.24	230	60,829

Table 4: Payout statistics per year

This table summarizes the payout statistics per year. D_rep, D_div and D_payout are the mean values of the dummies. Avg. amount displays the average million dollar value of respectively a buyback, dividend, and total payout per firm. Agg. Amount displays the aggregate million dollar value spent on respectively repurchases, dividends and total payout per year.

Year	N	D_Rep	Avg. rep.	Agg. Rep.	D_Div	Avg. Div.	Agg. Div.	D_payout	Avg. Payout	Agg. Payout
1984	361	-	-	-	0.438	6	2,127	-	6	2,127
1985	1810	0.219	1	292	0.506	21	37,183	0.546	21	37,474
1986	1933	0.308	12	19,377	0.506	20	39,444	0.615	30	58,821
1987	2067	0.380	16	29,221	0.453	21	44,124	0.621	36	73,345
1988	2073	0.356	16	30,609	0.458	24	49,040	0.606	38	79,650
1989	2076	0.311	14	26,897	0.467	27	55,883	0.591	40	82,779
1990	2133	0.358	12	23,448	0.460	30	63,089	0.605	41	86,456
1991	2234	0.264	7	14,223	0.446	29	64,672	0.561	35	78,895
1992	2437	0.231	8	17,977	0.431	27	66,925	0.534	35	84,902
1993	2702	0.244	8	18,196	0.413	26	70,167	0.524	33	88,364
1994	2887	0.260	10	25,545	0.386	26	76,107	0.512	35	101,652
1995	3203	0.270	20	55,325	0.370	28	90,281	0.495	46	145,607
1996	3563	0.277	19	57,537	0.359	28	98,267	0.487	44	155,803
1997	3689	0.302	27	88,883	0.357	28	101,573	0.498	52	190,453
1998	3628	0.386	34	116,372	0.356	36	131,150	0.564	68	247,522
1999	3706	0.390	36	122,203	0.350	32	118,269	0.564	65	240,473
2000	3784	0.370	42	144,006	0.336	34	128,470	0.526	72	272,457
2001	3606	0.342	33	115,384	0.312	39	140,622	0.511	71	256,005
2002	3503	0.323	38	129,990	0.315	42	145,339	0.515	79	275,330
2003	3458	0.309	42	142,037	0.343	49	168,454	0.508	90	310,487
2004	3504	0.292	64	211,174	0.363	61	213,358	0.503	121	424,533
2005	3511	0.331	103	341,050	0.370	78	274,359	0.531	176	615,409
2006	3536	0.376	142	474,306	0.362	84	295,322	0.543	218	769,628
2007	3611	0.402	165	553,210	0.360	105	378,378	0.564	259	931,587
2008	3448	0.468	117	390,538	0.357	105	360,597	0.622	218	751,135
2009	3376	0.349	46	152,584	0.342	103	347,954	0.549	148	500,538
2010	3379	0.383	84	270,049	0.360	107	361,037	0.574	187	631,086
2011	3377	0.440	138	441,469	0.377	125	420,538	0.618	256	862,007
2012	3349	0.437	108	343,748	0.415	137	457,871	0.630	240	801,618
2013	3425	0.422	139	444,761	0.411	160	544,281	0.626	290	989,042
2014	3532	0.440	166	537,784	0.403	144	506,695	0.623	296	1,044,479
Total	92901	0.350	63	5,338,196	0.381	63	5,851,577	0.556	121	11,200,000

Table 5 gives payout data for subsamples based on SIC codes. The differences between the sectors are noteworthy and reason to observe the industries separately as well. The sectors vary significantly in the number of observations, the biggest sector comprising of manufacturing firms and the smallest administration and other firms (see Table 6).

Table 5: Payout data per sector

This table summarizes the payout statistics per sector. D_rep, D_div and D_payout are the mean values of the dummies. Avg. amount displays the average million dollar value of respectively a buyback, dividend, and total payout per sector. Agg. amount displays the aggregate million dollar value spent on respectively repurchases, dividends and total payout per sector. Also see figures 4-6, which present these numbers graphically.

Sector	D_Rep	Avg. repurchase	Agg. repurchase	D_Div	Avg. dividend	Agg. dividend
Resource	0.300	38	250,224	0.446	65	467,109
Manufacturing	0.346	65	2,908,252	0.396	71	3,450,114
Transportation & public utility	0.345	108	693,794	0.504	153	1,082,773
Wholesale & retail	0.400	63	595,491	0.415	30	308,122
Service	0.357	47	799,992	0.258	19	368,509
Administration and other	0.281	168	90,443	0.303	275	174,951

Table 5: Payout data per sector (continued)

Sector	D_payout	Avg. payout	Agg. payout
Resource	0.594	99	717,334
Manufacturing	0.550	131	6,358,339
Transportation & public utility	0.653	250	1,776,567
Wholesale & retail	0.609	87	903,530
Service	0.495	62	1,168,501
Administration and other	0.467	417	265,393

Table 6: Distribution per sector

This table summarizes the amount of observations for six sectors. Firms are assigned to six different sectors based on their SIC Codes. Note that financial firms (SIC 6000-6999) and regulated utility firms (SIC 4900-4949) are deleted from the sample, because those firms are often subject to regulation that impairs their ability to repurchase shares.

Sector	SIC Code	N
Resource firms	<2000	7256
Manufacturing firms	2000-3999	48565
Transportation & public utility	4000-4999	7103
Wholesale & retail firms	5000-5999	10366
Service firms	7000-8999	18962
Administration and other firms	>8999	649
Total		92901

Table 7 shows that the correlation between the use of repurchases and the use of dividends is positive but close to zero (0.19). When both sources of payout are scaled to total assets, their correlation is negligible (the correlation between Rep_A and Div_A is 0.00). The transition probabilities in panel B of Table 7 report the change in payout behavior over time. The row values present the initial values, whereas the column values reflect the final values. The number 82.05 in the upper left corner therefore indicates that 82.05% of firms who do not repurchase in year t will not repurchase in the next year (t+1) either, whereas 17.95% will start buying back shares in the next year. The results indicate that firms are more likely to change their repurchase policy than their dividend policy, which is in line with hypothesis 1. The first hypothesis posits that repurchases are a more flexible means of payout than dividends.

Table 7: Payout interactions

This table contains the correlation coefficients between the payout variables. This is used to investigate the dependence between multiple variables. Panel A gives correlations between dummy variables. Panel B gives correlations between scaled payout variables (as of assets). Panel C displays the transition probabilities for the dummy variables. The number 82.05 in the upper left corner indicates that 82.05% of firms who do not repurchase in year t will not repurchase in year t+1 either, whereas 17.95% will start buying back shares in the next year.

A: Payout dummies correlation matrix

	D_Rep	D_Div	D_Payout
D_Rep	1.00		
D_Div	0.19	1.00	
D_Payout	0.66	0.71	1.00

B: Payout ratio correlation matrix

	Rep_A	Div_A	Payout_A
Rep_R	1.00		
Div_R	0.00	1.00	
Payout_R	0.63	0.05	1.00

C: Transition probabilities

D_Rep	0	1	Total
0	82.05	17.95	100.00
1	29.17	70.83	100.00
Total	63.49	36.51	100.00
D_Div	0	1	Total
0	94.68	5.32	100.00
1	9.22	90.78	100.00
Total	61.5	38.5	100.00
D_Payout	0	1	Total
0	80.48	19.52	100.00
1	13.04	86.96	100.00
Total	42.64	57.36	100.00

3.2. Linear versus logistic regression model

The first part of the study focuses on the motives and factors influencing the choice for employing a share repurchases. In the literature review several reasons to do a buyback have been examined. I use the observations in these earlier studies to form several hypotheses regarding the use of buybacks, which are now tested empirically. The literature discussion suggests that the probability of buying back shares increases for firms with high and volatile earnings and cash flows, low debt (leverage) and high cash reserves. My expectation is that buybacks are more likely when the cost of stock option exercises is high and when the share price has recently declined (market timing).

Summary statistics provide some information regarding the differences in firm characteristics between repurchasing firms and non-repurchasing firms. Regression analysis provides better and more detailed information on a firms' propensity to buy back shares. Regression analysis allows me to draw interferences on how the presence of several firm characteristics are related to (the probability of) a repurchase by firm i in year T. The dependent variable is the dummy variable for repurchase (value 1 if net repurchases for firm i in year t is positive, otherwise 0). The dependent variable is thus not continuous, but categorical (binary).

The purpose is to examine the factors that influence the decision of firm i to repurchase shares in year t. If the binary variable Y is used as the outcome variable with a continuous variable X as the predictor

variable, the fitted regression line does not give a good representation of the relationship. A better alternative is to model the probability that outcome Y = 1 occurs. I start examining a simple linear regression approach. The linear probability model assumes that dependent variable $P(Y_{it})$ is a linear function of the regressors:

$$P(Y_{it}) = \boldsymbol{x}_{it}\boldsymbol{\beta} + c_i + u_{it} \qquad \text{(i=1,…,N, t=1,…,T)} \qquad (1)$$

Where Y_{it} is the (binary) response variable, $\boldsymbol{x}_{it}$ is a 1 x K vector of observed explanatory variables (including a constant), $\boldsymbol{\beta}$ is a K x 1 vector of parameters, c_i is an unobserved time invariant individual (fixed) effect and u_{it} is the residual with mean equal to zero. The interpretation of the function is relatively straightforward. If β_2 is 0.1, it means that a one-unit increase in x_{2it} is associated with a 10 percentage point increase in $P(Y_{it})$. The conditional probability that Y is one is equal to the conditional expected value of Y. If the model is specified correctly, I have the following binary response model:

$$P(Y_{it} = 1|\, x_{it}c_i) = x_{it}\beta + c_i \qquad (2)$$

In this model the probability of a repurchase (Y=1) is a linear function of the explanatory values in the vector x. The disadvantage of this model is that it can generate predicted probabilities outside the (0,1) interval. In addition, the errors or residuals from the linear model are likely to violate the homoskedasticity and normality of errors assumptions. Linear models assume that residuals are normally distributed, which means that the response variable should be continuous and unbounded. Using linear regression models with a categorical (binary) response variable therefore result in invalid standard errors and invalid hypothesis tests (Long 1997 p. 38-40). The relationship between $P(Y_{it})$ and the continuous independent variables is not linear, but sigmoidal (S-shaped).

This is where the logistic regression model comes into play. A logistic (or logit) regression model addresses the previously mentioned problems and allows to establish a relationship between the binary dependent variable and (a group of) independent variables. The logistic function is useful because it can take any real input, whereas the output always takes values between zero and one, and can hence be interpreted as probability. Probit is a common alternative for logit, but I prefer a logit function because its results are relatively easy to interpret.

Logistic regression uses a logit link function, which is a function of the mean of the response variable Y instead of a function of Y itself. The logit link is appealing because it produces a linear model for the log of the odds (Rabe-Hesketh & Skrondal 2008, chapter 3 & 10). The odds of the dependent variable equaling a case (given some linear combination of the predictors) is equivalent to the exponential function of the linear regression expression. This illustrates how the logit serves as a link function between the probability and the linear regression expression.

The general nonlinear binary response model is written as follows:

$$P(Y_{it} = 1|\, x_{it}) = G(\beta_1 + \beta_2 x_2 + \cdots + \beta_K x_K) \qquad (3)$$

$$P(Y_{it} = 1|\, x_{it}) = G(\boldsymbol{x}_{it}\boldsymbol{\beta}) \quad (4)$$

Where G is the logit link function taking on values strictly between zero and one: $0 < G(z) < 1$. The index $\boldsymbol{x}_{it}\boldsymbol{\beta}$ is a scalar. $G(\boldsymbol{x}_{it}\boldsymbol{\beta})$ is thus bounded by 0 and 1, which ensures that the estimated response probabilities are between zero and one. The logit transformation maps probability ranging between 0 and 1 to log odds from -∞ to +∞. G is a cumulative density function, monotonically increasing in the index z (i.e. $\boldsymbol{x}_{it}\boldsymbol{\beta}$).

Logit functions are increasing in $x\beta$ and increase quickly at $x_{it}\beta = 0$, while the effect on G at extreme values of $x_{it}\beta$ tends to zero (also see figure 2). Logistic regression thus measures the relationship between a binary dependent variable and the independent variables by estimating the probabilities using a logit function, which is the cumulative logistic distribution. It models the logit-transformed probability log [p/(1-p)] as a linear relationship with the predictor variables and its parameter values via conditional maximum likelihood (Chamberlain 1984, p. 1274-1278). To maximize the likelihood function an iterative process must be used, which converges as soon as no more improvement is made:

$$Logit(p) = Log[p/(1-p)] = \beta_1 + \beta_2 x_{2it} + \ \ldots + \beta_K x_{Kit} + c_i \quad (5)$$

$$Log[p/(1-p)] = \boldsymbol{x}_{it}\boldsymbol{\beta} + c_i \quad (6)$$

Where $\boldsymbol{x}_{it}$ is a 1 x K vector of observed explanatory variables (including a constant), $\boldsymbol{\beta}$ is a K x 1 vector of parameters and c_i is an unobserved time invariant individual effect. The estimates of β give the greatest likelihood of observing the outcomes in the sample, conditional on the explanatory variables x. I use individual intercepts (c_i) instead of fixed constants for the sample, so that firms serve as their own controls. This type of regression is called conditional- or fixed effects logistic regression. Each estimated coefficient (β) is the expected change in log odds (of a given firm i doing a repurchase in year t) for a unit increase in the corresponding predictor variable (x), holding the other predictor variables constant.

A disadvantage of logistic regression is that the coefficients are more difficult to interpret than the coefficients in linear probability models. Working with log odds is not intuitive, it is therefore helpful to have odds ratios. For this, both sides of the regression equation must be exponentiated. It follows from the last equation that the logit model can be expressed as an exponential function of the odds:

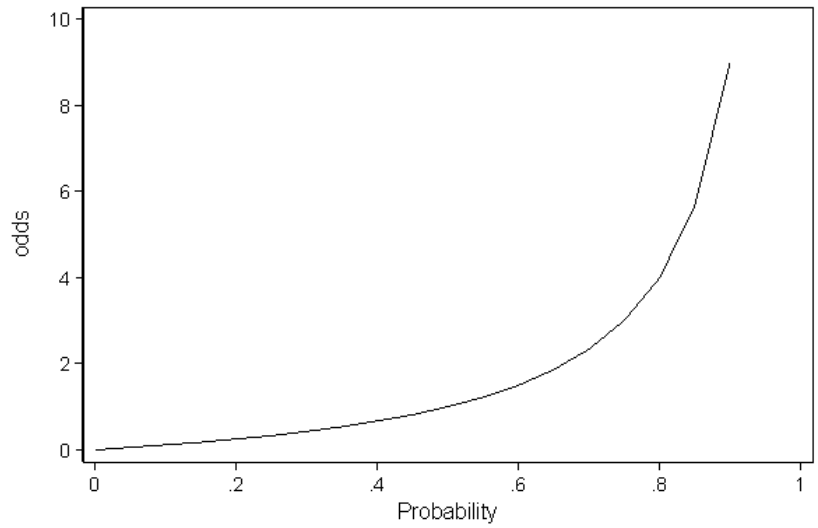
$$Odds(Y_{it} = 1|\, x_{it}) = \exp(\boldsymbol{x}_{it}\boldsymbol{\beta} + c_i + u_{it}) \quad (7)$$

Because the relationship between odds and probabilities is as follows:

$$Odds = P/(1-P) \quad (8)$$

$$\text{P} = Odds/(1+Odds) \quad (9)$$

Figure 2: Plot of odds against probabilities



Example: If the probability of a repurchase by firm i in year t is 0.8, then the probability of not doing a repurchase is 0.2. The odds of a repurchase are then defined as 0.8/0.2 = 4.

Stata has a built-in option to exponentiate the coefficients of log odds, so that the coefficients can be interpreted as odds-ratios. The coefficient for odds ratio give the change in the odds of the outcome Y (a given firm i doing a repurchase in year t) for a one unit increase in the corresponding predictor variable x, which is a more understandable measure. See figure 2 and 3 for further explanation on working with odds and odds ratios.

Figure 3: Interpretation of odds ratio (doubling odds)

Before doubling odds		After doubling odds	
Probability	Odds	Odds	Probability
10%	0.11	0.22	18%
20%	0.25	0.5	33%
30%	0.43	0.86	46%
40%	0.67	1.33	57%
50%	1	2	67%
60%	1.5	3	75%
70%	2.33	4.67	82%
80%	4	8	89%
90%	9	18	95%

Notes:
- Odds = p/(1-p)
- Odds ratio coefficient of 2 means that a one-unit increase in x doubles the odds that Y is 1
- Doubling odds is not the same as doubling probability:
- If p is close to 0, then doubling odds is almost the same as doubling probability
- If p is close to 1, then doubling the odds is almost the same as halving 1-p

3.3. Regression framework (motives for share repurchases)

The dummy indicator for repurchases serves as the dependent variable in my regression model. Because this is a binary variable, a logistic regression model is the appropriate econometric technique to test the hypotheses regarding the use of buybacks. The regression results will complement the evidence that is

provided in the summary statistics and will allow me to confirm or reject the hypotheses in section 2.4. These hypotheses resemble several factors of which I expect that they influence the decision to repurchase shares. These factors are profitability (ROA), volatility of earnings, operational cash flow, lagged annual stock return, debt ratio, cash ratio, option expense ratio, growth opportunities (Tobin's Q), size (Log Assets) and the market stock return. The estimation equations of the regression models can be found in Table 8. The coefficients (betas) of the regression models will outline the effect of the factors on the buyback choice.

Table 8: Regression models (motives for share repurchases)

This table reports the (fixed-effects) regression equations for the first part of the study, the factors likely to influence the probability a firm repurchases shares. The hypotheses regarding the factors and their proxy can be found in Table 1. All estimations use fixed effects logit regression models, where parameter values (β) are estimated using maximum likelihood.
- Model 1 in Panel A is a univariate logit regression model, which tests all hypotheses independently of each other.
- Model 1 in Panel B combines multiple independent variables in one logit regression model (tests all hypotheses jointly).
- Model 2 is an extension of model 1, and adds the lagged value for the outcome variable as independent variable.
- Model 3 is an extension of model 2, and adds the average market stock return as independent variable, controlling for market conjuncture effects.
- Model 4 is an extension of model 3, and adds a variable that identifies the time trend (period: which splits sample in quintiles based on year).
- Model 5 is also an extension of model 3, and adds year dummies to control for time effects.
- Model 6 is an extension of model 4, it adds the industry dummies so that model 5 is estimated separately for each industry.
- β_1 is the coefficient corresponding to independent variable x_{1it}.
- The probability p is the probability that Y_{it} is 1 (the probability that firm i has positive net repurchases in year t).
- The dependent variable Log [p / (1 − p)] is the natural log of the odds p/(1-p).
- The outcome variable Y_{it} is a dichotomy dummy variable for repurchases, with value 1 if net repurchases for firm i in year t are positive, otherwise 0.

Panel A: Univariate logistic regression models

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \varepsilon_{it} \quad (\ldots) \quad Log\,[p\,/\,(1-p)] = \beta_{1it} Vol(Netincome)_{1it} + \varepsilon_{it} \quad (\ldots) \quad \text{etc.} \tag{1}$$

Panel B: Multivariate logistic regression models

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9 \text{Log}(Assets)_{9it} + \varepsilon_{it} \tag{1}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9 Log(Assets)_{9it} + \beta_{10}\ D(Rep)_{10i,t-1} + \varepsilon_{it} \tag{2}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9 \text{Log}(Assets)_{9it} + \beta_{10}\ D(Rep)_{10i,t-1} + \beta_{11}\ Ret(Market)_{11it} + \varepsilon_{it} \tag{3}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9\ Log(Assets)_{9it} + \beta_{10}\ D(Rep)_{10i,t-1} + \beta_{11}\ Ret(Market)_{11it} + \beta_{12} Period_{12t} + \varepsilon_{it} \tag{4}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9\ \text{Log}(Assets)_{9it} + \beta_{10}\ D(Rep)_{10i,t-1} + \beta_{11}\ Ret(Market)_{11it} + \beta_t YearFE_t + \varepsilon_{it} \tag{5}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ROA_{1it} + \beta_2 Vol(Netincome)_{2it} + \beta_3 CFO_A ratio_{3it} + \beta_4 Stock\ return_{4i,t-1} + \beta_5 Debt\ ratio_{5i,t-1} + \beta_6 Cash\ rate_{6i,t-1} + \beta_7 Optionexpr_{7i,t-1} + \beta_8\ TobinsQ_{8it} + \beta_9\ \text{Log}(Assets)_{9it} + \beta_{10}\ D(Rep)_{10i,t-1} + \beta_{11}\ Ret(Market)_{11it} + \beta_t YearFE_t + Dum(Industry)_i + \varepsilon_{it} \tag{6}$$

First I test the formulated hypotheses individually using univariate regressions. All hypotheses link one firm characteristic (proxied by a variable) to the use of buybacks. The variable of interest of a specific hypothesis is used as the only explanatory variable in the estimation equation, so that an individual coefficient for all variables is obtained. A positive regression coefficient indicates that there is a positive relation between the predictor variable and the dependent variable. Then I run all univariate regressions in one regression model, testing all hypotheses jointly in one estimation. The third specification adds robustness to the model by including the lagged dummy variable for repurchases as independent variable. The fourth model controls for stock market conjuncture, as it has been shown that repurchases occur more frequently in bull markets. To control for time effects, the variable period is incorporated in model 5. This variable splits up the sample in five sub periods.

The effects of the independent variables can be modeled using either random- or fixed-effects. The difference with a random-effects model is that a fixed-effects model cannot estimate time-invariant (stable) factors directly, whereas random-effects models can. The variation across firms is assumed to be random and uncorrelated with the predictor variables in a random-effects model. A fixed-effects model controls for unobservable temporally constant firm-specific (within) effects, whereas a random-effects model does not. Fixed effects methods help to control for omitted variable bias by having individual firms serve as their own controls, much like demeaning in a linear model. The effects of stable characteristics, such as the industry a firm operates in, are controlled for (absorbed by the intercept) in a fixed-effects logit model. The disadvantage is that the effects of these characteristics are not estimated.

I am looking at the effects of (changing) firm characteristics on the probability that the same firm repurchases shares. Both variables vary over time, which hints towards fixed-effects. A Hausman test, which basically tests whether the unique errors are correlated with the regressors, is conducted to provide a conclusive answer (not-reported). Random effects is preferred under the null hypothesis due to higher efficiency, while under the alternative Fixed Effects (FE) is at least consistent and thus preferred. The Hausman test-statistic indicates that a random effects estimation cannot be used, as the null hypothesis of consistency of is rejected (Prob>chi2 = 0.0000). The coefficients under a random effects estimation would thus be inconsistent. The Hausman test indicates that the use of conditional fixed-effects seems to fit my data better.

Using fixed-effects logit regression is convenient because I have more than one observations for the dependent variable (d_rep) for almost all firms in my sample. The dummy variable also shows variation across time for most firms. Data loss due to all positive or all negative within groups is therefore limited and tolerable. The disadvantage is that the effects of non-changing firm characteristics, such as industry effects, are not estimated. Therefore I also run the last estimation separately for each industry group, which allows me to identify differences between industries.

The logistic regression model is difficult to interpret as it reports log odds. To enhance interpretability I also report the results as odds ratios after exponentiation of both sides of the logistic regression equation.

Odds ratios are more intuitive than log odds, but still not as straightforward as linear regression coefficients. Figure 2 and 3 help with the interpretation of odds (ratios).

3.4. Regression framework (real effects of share repurchases)

After identifying the factors that influence the decision to repurchase shares, I move on to the next step, which are the consequences of repurchases. To estimate the effect of repurchases on investments I regress relative changes in these investment variables on several buyback predictor variables. This time the outcome variables are not categorical so a logistic regression model is not needed. The outcome variables are changes in capital expenditures, R&D expenses and employment. To measure the changes I take the value for these variables the year after the repurchase minus the value for these variables the year before the repurchase. The difference is scaled by lagged assets (at the end of the year before the repurchase). I also repeat this procedure with a longer period for the change in the investment variables. The procedure is the same, but now I use the change in the investment variables up to three years after the repurchase. This allows me to observe the changes over a longer time period. The dependent variable (change in investment) therefore has the following form:

$$Relative\ change\ in\ investment = \left[Inv_{t+j} - Inv_{t-1}\right]/Assets_{t-1} \quad (10)$$

Where Inv is the level of either capital expenditures, R&D expenses or employment, $Assets_{t-1}$ is the lagged end of the year total asset value, and j is either 1 or 3 years. The period over which I measure the change in investment has a time overlap with the year in which I measure repurchases. This introduces some endogeneity issues, as companies might anticipate future repurchases and lower its investment level already the year before actually repurchasing shares. But if I would choose to start observing the change in investment from the same year in which the repurchase took place, there would be a bigger bias because Inv_t is automatically lower if there are positive repurchases in year t. The endogeneity problem is then still present and probably be more significant, because companies must choose between spending the money on repurchases or investments (available cash cannot be spent twice). Year $t-1$ is in that respect a more neutral year than year t.

I run the regressions with several different predictor values for repurchases: a repurchase dummy, a dummy indicating the start of a buyback program and a relative measure of repurchases (as of lagged assets). The first dummy variable single out the effect of repurchase activity in a firm-year (standard dummy), it has a value of 1 if net repurchases in that firm-year are positive, otherwise 0. The second dummy points out when a firm starts a buyback program, it has value 1 if the firm has positive net repurchases in this year and non-positive net repurchases the previous year. The third predictor value that I use in the regressions is a relative measure of repurchases (net repurchases scaled to lagged assets). This measure takes the scale/size of the repurchases during the firm-year into account. The simple univariate regression model is of the following form:

$$Y_{it} = a + \beta_1 x_{1it} + c_i + u_{it} \qquad (i=1,\ldots,N,\ t=1,\ldots,T) \quad (11)$$

Where Y_{it} represents the change in the investment (outcome) variable, x_{1it} is the predictor variable (one of the three repurchase variables), β_1 is the coefficient for that repurchase variable, c_i is the unknown specific error term for each firm and u_{it} is the error term with mean 0. Stata reports an intercept a, which is simply the average value of the fixed effects. This intercept is actually irrelevant as I already have a fixed effect for each firm. My main point of interest are the estimates of the coefficients β. The regressions are restricted to within-firm effects using fixed-effects regressions. This controls for time-invariant observable or unobservable characteristics. The fixed-effects estimator uses OLS to perform the following estimation:

$$(y_{it} - \bar{y}_{it}) = (x_{it} - \bar{x}_{it})\beta + (u_{it} - \bar{u}_{it}) \qquad \text{(i=1,…,N, t=1,…,T)} \qquad (12)$$

In these univariate OLS regressions, I find that repurchases are associated with negative changes in capital expenditures, R&D expenses and employment. Following Almeida et al. (2015) and Rauh (2006), I also run the previous regressions with added control variables. I use control variables for investment opportunities (Tobin's Q), profitability (ROA) and size (log assets). The result is a multivariate regression model of the following form:

$$Y_{it} = a + \beta_1 x_{1it} + \cdots + \beta_k x_{kit} + c_i + u_{it} \qquad \text{(i=1,…,N, t=1,…,T)} \qquad (13)$$

In the previously mentioned papers it is shown that adding these relevant control variables makes the relation between repurchases and investment variables more evident. By controlling for these variables, the pure relationship between repurchases and changes in investment is isolated from the effects of the control variables. OLS assumes strict exogeneity, which states that errors are strictly independent of all past and future values. To control for (aggregate) time-series trends, I introduce year dummies in the third and last estimation model:

$$Y_{it} = a + \beta_1 x_{1it} + \cdots + \beta_k x_{kit} + c_i + \delta_t T_t + u_{it} \qquad \text{(i=1,…,N, t=1,…,T)} \qquad (14)$$

Where T_t are a range of dummy variables per year, and δ_t is the corresponding coefficient for each year dummy. Controlling for time effects is especially important because the sample is observed over a long time period (T=31) with several rough years (crises) and time effects. The last estimation, which includes the control variables and year dummies, is repeated separately for each industry as well to see if there are notable differences between the industries. For an overview of the estimation equations, see Table 9. The reported standard errors are robust for heteroscedasticity, since they are estimated using a Huber/White/sandwich estimator (White 1980).

Table 9: Regression models (real effects of share repurchases)

- This table reports the (fixed-effects) regression equations for the second part of the study, the real (investment) effects of share repurchases.
- Parameters are estimated using Ordinary Least Squared (OLS).
- The dependent variable in each regression equation is the change in one of three investment variables: changes in capital expenditures, changes in R&D expenditures and changes in employment. To measure the changes in investment I use two different time intervals:
    1. Two year change interval: the value of each of these variables the year after the repurchases, minus the value of each of these variables the year before the repurchases, and scale the difference by assets lagged by one year (equations 1a, 2a, 3a).
    2. Four year change interval: the value of each of these variables three years after the repurchases, minus the value of each of these variables the year before the repurchases, and scale the difference by assets lagged by one year (equations 1b, 2b, 3b).
- The three investment variables are regressed on three different predictor variables, which are different measures of share repurchases:
    1. $D(Rep)_{it}$: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See Panel A1.
    2. $D(Start)_{it}$: Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See Panel A2.
    3. $Rep(Ratio)_{it}$: Relative measure of the size of the repurchase activities during a firm-year. It is calculated as the net value of repurchases during the firm-year, divided by the beginning of the year value of assets. See Panel A3.
- The first estimation model (equations 1a and 1b) is univariate, with only one of the three repurchase variables as independent variable.
- The second estimation model (equations 2a and 2b) is a multivariate model, where three common control variables are added for investment/growth opportunities (Tobins Q), profitability (ROA), and firm size (Log of assets).
- The third estimation model (equations 3a and 3b) adds year dummies to the second model to control for time effects.

Panel B reports the regression equations (third estimation model) that are used to estimate the effects for each of the six industry groups separately.

Panel A1: Explanatory variable = Dummy Repurchase	
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \varepsilon_{it}$	(1a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \varepsilon_{it}$	(1b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3b)
Panel A2: Explanatory variable = Dummy for start of a buyback program	
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \varepsilon_{it}$	(1a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \varepsilon_{it}$	(1b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 D(Start)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3b)
Panel A3: Explanatory variable = Repurchase ratio (as of assets)	
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \varepsilon_{it}$	(1a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \varepsilon_{it}$	(1b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \varepsilon_{it}$	(2b)
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Rep(Ratio)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3b)
Panel B: Estimations 3a & 3b per industry (split per industry)	
$(Inv_{i,t+1} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Dum(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3a)
$(Inv_{i,t+3} - Inv_{i,t-1})/Assets_{i,t-1} = \alpha + \beta_1 Dum(Rep)_{it} + \beta_2 Tobins\ Q_{it} + \beta_3 ROA_{it} + \beta_4 Log(assets)_{it} + \beta_t YearFE_t + \varepsilon_{it}$	(3b)

The applied regressions are useful for describing the relationship between variables. The problem is that a relationship between variables does not necessarily imply causality of one variable on the other. Although the applied regression methodologies provide a lot of insight because lagged repurchase data

are linked to (future) investment, payout, leverage and profitability data, they are not sufficient to draw rock-solid conclusions about the causal effects of stock buybacks on investment. There is always a chance that this relationship is affected by an omitted variable. Differences in investment levels can for instance be explained by variation in appealing investment opportunities. Investment opportunities are not directly observed, but often proxied using Tobin's Q or market-to-book ratio. Using one of these proxies as control variable in the regression estimations solves part of the problem, but still allows for measurement errors (Adam & Goyal 2008). Firms who repurchase shares choose to do so, and these firms are probably different from the population of all firms. This endogeneity of the repurchase decision can bias estimates of changes in investment.

I use several strategies to address the endogeneity/selection problem. First, firm-fixed effects are employed to control for time-constant unobserved heterogeneity. Second, I use control variables to capture effects that cannot be attributed to repurchases but to variation in firm size, profitability and growth opportunities. As said before, these are still subject to measurement errors. Third, I use lagged repurchase data to predict future changes in investments. The measurement period for the change in the investment variables is not simultaneous with the year in which the repurchases took place (or no repurchases were undertaken), but one or three years later. The time sequence between the two variables solves some issues about reverse causality (endogeneity).

4. Data

4.1. Data

Dividends were the dominant form of payout for a long time, the move towards buybacks started roughly in the 1980s. For this reason, I use 1984 as starting point of my sample. I use annual data on repurchases of all NYSE, Amex and Nasdaq constituents from Compustat North-America for the years 1984-2014. A list of historical constituents is extracted from the Center for Research in Security Prices (CRSP). Figure 4, 5 and 6 illustrate that the use of buybacks really hits off in the 1990s. The use of repurchases exceeds the use of dividends already before the turn of the century.

Figure 4: aggregate dividends, repurchases and payout of all firms: 1984-2014

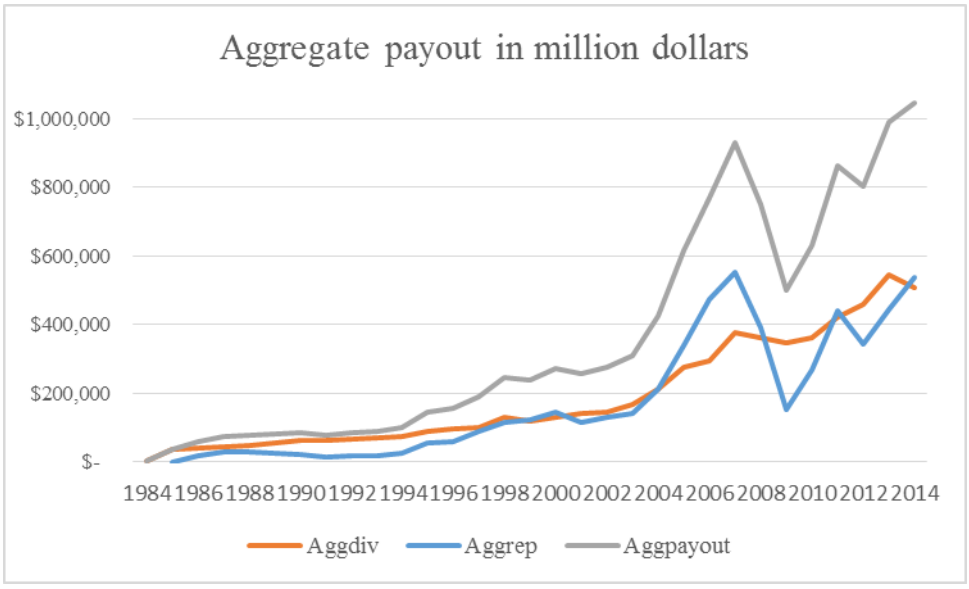


Figure 5: Average dividends, repurchases and payout per firm: 1984-2014

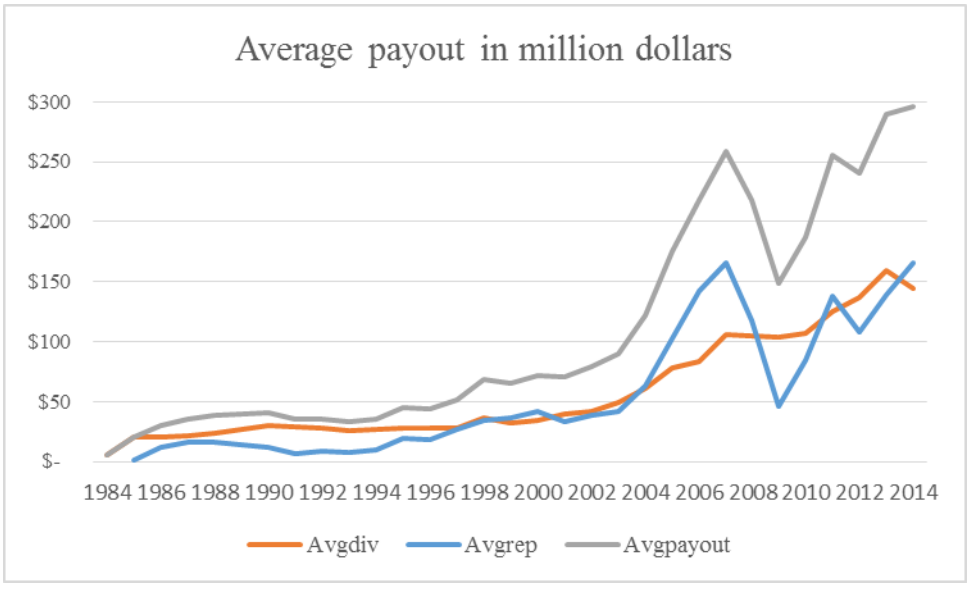
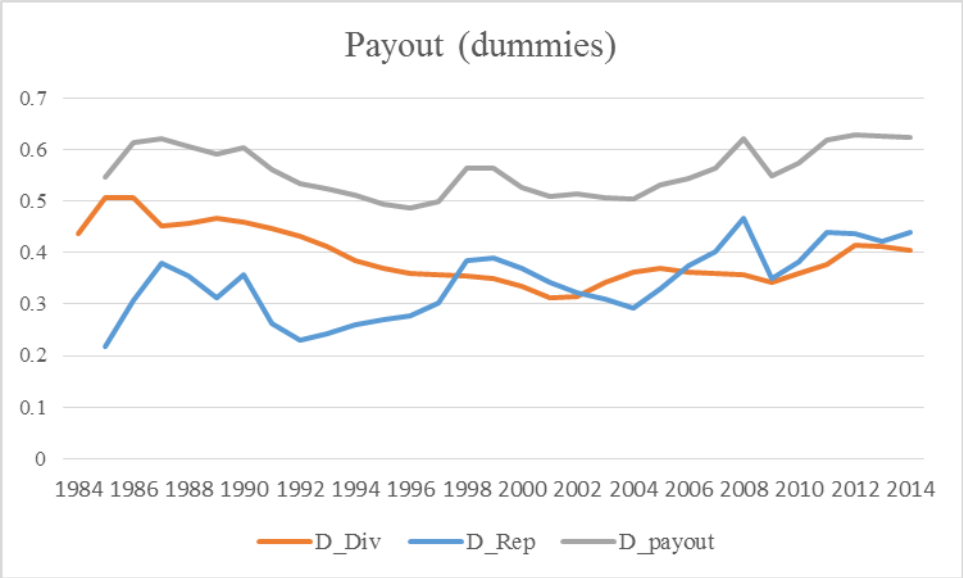


Figure 6: Average dummy values for dividends, repurchases and payout: 1984-2014



Financials (SIC 6000-6999) and regulated utility firms (SIC 4900-4949) are typically not incorporated in earlier studies. I follow this approach because these companies are often subject to stricter regulations that can impair their ability to repurchase shares. All firm data to come on the characteristics and performance of the firms buying back stocks are from Compustat North-America as well. Firms without data for or a negative stock price, common shares outstanding, total assets, cash and short-term investments, stockholder's equity and negative turnover are excluded from the sample. For comparability reasons, I also delete firms who report in other currencies than US dollar. These requirements more than halve the number of observations.

The result is a comprehensive unbalanced panel dataset with a total number of 92,901 firm-year observations for 8,340 unique firms. Table 2 (see appendix) gives an overview of all variables, with a description or definition and, if applicable, the computation. For sake of clarity, I present the variables in several panels: ID variables, firm characteristics, payout variables, investment variables and other variables.

The decision to buy back shares is investigated by analyzing a variety of fundamental firm characteristics. To examine the probability of buying back shares, I collect annual data from Compustat North-America on accounting data for all firms in the dataset. These data items are used to compute several important ratios and firm characteristics, which serve as the regressors in the logistic regression. The firm data is necessary for modelling the probability that a firm repurchases shares. The firms who choose to buy back shares are likely to have a different profile than firms who do not repurchase shares. Panel A of Table 10 lists summary statistics on the explanatory variables for the total sample. Data coverage is excellent for most variables, although there is some missing data for certain variables. Some variables are partially computed with a lagged data item, which is a reason for less observations. Consider for instance return on assets, which is calculated using this year's net income over the starting

asset value. Since balance sheet data are end of year items, this means I use lagged assets, which is not always available.

As said before, the dummy variable for repurchases is used to split up the entire sample in a subsample with repurchasing firm-years and non-repurchasing firm-years (see panel B and C of Table 10) for the results. Panel D shows the results from a mean comparison test. Firms who repurchase shares are bigger in terms of asset value, employees, turnover and market value of equity. In terms of earnings and (operational) cash flow, repurchasing firms perform better. The observations on R&D confirm the negative relation between repurchases and investment. The descriptive statistics are well in line with the firm life-cycle trajectory theorem. Repurchasing firms are mature and profitable and therefore more likely to be confronted with a shrinking investment opportunity set. Repurchasing firms tend to have lower growth opportunities (option value) as indicated by lower Tobin's Q and a lower market-to-book ratio. I do not find that repurchasing firms have higher cash ratios, which seems counterintuitive. Repurchasing firms are significantly more likely to pay dividends than non-repurchasing firms.

Table 10: Descriptive Statistics

Table 10 provides summary statistics on firm characteristics. Panel A provides statistics for the entire sample. Panel B and C provide statistics for a subsample of repurchasing and non-repurchasing firms. Panel D compares the means of panel B and C, and reports the t-test statistics T-test for the difference of the means.

Panel A: Total Sample

	N	Mean	Min	p25	Median	p75	p95	Max	SD	Skewness	Kurtosis
MVE	92,899	3316	0	39.31	203	1,055	12,442	647,507	16,433	12.81	243
Assets	92,899	3144	0	40.15	177	952	11,970	797,769	17,358	18.14	529
Liabilities	92,690	1892	0	12.07	63.65	471	7,112	684,157	12,186	25.26	993
Cash ratio	92,892	0.21	0	0.03	0.12	0.31	0.75	1	0.24	1.42	4.27
Debt ratio	92,683	0.45	0	0.27	0.45	0.61	0.83	1	0.22	0.15	2.23
Book lever	92,675	3.32	0	0.37	0.82	1.61	5.03	87,702	290.20	297.96	90,002
MtB ratio	92,884	5.15	0	1.20	2.06	3.67	10.63	24,950	98.43	189.81	45,314
Tobins Q	92,892	1.94	0	0.56	1.04	1.97	5.38	2,550	15.03	133.17	20,665
Turnover	92,756	2591	0	31.68	162.33	896	10,097	483,521	13,187	15.82	374
Net Income	92,762	153	-98,696	-2.14	3.74	37.97	613	104,821	1,266	13.63	1,553
ROA	84,502	-0.18	-9,926	-0.04	0.04	0.09	0.21	229	34.94	-273.56	77,221
ROE	84,495	-0.32	-9,926	-0.08	0.08	0.18	0.45	973	43.08	-185.38	38,773
NCF	86,455	21.71	-42,930	-3.37	0.33	10.61	170	50,435	480	11.57	2,629
NCF_A ratio	86,448	0.01	-19.48	-0.02	0.00	0.04	0.25	2.31	0.22	-22.83	1,689
CFO	86,441	341.66	-17,332	-0.05	11.00	90.26	1,233	59,725	1,900	12.95	232
CFO_A ratio	86,434	0.03	-26.15	0.00	0.07	0.13	0.23	31.78	0.30	-1.33	2,505
EPS	92,645	0.69	-105.74	-0.20	0.38	1.32	3.73	1,362	7.09	124.93	21,622
Option_R	53,058	0.06	-8.79	0.00	0.00	0.06	0.28	5.16	0.16	3.58	293
Capex/A ratio	91,822	0.06	0	0.02	0.04	0.08	0.20	6.08	0.08	8.63	407
Capex/S ratio	90,106	0.58	0	0.02	0.04	0.09	0.51	7,826	36.57	161.52	29,801
R&D_A ratio	57,367	0.09	0	0.01	0.04	0.12	0.35	17.97	0.18	22.27	1,655
R&D_S ratio	56,334	3.00	0	0.01	0.05	0.15	1.45	25,684	133.52	146.62	25,894
Employees	90,187	10.07	0	0.18	0.90	4.79	46.60	2,200	42.49	20.55	791
Employees_A	90,182	9.90	0	2.22	4.94	10.15	28.45	10,333	51.81	104.85	18,184

Panel B: Repurchasing firms (firm-years with positive net repurchases)

	N	mean	min	p25	p50	p75	p95	max	sd	skewness	kurtosis
MVE	29,583	6564	0	89	544	2,850	29,441	647,507	24,432	8.65	111
Assets	29,583	5761	0	106	520	2,584	24,603	795,337	24,025	12.86	268
Liabilities	29,507	3462	0	35	220	1,376	14,714	671,774	16,726	17.96	504
Cash ratio	29,583	0.17	0	0.03	0.10	0.25	0.58	1	0.19	1.62	5.46
Debt ratio	29,507	0.47	0	0.31	0.48	0.62	0.82	1	0.21	0.05	2.35
Book lever	29,506	5.51	0	0.46	0.92	1.65	4.69	87,702	512.35	170.01	29,093
MtB ratio	29,582	4.11	0	1.20	1.99	3.38	8.11	7,071	60.68	96.51	10,439
Tobins Q	29,583	1.38	0	0.57	0.99	1.67	3.73	139	1.64	23.56	1,729
Turnover	29,578	4913	0	106.84	541.21	2,474	20,880	483,521	18,874	11.17	185
Net Income	29,578	349	-38,119	1.16	20.26	140.50	1,619	98,806	1,749	13.60	481
ROA	29,577	0.05	-14	0.01	0.06	0.10	0.21	14	0.20	-2.33	1,737
ROE	29,576	0.18	-829	0.03	0.12	0.21	0.46	973	8.53	31.83	9,557
NCF	28,341	26.29	-21,264	-9.03	0.19	16.23	306	50,435	633	18.26	1,540
NCF_A ratio	28,341	0.00	-9.95	-0.02	0.00	0.03	0.12	0.90	0.14	-19.43	1,114
CFO	28,339	673.28	-3,991	6.01	51.07	279.21	2,914	59,725	2,695	9.02	114
CFO_A ratio	28,339	0.09	-5.80	0.05	0.10	0.15	0.25	1.97	0.14	-7.59	196
EPS	29,569	1.34	-58.32	0.14	0.95	2.05	4.92	310	4.73	31.78	1,667
Option_R	19,867	0.05	-0.99	0.00	0.00	0.06	0.24	4.08	0.13	7.81	125
Capex/A ratio	29,339	0.06	0	0.02	0.04	0.07	0.17	0.93	0.06	3.51	25
Capex/S ratio	29,257	0.11	0	0.02	0.04	0.07	0.28	192	1.69	85.43	8,490
R&D_A ratio	18,034	0.06	0	0.01	0.03	0.08	0.19	3.33	0.10	10.50	236
R&D_S ratio	17,992	0.31	0	0.01	0.03	0.10	0.28	1,107	9.79	89.95	9,463
Employees	29,106	17.78	0	0.54	2.61	11.50	83.00	2,200	62.92	17.09	481
Employees_A	29,106	9.69	0	2.27	4.78	9.59	26.86	2,568	41.52	37.99	1,881

Panel C: Non-repurchasing firms

	N	mean	min	p25	p50	p75	p95	max	sd	skewness	kurtosis
MVE	54,908	1936	0	29.74	141.40	671	7,011	596,476	10,990	18.26	522
Assets	54,908	2104	0	30.39	124.47	597	7,288	797,769	13,808	23.75	892
Liabilities	54,788	1274	0	9.30	42.77	281	4,196	684,157	9,874	32.69	1,643
Cash ratio	54,903	0.22	0	0.03	0.12	0.33	0.76	1	0.24	1.36	4.01
Debt ratio	54,783	0.44	0	0.26	0.44	0.61	0.83	1	0.23	0.19	2.20
Book lever	54,780	2.32	0	0.35	0.79	1.62	5.24	4,565	30.27	100.71	12,982
MtB ratio	54,900	4.65	0	1.17	2.01	3.65	11.02	7,426	45.80	97.61	13,568
Tobins Q	54,903	1.89	0	0.54	1.02	2.00	5.68	828	7.00	76.00	7,809
Turnover	54,847	1638	0	22.70	110.01	533	5,999	475,794	9,771	21.06	669
Net Income	54,852	67	-98,696	-4.12	1.48	19.66	281	104,821	1,007	6.60	4,171
ROA	54,849	-0.31	-9,926	-0.09	0.03	0.08	0.22	229	43.36	-220.40	50,124
ROE	54,843	-0.59	-9,926	-0.17	0.05	0.17	0.45	576	53.11	-152.54	25,868
NCF	52,132	17.69	-42,930	-2.57	0.19	7.25	114	32,336	396	-7.24	3,907
NCF_A ratio	52,127	0.00	-19.48	-0.03	0.00	0.04	0.22	2.31	0.23	-28.11	2,021
CFO	52,122	193.35	-17,332	-0.85	5.24	46.68	625	57,454	1,384	18.01	443
CFO_A ratio	52,117	0.00	-18.00	-0.03	0.06	0.12	0.22	31.78	0.32	10.13	2,076
EPS	54,800	0.41	-105.74	-0.32	0.18	0.99	2.94	1,362	8.32	126.98	19,223
Option_R	30,698	0.06	-1.61	0.00	0.00	0.07	0.31	5.16	0.17	7.33	109
Capex/A ratio	54,259	0.06	0	0.02	0.04	0.08	0.20	2.35	0.08	3.94	38
Capex/S ratio	53,036	0.80	0	0.02	0.04	0.10	0.58	7,826	47.34	126.26	18,016
R&D_A ratio	34,360	0.11	0	0.01	0.05	0.14	0.42	17.97	0.21	22.16	1,493
R&D_S ratio	33,630	4.36	0	0.01	0.06	0.17	2.21	25,684	170.87	116.73	16,157
Employees	53,203	6.74	0	0.13	0.58	2.90	30.20	1,244	27.86	12.85	270
Employees_A	53,198	9.59	0	2.20	5.00	10.12	28.16	2,719	34.72	40.09	2,279

Panel D: Difference in means (t-test)

	d_rep=0	d_rep=1	Mean diff	Std. error	T-stat	P (|T| > |t|)	H0: diff = 0
MVE	1936	6564	-4628.9***	122.286	-37.852	0.000	Rejected
Assets	2104	5761	-3657.9***	130.214	-28.090	0.000	Rejected
Liabilities	1274	3462	-2188.7***	91.709	-23.864	0.000	Rejected
Cash ratio	0.219	0.170	0.0489***	0.002	30.248	0.000	Rejected
Debt ratio	0.443	0.471	-0.0274***	0.002	-17.145	0.000	Rejected
Book lever	2.32	5.51	-3.188	2.196	-1.452	0.147	Not rejected
MtB ratio	4.65	4.11	0.544	0.371	1.462	0.144	Not rejected
Tobins Q	1.89	1.38	0.512***	0.041	12.373	0.000	Rejected
Turnover	1638	4913	-3275.0***	98.603	-33.212	0.000	Rejected
Income	66.52	349	-282.8***	9.492	-29.788	0.000	Rejected
ROA	-0.309	0.046	-0.355	0.252	-1.409	0.159	Not rejected
ROE	-0.586	0.176	-0.762**	0.311	-2.451	0.014	Rejected
NCF	17.69	26.29	-8.595**	3.636	-2.364	0.018	Rejected
NCF_A ratio	0.060	0.007	0.053***	0.012	4.565	0.000	Rejected
CFO	193.35	673.26	-479.9***	14.385	-33.361	0.000	Rejected
CFO_A ratio	-0.095	0.105	-0.200	0.136	-1.470	0.142	Not rejected
EPS	0.407	1.337	-0.930***	0.052	-17.741	0.000	Rejected
Option_R	0.065	0.051	0.0143***	0.001	10.190	0.000	Rejected
Capex_A ratio	0.062	0.057	0.00416***	0.001	8.006	0.000	Rejected
Capex_S ratio	0.798	0.113	0.685**	0.277	2.473	0.013	Rejected
R&D_A ratio	0.057	0.112	0.0556***	0.002	33.062	0.000	Rejected
R&D_S ratio	4.360	0.309	4.050***	1.275	3.177	0.001	Rejected
Employees	6.74	17.78	-11.05***	0.318	-34.745	0.000	Rejected
Employees_A	9.59	9.69	-0.0991	0.272	-0.365	0.715	Not rejected
D_Div	0.32	0.51	-0.196***	0.003	-56.802	0.000	Rejected
Dividend	34.44	129.85	-95.41***	3.716	-25.671	0.000	Rejected
Div_r	0.017	0.015	0.00246	0.003	0.881	0.378	Not rejected
D_payout	0.317	1.000	-0.683***	0.003	-250.000	0.000	Rejected
Payout	34.33	309.99	-275.7***	6.476	-42.569	0.000	Rejected
Payout_r	0.012	0.054	-0.0420***	0.002	-24.581	0.000	Rejected

Two-sample t-test on mean differences with assumption of equal variances
H0: difference in means = 0
* p<0.10, ** p<0.05, *** p<0.01

Table 11 provides information regarding the distribution of the sample per year. The composition of companies in the dataset changes over the course over the years. Some companies only stay in the sample for one or two years, whereas some firms are observed throughout the entire period. These participation statistics are presented in Table 12. The average firm timespan is 8 years, meaning that I have on average eight firm-year observations for each company.

The dataset is further split up in six sectors based on the SIC code of each company (see Table 6 in methodology section). These sectors are Resource firms (SIC < 2000), Manufacturing firms (2000 < SIC < 4000), Transportation and Public Utility firms (4000 < SIC < 5000), Wholesale & Retail firms (5000 < SIC < 6000), Service firms (7000 < SIC < 9000), and Administration and Other firms (SIC codes between 9,000 and 10,000). This enables me to control for industry effects and observe differences in buy back habits among industries. Correlations statistics for the major variables concerning payout data, investment data, general firm characteristics and several ratios are presented in a correlation matrix in Table 11.

Table 11: Correlation Matrix

This table contains the correlation coefficients between the most important variables. The correlation matrix is used to investigate the dependence between multiple variables. Correlation between payout and repurchases/dividends are relatively high, as well as the correlation between investment variables such as R&D and Capex.

	D_Rep	D_Div	D_payout	Cash rate	Debt rate	Book lever	MtB	TobinsQ
D_Rep	1.00							
D_Div	0.24	1.00						
D_payout	0.75	0.65	1.00					
Cash rate	-0.17	-0.30	-0.26	1.00				
Debt rate	0.09	0.22	0.16	-0.44	1.00			
Book lever	0.00	0.00	0.00	-0.03	0.10	1.00		
MtB	0.00	-0.01	-0.01	0.02	0.08	0.75	1.00	
TobinsQ	-0.08	-0.07	-0.10	0.26	-0.16	-0.01	0.11	1.00
ROA	0.02	0.01	0.02	-0.02	-0.01	0.00	-0.01	-0.03
ROE	0.01	0.00	0.01	-0.01	0.00	0.00	0.00	-0.02
CFO	0.14	0.21	0.16	-0.10	0.12	0.00	0.00	-0.02
Net CF	0.00	0.04	0.03	0.01	0.04	0.00	0.00	0.00
Optionexp rate	-0.06	-0.11	-0.10	0.14	-0.10	-0.01	0.00	0.07
Capex rate	-0.01	-0.01	-0.01	0.01	0.00	0.00	0.00	0.00
R&D rate	-0.02	-0.01	-0.02	0.04	-0.01	0.00	0.00	0.01

	TobinsQ	ROA	ROE	CFO	Net CF	Optionexp. rate	Capex rate	RD rate
TobinsQ	1.00							
ROA	-0.03	1.00						
ROE	-0.02	0.94	1.00					
CFO	-0.02	0.01	0.00	1.00				
Net CF	0.00	0.00	0.00	0.21	1.00			
Optionexp rate	0.07	-0.01	0.00	-0.04	0.00	1.00		
Capex rate	0.00	0.00	0.00	0.00	0.00	0.00	1.00	
RD rate	0.01	0.00	-0.01	-0.01	0.00	0.00	0.82	1.00

4.2. Panel data challenges

The term panel data, or longitudinal data, refers to a multi-dimensional data set observed over multiple time periods. A panel data set has multiple entities (cross-section), each of which has repeated measurements at different time periods (time series). A balanced panel dataset thus contains *n* entities or firms, each of which includes *T* observations measured at 1 through *t* time period. Panel data thus have individual (group) effect, time effect or both. Given well-organized panel data, this makes for a very informative dataset. As Baltagi (2001, p. 6) puts it, "Panel data give more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency". Panel data accounts for individual heterogeneity and controls for unobservable variables.

Panel data techniques try to combine information from two dimensions (time and entities) in one regression. The panel structure can, if properly understood, capture several statistical problems, such as endogeneity and errors-in-variables problems because these are caused by complex relations between variables. A panel regression makes statements over several regressions at once and the interactions between them, either over time or between identities. Although panel data techniques can provide more information and therefore allow me to explore more issues than cross-sectional or time-series data alone, they are prone to several (technical) difficulties. With panel data, many of the firm-year observations are not independent since there are multiple observations for the same firm. Special techniques are required, since it would be a mistake to treat more than 8000 firms measured at 31 different points in time as if they were all independent observations.

In this study there is no requirement that data be available for each firm throughout the entire period. The constituents of NYSE, AMEX and NASDAQ change annually so firms are rotated in and out of the sample. My sample therefore qualifies as an unbalanced panel, which is a set of data in which some firm data is not observed in certain years. Stated quite simply, not all firms remain in the dataset for the entire length of the study. The majority of companies that are present from the beginning (1985) in my dataset drop out before 2015. In a similar vein, most companies with observations for 2015 have dropped in later than 1985. Table 12 provides some informative general panel data statistics for my sample. Table 13 reports the number of firm-year observations separately for each year over the period 1984-2014.

Table 12: Distribution per year

This table summarizes the amount of observations for each year. I use annual data of all NYSE, AMEX and NASDAQ constituents from Compustat North-America for the years 1984-2014. Firms without data for or a negative stock price, common shares outstanding, total assets, cash and short-term investments, stockholder's equity and turnover are excluded.

Year	N	Percent
1984	361	0.39
1985	1810	1.95
1986	1933	2.08
1987	2067	2.22
1988	2073	2.23
1989	2076	2.23
1990	2133	2.30
1991	2234	2.40
1992	2437	2.62
1993	2702	2.91
1994	2887	3.11
1995	3203	3.45
1996	3563	3.84
1997	3689	3.97
1998	3628	3.91
1999	3706	3.99
2000	3784	4.07
2001	3606	3.88
2002	3503	3.77
2003	3458	3.72
2004	3504	3.77
2005	3511	3.78
2006	3536	3.81
2007	3611	3.89
2008	3448	3.71
2009	3376	3.63
2010	3379	3.64
2011	3377	3.64
2012	3349	3.60
2013	3425	3.69
2014	3532	3.80
Total	92901	100

Table 13: Distribution of N_t

This table describes the general panel data characteristics of my sample. I have a total of 92901 firm-year observations for 8340 firms over the period of 1984-2014. Span indicates the number of years a firm stays in the database.

Total firms (N):	8,340
Total years (t):	31
Min. span:	1 year
25% span:	4 years
Average span:	8 years
75% span:	17 years
Max. span:	31 years

An unbalanced panel comes at the expense of some methodological, computational and interpretational complications. Provided the decision to rotate units out of a panel is made randomly and not based on factors that are systematically related to the response variable, there is no selection problem. The main variables (response variables) that I investigate are repurchase variables and derivatives. The occurrence of repurchases are unlikely to be a cause of any delistings. Hence there is no question of a selection bias. If only firms that have been listed for the entire period are selected, I would have obtained a balanced panel. The problem with this is that throwing away pieces of usable information to get a balanced panel raises selectivity problems and –biases. The sample is then not representative, as it omits younger firms

(startups) and firms that were delisted (survivorship bias). The sample would consequently be biased towards stable, mature and profitable firms.

Another complication holds concern with data availability. For a majority of the firms, data coverage in Compustat North-America is incomplete, but this is not necessarily a major problem. As can be seen from the descriptive statistics, the data coverage is high for the majority of the variables, with few missing observations. As I outlined earlier, observations (entire rows) are deleted if several key data items were missing. Considering that I have a comprehensive dataset, some missing values for particular variables are not a problem. STATA simply ignores all observations with missing values and conducts the regression analysis with the resulting smaller sample.

5. Results

5.1. Logit regressions (motives for share repurchases)

In this section I present the regression output, starting with the logit regressions for the factors influencing the decision to repurchase shares. Table 14 gives the estimates for the univariate logit regression models, which are used to test the hypotheses from section 2.4 individually. The dependent variable (d_rep) is a dummy with value 1 if company i has positive net repurchases in year t, otherwise 0. Recall that all models are fixed effects regression models, because the Hausman test rejected the model with random effects. A fixed effects estimator does not use information provided by inter-firm comparisons of repurchase decisions. The repurchase effect of the independent variables are identified by firms who change (start or quit) their repurchase policy during the observed period. Not all observations in my dataset are used in the analysis, because some firms with no variation in the dependent variable (D_rep) drop out. The number of observations that are used in the univariate regression equations varies. The variation can be explained by missing data for some of the independent variables. Another reason for missing data is that some of the estimations use lagged values for dependent variables, such as lagged stock return and lagged debt ratio. In those cases the first year-observation for each firm are dropped automatically.

Table 14 gives a summary of the regression output for the univariate logit models (estimation 1 of Table 8). All coefficients are of the expected sign, except for the coefficient for lagged annual stock return, which is negative but insignificantly different from 0. The relationship between the volatility of net income and the probability a repurchase occurs is not significant, whereas the effect of the cost of stock option exercises is only significant at the 0.10 level. The sign of the other coefficients are significant at the 0.05 level and no strange results are observed. The effect of size (Log assets), leverage (Debt ratio) and investment opportunities (Tobin's Q), and the stock market conjuncture (Market stock return) on the propensity to repurchase shares are large. When the lagged dependent variable (D_rep_lag) is used as independent variable, its coefficient is significantly positive. This means the occurrence of buybacks in a certain year is heavily determined by the occurrence of buybacks the past year. This makes intuitive sense, because the execution of buyback programs typically takes longer than one year to be completed.

One must be careful about making quantitative statements since the reported coefficients do not correspond to marginal effects. The coefficients for the odds ratios (which are easier to interpret than the log odds) are presented at the bottom of Table 14. The interpretation of odds ratios is still not straightforward, as outlined earlier in section 3.4 and in figure 2 and 3. A coefficient for odds ratio higher than 1 means the relationship between the odds of a repurchase and the predictor variable is positive. Or in other words, that the probability of a repurchase increases (all else equal). A high debt ratio is associated with lower odds of doing a repurchase, while high levels of cash are associated with higher odds of doing a repurchase. The coefficient for the odds ratio of return on assets (ROA) is 1.399, which should be read as follows. For a one unit increase in ROA, the odds of a buyback increase by a factor of

1.399. If probability is close to zero, then an odds ratio of 1.399 is almost the same as increasing probability by 1.399. On the other hand, when probability is close to 1, then an odds ratio of 1.399 is almost the same as dividing (1-p) by 1.399.

From Table 14 it becomes clear that repurchases are associated with profitable, unlevered firms with a large asset base, weak growth opportunities and abundant cash levels. Repurchases are more likely when operating cash flows increase. Repurchases are also more likely to happen in bullish stock markets, although the effect of lagged stock annual returns is unclear. The cyclicality of repurchases is confirmed convincingly by the results of the univariate regressions. The coefficient of D_rep_lag illustrates that repurchases are repetitive, which is in line with the transition probabilities presented in Table 7. Some of the variables that are investigated separately in the univariate estimations, are correlated with each other.

Table 14: Univariate conditional fixed-effects logistic regression

This table reports the regression output for the (fixed-effects) univariate logit regression equations (see panel A of Table 8). Parameter values (β) are estimated using maximum likelihood. The dependent variable is a dummy with value 1 if company i has positive net repurchases in year t, otherwise 0. The reported coefficients are log odds, odds ratios are presented at the bottom of the table.

	Expect.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ROA	+	0.336***										
		(7.07)										
Vol(income)	+		0.000315									
			(1.37)									
CFO_A ratio	+			0.585***								
				(9.49)								
Ret (lag)	+				-0.00099							
					(-0.85)							
Debt_r (lag)	-					-1.545***						
						(-22.41)						
Cash_r (lag)	+						0.669***					
							(8.95)					
Option_r	+							0.148*				
								(1.86)				
Tobins Q	-								-0.153***			
									(-18.92)			
Log(assets)	+									0.500***		
										(41.93)		
D_rep (lag)	+										1.326***	
											(67.84)	
Ret_mkt	-											-0.509***
												(-15.82)
Coef. Odds ratio		1.399	1.000	1.794	0.999	0.213	1.952	1.159	0.858	1.649	3.765	0.601
St. error OR		0.066	0.000	0.110	0.001	0.015	0.146	0.092	0.007	0.020	0.074	0.019
LR chi2		66.07	3.42	104.35	1.01	517.21	79.99	333.77	454.14	1942.20	4666.25	251.30
P > chi2		0.000	0.065	0.000	0.315	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of obs.		68087	62122	64362	62294	67985	68150	38883	68166	68166	61135	68169
Number of groups		4504	4169	4374	4175	4503	4507	3269	4508	4508	4128	4508
(Pseudo) R^2		0.001	0.000	0.002	0.000	0.008	0.001	0.010	0.007	0.031	0.082	0.004

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The multivariate logit regression models are used to determine the relative influence of each predictor variable on the probability of a repurchase. For all models, the outcome variable is coded 1 if net repurchases in a firm-year are positive, otherwise 0. The dependent variable is the odds of this dummy variable having the value 1. Table 15 gives the logit estimates for four different fixed effects models (see panel B of Table 8 for the regression formulas). All hypotheses are tested jointly in the first multivariate estimation model. Model 2 is an extension of model 1, as it adds the lagged value for the dependent variable (D_rep_lag) as independent variable. Model 3 controls for the stock market conjuncture by including the average annual stock return (weighted for all firms in the dataset) as independent variable, and model 4 includes the variable "Period", which splits up the entire sample in five quintiles. Model 5 controls model 3 for year fixed effects by including year dummies. I am not specifically interested in the coefficients of the year dummies, but including these in the model allows me to control for aggregate time-series effects/trends. Expanding the models stepwise adds robustness.

Table 15 gives the logit estimates for all multivariate models. The coefficients of all predictor variables except for lagged return are of the expected sign. When comparing each of the five models, it becomes clear that the estimated coefficients for the log odds (and odds ratios) of the independent variables are rather stable and robust. Including D_rep_lag (model 2), Ret_markt (model 3), and Period (model 4) does not alter the sign of the coefficients either. The control variables do have a significant effect on the probability to buy shares. The market return is positively correlated with buybacks, which is in line with the procyclical nature of share repurchases. The positive coefficient for Period indicates that the use of buybacks has been increasing over time. On an all other things equal basis, repurchases are thus more likely to occur in the later years.

In the univariate regressions the majority of independent variables had a significant effect on the odds of doing a repurchase. Multivariate analysis allows for an overarching view and controls for cross tabulation and partial correlation. Therefore it gives a richer and more realistic picture of the relationship between variables and a more powerful test of significance. When the odds of doing a repurchase is regressed on multiple independent variables at once, the relationship between some variables is no longer significant. Based on this model, a higher volatility (variance) of net income is no longer related to the probability of doing a repurchase. The test results do not provide significant support for the hypothesis that companies do buybacks more often when the costs of stock option exercises are high, although the test coefficients are positive. The market timing theory suggests that managers can time the market, from which I implied that repurchases are more likely to occur after a share price decline. I included the one year lagged stock return of the company as independent variable in the model and expected that it would have negative test coefficients. I do indeed observe negative coefficients for lagged return, but the relationship is not significant at the 0.05 level in most models. The market timing effect is not very obvious in my sample, although one could also argue that lagged stock return is a disputable proxy.

Table 15: Conditional fixed-effects logistic regression

This table presents the regression output for the fixed-effects multivariate logistic regression models (see panel B of Table 8). Parameter values (β) are estimated using maximum likelihood. The dependent variable is a dummy with value 1 if company i has positive net repurchases in year t, otherwise 0. The reported coefficients are log odds, odds ratios are presented in italics. Coefficients of year dummies (model 5) are not reported, but 15 out of 26 were significant at the 0.05 level.

		(1)	(2)	(3)	(4)	(5)
	Expect.	d_rep	d_rep	d_rep	d_rep	d_rep
ROA	+	0.158*	0.642***	0.670***	0.690***	0.611***
		1.171	*1.900*	*1.954*	*1.994*	*1.842*
		(1.82)	(5.25)	(5.47)	(5.64)	(4.96)
Vol(Income)	+	0.000624	0.000451	0.00047	0.00048	0.000444
		1.001	*1.000*	*1.000*	*1.000*	*1.000*
		(1.41)	(1.07)	(1.16)	(1.16)	(1.09)
CFO_r	+	0.589***	0.461***	0.418***	0.442***	0.562***
		1.803	*1.585*	*1.519*	*1.556*	*1.753*
		(5.01)	(3.24)	(2.95)	(3.12)	(3.91)
Ret (Lag)	+	-0.0169**	-0.00801	-0.0116	-0.0131*	-0.00781
		0.983	*0.992*	*0.989*	*0.987*	*0.992*
		(-2.18)	(-1.23)	(-1.60)	(-1.78)	(-1.15)
Debt_r (lag)	-	*-1.864***	*-1.847***	*-1.815***	*-1.850***	*-1.860***
		0.155	*0.158*	*0.163*	*0.157*	*0.156*
		(-16.24)	(-15.07)	(-14.77)	(-15.03)	(-14.99)
Cash_r (lag)	+	0.770***	0.880***	0.885***	0.793***	0.885***
		2.160	*2.410*	*2.423*	*2.211*	*2.422*
		(5.97)	(6.44)	(6.47)	(5.77)	(6.38)
Option_r	+	0.141	0.136	0.141	0.149	0.159*
		1.151	*1.145*	*1.151*	*1.161*	*1.172*
		(1.61)	(1.48)	(1.52)	(1.61)	(1.71)
Tobins Q	-	-0.170***	-0.159***	-0.139***	-0.139***	-0.158***
		0.844	*0.853*	*0.870*	*0.870*	*0.854*
		(-12.37)	(-10.78)	(-9.56)	(-9.57)	(-10.51)
Log(Assets)	+	0.475***	0.390***	0.396***	0.301***	0.287***
		1.608	*1.477*	*1.486*	*1.351*	*1.333*
		(25.56)	(19.96)	(20.23)	(12.16)	(11.25)
D_rep (lag)	+		1.230***	1.240***	1.231***	1.217***
			3.420	*3.455*	*3.424*	*3.375*
			(43.5)	(43.66)	(43.27)	(42.04)
Ret_mkt	-			-0.582***	-0.584***	1.046
				0.559	*0.558*	*2.847*
				(-11.73)	(-11.76)	(0.66)
Period	+				0.0979***	
					1.103	
					(6.2)	
LR chi2		1417.33	3395.41	3534.40	3572.85	3887.74
P > chi2		0.000	0.000	0.000	0.000	0.000
Number of obs.		31,655	31,082	31,082	31,082	31,082
Number of groups		3,435	3,397	3,397	3,397	3,397
Pseudo R^2		0.051	0.124	0.129	0.130	0.141
Year dummies sign.		-	-	-	-	(15/26)

Coefficient odds ratios in italics
t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Share buybacks appear to be determined by the simultaneous existence of several factors, suggesting that firms choose to repurchase shares when a range of conditions are met. I find a positive relationship between profitability (ROA), operational cash flow (CFO_r) and buybacks. This makes economic sense, because buybacks are costly and preferably funded with internally generated cash. This is also in line with the agency costs theory, which posits that excess cash should be distributed to shareholders. These notions are also reflected in the positive test coefficient for cash ratio. Companies with large cash reserves show higher propensity to repurchase shares. Share repurchases strongly affect the composition of a firms' balance sheet through lower cash holdings, and consequently a smaller asset base. The disciplining function of repurchases emerges in the negative coefficient for leverage (Debt ratio) as well. Repurchases can be used to increase leverage and exploit interest tax benefits, especially when the proceeds of issued debt are used to fund the buybacks. The output is clear on this matter, as firms with conservative levels of debt are more inclined to repurchase shares.

The life cycle trajectory of a typical firm is one with a shrinking investment opportunity set. The life cycle theorem posits that mature firms are more likely to payout abundant earnings through repurchases (or dividends), whereas smaller firms are inclined to invest their earnings in development and expansion. I use Tobin's Q to proxy for a firm's investment/growth opportunities. My results support the notion that repurchases are more accepted for mature firms with low growth opportunities. The regression coefficient for Tobin's Q is negative, whereas the coefficient for firm size (Log assets) is positive. Mature firms with low growth opportunities and a large asset base are thus significantly more likely to repurchase shares from the stock market than smaller firms with growth potential.

5.2. Logit regressions per industry (motives for share repurchases)

Table 16 reports the logistic regression results for the last multivariate regression model separately for the six different industry groups (see panel B of Table 8 for the regression formulas). The control variables lagged repurchase (D_rep_lag), stock market conjuncture (Ret_markt) and sample-year quintiles (period) are also regressed on the odds of a repurchase. Each sector group has a different number of observations and therefore the statistical power varies significantly. Generally speaking, significance levels drop compared to the full sample regression results, which can be attributed to a lower number of observations. Due to its low number of (group) observations, the coefficients for the "Administration and Others" group must be interpreted with a lot of caution.

Table 16: Conditional fixed-effects logistic regression per sector

This table reports the logistic regression results for estimation model 4 separately for the six different industry groups. Parameter values (β) are estimated using maximum likelihood. The dependent variable is a dummy with value 1 if company i has positive net repurchases in year t, otherwise 0. The reported coefficients are log odds, odds ratios are presented in italics. Number of observations and goodness-of-fit measures for each sector are reported at the bottom of the table.

		(1)	(2)	(3)	(4)	(5)	(6)
		Manufacturing	Other	Resource	Service	Transport	Wholesale
	Exp.	d_rep	d_rep	d_rep	d_rep	d_rep	d_rep
ROA	+	0.897***	-0.0459	1.672***	0.666***	1.395***	3.258***
		2.453	*0.955*	*5.325*	*1.946*	*4.037*	*26.005*
		(6.29)	(-0.10)	(3.52)	(3.55)	(2.61)	(5.59)
Vol(Income)	+	-0.000546	-0.00229	0.00179	0.000775	0.00322	0.00171
		0.999	*0.998*	*1.002*	*1.001*	*1.003*	*1.002*
		(-0.57)	(-0.10)	(0.39)	(0.65)	(0.64)	(1.13)
CFO_r	+	0.602***	0.0294	0.401	0.460*	0.152	0.834*
		1.827	*1.030*	*1.493*	*1.584*	*1.164*	*2.303*
		(2.91)	(0.02)	(0.69)	(1.81)	(0.23)	(1.66)
Ret (lag)	+	-0.00775	-0.6	-0.00196	-0.0428***	-0.0034	-0.0449
		0.992	*0.549*	*0.998*	*0.958*	*0.997*	*0.956*
		(-0.88)	(-1.09)	(-0.34)	(-2.62)	(-0.10)	(-1.05)
Debt_r (lag)	-	-1.885***	-4.921**	-1.885***	-2.164***	-1.436***	-1.504***
		0.152	*0.007*	*0.152*	*0.115*	*0.238*	*0.222*
		(-11.19)	(-2.24)	(-4.34)	(-8.67)	(-3.12)	(-3.90)
Cash_r (lag)	+	*0.760***	*-0.107*	*0.509*	*0.560***	*0.75*	*2.193****
		2.138	*0.898*	*1.664*	*1.750*	*2.118*	*8.964*
		(4.16)	(-0.07)	(0.89)	(2.17)	(1.19)	(4.26)
Option_r	+	0.0761	-5.051*	-0.0699	0.328**	0.397	-0.422
		1.079	*0.006*	*0.932*	*1.389*	*1.488*	*0.656*
		(0.62)	(-1.78)	(-0.12)	(2.18)	(0.76)	(-0.92)
Tobins Q	-	-0.0987***	-0.153	-0.263***	-0.172***	-0.141**	-0.299***
		0.906	*0.858*	*0.769*	*0.842*	*0.869*	*0.741*
		(-5.57)	(-0.55)	(-3.05)	(-6.12)	(-2.13)	(-4.81)
Log(assets)	+	0.333***	0.724**	0.240***	0.254***	0.154*	0.303***
		1.395	*2.063*	*1.272*	*1.289*	*1.166*	*1.354*
		(9.56)	(2.49)	(2.80)	(5.10)	(1.78)	(3.71)
D_rep (lag)	+	1.242***	0.955**	1.275***	1.099***	1.308***	1.348***
		3.462	*2.598*	*3.578*	*3.002*	*3.701*	*3.850*
		(32.09)	(2.07)	(12.11)	(17.86)	(12.18)	(16.48)
Ret_mkt	-	-0.631***	-0.713	-0.305*	-0.700***	-0.431**	-0.550***
		0.532	*0.490*	*0.737*	*0.496*	*0.650*	*0.577*
		(-9.14)	(-0.87)	(-1.68)	(-6.75)	(-2.28)	(-3.75)
Period	+	0.0275	-0.1880	0.112*	0.188***	0.184***	0.239***
		1.028	*0.829*	*1.119*	*1.206*	*1.202*	*1.270*
		(1.32)	(-0.81)	(1.67)	(5.16)	(2.97)	(4.99)
LR chi2		1787.46	22.58	257.61	860.56	232.90	729.86
P > chi2		0.000	0.007	0.000	0.000	0.000	0.000
Number of obs.		16740	151	2319	6835	2153	3868
Number of groups		1505	16	225	751	240	359
Pseudo R^2		0.123	0.208	0.137	0.131	0.129	0.182

Coefficient odds ratios in italics
t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The regression results should be read in conjunction with the payout statistics per sector, which are to be found in Table 5. Repurchases are most frequently observed in the Wholesale and Retail sector (average D_rep = 0.4), while the average size of the repurchase program per year is rather small (63 million dollar) in this sector group. In contrast, positive net repurchases are only observed in 28% of the firm-years in the Administration and Others sector. The scale of the buybacks is much bigger in this group (168 million dollar). When looking at the regression output it becomes clear that a lot of variation exists between the industries, although most regression test coefficients are of the expected sign. The positive effects of profitability, operational cash flow and availability of cash on the probability of repurchases are for instance much larger in the Wholesale and Retail sector than in the other sectors.

Apart from the Administration and Others sector, there are not many controversial results. Most results that were observed for the entire sample are also present at the industry level. The lagged annual stock return is found to be strongly negatively related to the propensity to repurchase shares in the Service sector. This is a relationship that is not flagrant in the other sectors. The positive relationship between operational cash flow and the propensity to do buybacks is not as clear-cut in most industries as it was in the full sample results. The positive coefficient for operational cash flow is not nearly significant at the 95% level for the Transportation firms, Resource firms, and the Administration and Others sector. All in all, the results do not provide evidence for major differences between industries. Perhaps the differences between industries are not as big because the sample is only split up in six groups. This way, many different companies are still assigned to the same sector.

5.3. Results for the effect of share repurchases on investment

To assess the relationship between repurchases and future investments I regressed relative changes in three investment (dependent) variables on three alternative buyback predictor variables. The investment outcome variables that I considered are changes in capital expenditures (c_cpx_a), R&D expenses (c_rd_a) and employment (c_emp_a). These three different dependent variables are three proxies for corporate investment. Employment may not be a frequently used proxy for investment, but I choose to include it because employment can be seen as an investment in human capital.

To measure the changes in investment I take the value for each of the three variables the year after the repurchase minus the value for these variables the year before the repurchase. The difference is normalized by lagged assets (at the end of the year before the repurchase). Apart from this two-year change interval, I also use a longer four year observation period. The latter takes the investment value at the third year after the repurchase as final point of measurement and compares it to the value the year before the repurchase. This enables me to observe the medium- to long-term effects of repurchases on investment.

The predictor variables are two dummy variables and one “normal” variable. All three variables proxy for repurchases. The first predictor value is a simple dummy for repurchases (value 1 if net repurchases

in a firm-year are positive). The second predictor value is a dummy variable for the start of a buyback program (value 1 if the firm has positive net repurchases in this year and non-positive net repurchases in the previous year). The last predictor value is a relative measure of repurchases that takes the scale of the repurchase program during the year into account (net repurchases scaled to lagged total assets).

An overview of the estimation equations can be found in Panel A1, A2 and A3 of Table 9. The first estimation model (1a and 1b) in each panel is univariate, with the three repurchase variables as sole alternating predictor variables. The first two columns of Table 17A, 17B and 17C report the univariate regression results for capital expenditures, R&D expenses and employment respectively. The second estimation model (2a and 2b) adds three control variables for growth opportunities (Tobin's Q), profitability (ROA) and firm size (Log assets). The results of these regression equations are reported in the third and fourth column of Table 17ABC. The last estimation model (3a and 3b) is an extension of the second model and equips year dummies to control for fixed time effects. The output is presented in columns 5 and 6 of Table 17ABC. The year dummies are used to increase the model's accuracy, their coefficients are not reported.

Table 17A: Fixed-effects regressions (consequences of buybacks on capital expenditures)

This table reports the regression output for the investment effects of share repurchases (Formulas Table 9). Parameters are estimated using Ordinary Least Squared (OLS). The first two columns are univariate regression estimations, the third and fourth column add control variables and the fifth and sixth column add year dummies to control for fixed time effects. Three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See Panel A.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See Panel B.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See Panel C.

The two alternating dependent variables are the change in capital expenditures over a short two year period (c_cpx_a1) or a long four year period (c_cpx_a3).

1. c_cpx_a1: the value of capital expenditures one year after the repurchases, minus the value of capital expenditures the year before the repurchase, scaled by assets lagged by one year (equations 1a, 2a, 3a).
2. c_cpx_a3: the value of capital expenditures three years after the repurchases, minus the value of capital expenditures the year before the repurchase, scaled by assets lagged by one year (equations 1b, 2b, 3b).

The number of observations and goodness-of-fit measures for each regression are reported at the bottom of each panel.

Panel A: Main predictor variable: Dummy Repurchase

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3
D_rep	-0.0237***	-0.0387***	-0.0137***	-0.0154	-0.0118***	-0.00982
	(-7.19)	(-9.73)	(-4.58)	(-0.87)	(-3.62)	(-0.61)
Tobins Q			0.00217	0.00612	0.00186	0.00421
			(0.86)	(0.46)	(0.74)	(0.32)
ROA			0.01	1.139	0.00997	1.139
			(0.51)	(1.14)	(0.51)	(1.14)
Log(assets)			-0.0284***	-0.138***	-0.0336***	-0.198***
			(-4.85)	(-3.79)	(-4.20)	(-3.66)
F stat.	51.70	94.64	14.47	17.43	11.78	6.24
Prob. F	0.000	0.000	0.000	0.000	0.000	0.000
N	75581	62528	75536	62491	75536	62491

Panel B: Main predictor variable: Dummy for start of buyback program

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3
D_start(rep)	-0.00953***	-0.0135**	-0.00797**	-0.0321*	-0.00803**	-0.0256
	(-3.88)	(-2.55)	(-1.97)	(-1.78)	(-2.11)	(-1.58)
Tobins Q			0.00071	-0.00479	0.00014	-0.00679
			(0.19)	(-0.28)	(0.04)	(-0.39)
ROA			0.0575	1.628	0.0575	1.628
			(0.25)	(1.28)	(0.25)	(1.28)
Log(assets)			-0.0263***	-0.135***	-0.0315***	-0.201***
			(-3.78)	(-3.61)	(-3.14)	(-3.35)
F stat.	15.07	6.49	7.35	4.08	13.10	4.18
Prob.F	0.000	0.011	0.000	0.003	0.000	0.000
N	68899	56966	68864	56936	68864	56936

Panel C: Main predictor variable: Repurchase ratio, scaled by lagged assets

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3	c_cpx_a1	c_cpx_a3
Rep_r	-0.0714***	-0.202***	-0.0442***	-0.243	-0.0529***	-0.265
	(-3.71)	(-7.34)	(-2.87)	(-1.37)	(-3.19)	(-1.55)
Tobins Q			0.00219	0.00616	0.00188	0.00422
			(0.87)	(0.47)	(0.74)	(0.32)
ROA			0.01	1.139	0.0997	1.139
			(0.51)	(1.14)	(0.51)	(1.14)
Log(assets)			-0.0293***	-0.138***	-0.0342***	-0.198***
			(-5.04)	(-3.85)	(-4.28)	(-3.69)
F stat.	13.79	53.91	7.92	11.67	10.81	5.50
Prob.F	0.000	0.000	0.000	0.000	0.000	0.000
N	75580	62528	75536	62491	75536	62491

t statistics in parentheses (SE robust for heteroscedasticity)
* p<0.10, ** p<0.05, *** p<0.01

Table 17B: Fixed-effects regressions (consequences of buybacks on R&D expenditures)

This table reports the regression output for the investment effects of share repurchases (Formulas Table 9). The first two columns are univariate regression estimations, the third and fourth column add control variables and the fidth and sixth column add year dummies to control for fixed time effects. Parameters are estimated using Ordinary Least Squared (OLS). Three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See Panel A.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See Panel B.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See Panel C.

The two alternating dependent variables are the change in R&D expenditures over a short two year period (c_rd_a1) or a long four year period (c_rd_a3).

1. c_rd_a1: the value of R&D expenditures one year after the repurchases, minus the value of R&D expenditures the year before the repurchase, scaled by assets lagged by one year (equations 1a, 2a, 3a).
2. c_rd_a3: the value of R&D expenditures three years after the repurchases, minus the value of R&D expenditures the year before the repurchase, scaled by assets lagged by one year (equations 1b, 2b, 3b).

The number of observations and goodness-of-fit measures for each regression are reported at the bottom of each panel.

Panel A: Main predictor variable: Dummy Repurchase

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3
D_rep	-0.0164***	-0.0353***	0.00297	0.00622	0.00106	0.0112
	(-6.23)	(-8.31)	(-0.36)	(0.38)	(0.11)	(0.59)
Tobins Q			0.00399	0.0108**	0.00299	0.00881
			(1.22)	(2.02)	(0.86)	(1.50)
ROA			-0.367	-0.613	-0.367	-0.614
			(-1.02)	(-0.77)	(-1.02)	(-0.77)
Log(assets)			-0.0125	-0.0893***	-0.00738	-0.119***
			(-1.15)	(-3.32)	(-0.49)	(-3.01)
F stat.	38.87	69.05	15.03	25.93	8488.00	7368.00
Prob.F	0.000	0.000	0.000	0.000	0.000	0.000
N	46394	37857	46373	37837	46373	37837

Panel B: Main predictor variable: Dummy for start of buyback program

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3
D_start(rep)	-0.00933***	-0.0173***	-0.00898***	-0.0159***	-0.0100***	-0.0158***
	(-2.83)	(-3.54)	(-2.63)	(-2.83)	(-2.98)	(-2.89)
Tobins Q			0.00628***	0.0153***	0.00595***	0.0149***
			(4.23)	(4.18)	(4.00)	(4.01)
ROA			0.0569***	0.312***	0.0569***	0.311***
			(3.57)	(5.58)	(3.56)	(5.57)
Log(assets)			-0.000903	-0.0560***	0.00933**	-0.0657***
			(-0.31)	(-6.45)	(2.02)	(-5.29)
F stat.	8.02	12.50	15.00	27.19	7246.00	7621.00
Prob.F	0.005	0.000	0.000	0.000	0.000	0.000
N	42472	34635	42455	34619	42455	34619

Panel C: Main predictor variable: Repurchase ratio, scaled by lagged assets

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3	c_rd_a1	c_rd_a3
Rep_r	-0.0784***	-0.212***	0.0294	0.0591	0.0405	0.0576
	(-6.65)	(-9.37)	(0.35)	(0.34)	(0.46)	(0.33)
Tobins Q			0.00400	0.0108**	0.00299	0.00876
			(1.21)	(2.01)	(0.86)	(1.49)
ROA			-0.367	-0.613	-0.367	-0.614
			(-1.02)	(-0.77)	(-1.02)	(-0.77)
Log(assets)			-0.0129	-0.0891***	-0.0074	-0.118***
			(-1.21)	(-3.37)	(-0.50)	(-3.05)
F stat.	44.16	87.77	10.18	24.63	7.65	6.32
Prob.F	0.000	0.000	0.000	0.000	0.000	0.000
N	46394	37857	46373	37837	46373	37837

t statistics in parentheses (SE robust for heteroscedasticity)
* p<0.10, ** p<0.05, *** p<0.01

Table 17C: Fixed-effects regressions (consequences of buybacks on Employment)

This table reports the regression output for the investment effects of share repurchases (Formulas Table 9). The first two columns are univariate regression estimations, the third and fourth column add control variables and the fifth and sixth column add year dummies to control for fixed time effects. Parameters are estimated using Ordinary Least Squared (OLS). Three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See Panel A.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See Panel B.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See Panel C.

The two alternating dependent variables are the change in employment over a short two year period (c_emp) or a long four year period (c_emp_a3).

1. c_emp_a1: the number of employees one year after the repurchases, minus the number of employees the year before the repurchase, scaled by assets lagged by one year (equations 1a, 2a, 3a).
2. c_emp_a3: the number of employees three years after the repurchases, minus the number of employees the year before the repurchase, scaled by assets lagged by one year (equations 1b, 2b, 3b).

The number of observations and goodness-of-fit measures for each regression are reported at the bottom of each panel.

Panel A: Main predictor variable: Dummy Repurchase

	(1a) c_emp_a1	(1b) c_emp_a3	(2a) c_emp_a1	(2b) c_emp_a3	(3a) c_emp_a1	(3b) c_emp_a3
D_rep	-0.00192***	-0.00367***	-0.000939**	-0.00292**	-0.000524	-0.00243*
	(-6.10)	(-6.41)	(-2.21)	(-2.10)	(-0.70)	(-1.88)
Tobins Q			0.000418	0.00291	0.000391	0.00284
			(1.34)	(1.58)	(1.37)	(1.56)
ROA			0.00589	0.127	0.00588	0.127
			(0.72)	(1.22)	(0.72)	(1.22)
Log(assets)			-0.00324***	-0.00899***	-0.00294**	-0.0102***
			(-2.92)	(-4.57)	(-2.52)	(-4.08)
F stat.	37.25	41.08	11.78	8.08	8.68	5.07
Prob. F	0.000	0.000	0.000	0.000	0.000	0.000
N	73873	61075	73829	61042	73829	61042

Panel B: Main predictor variable: Dummy for start of buyback program

	(1a) c_emp_a1	(1b) c_emp_a3	(2a) c_emp_a1	(2b) c_emp_a3	(3a) c_emp_a1	(3b) c_emp_a3
D_start(rep)	-0.00018	-0.00021	-0.00181	-0.00253	-0.00178	-0.00231
	(-0.45)	(-0.34)	(-1.37)	(-1.39)	(-1.46)	(-1.41)
Tobins Q			0.0017	0.00420*	0.0016	0.00414*
			(1.38)	(1.89)	(1.37)	(1.87)
ROA			0.0941	0.178	0.0941	0.178
			(1.24)	(1.33)	(1.24)	(1.33)
Log(assets)			-0.00334**	-0.00962***	-0.00392*	-0.0117***
			(-2.28)	(-3.71)	(-1.96)	(-3.18)
F stat.	0.21	0.12	1.38	3.78	1.93	2.88
Prob. F	0.650	0.732	0.238	0.005	0.002	0.000
N	67553	55802	67518	55774	67518	55774

Panel C: Main predictor variable: Repurchase ratio, scaled by lagged assets

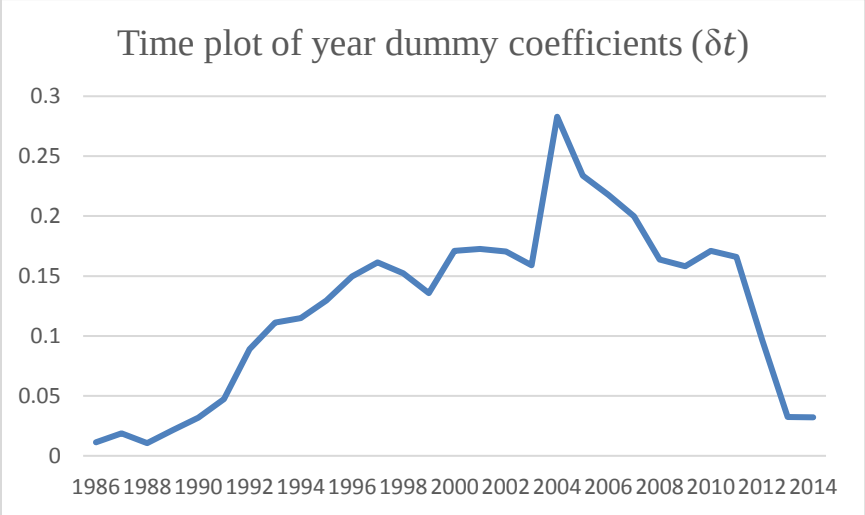
	(1a) c_emp_a1	(1b) c_emp_a3	(2a) c_emp_a1	(2b) c_emp_a3	(3a) c_emp_a1	(3b) c_emp_a3
Rep_r	-0.00950***	-0.0132*	-0.00685***	-0.0233	-0.00541**	-0.0221
	(-6.01)	(-1.68)	(-3.89)	(-1.25)	(-2.23)	(-1.23)
Tobins Q			0.00042	0.00292	0.00039	0.00284
			(1.34)	(1.58)	(1.37)	(1.56)
ROA			0.00589	0.127	0.00588	0.127
			(0.72)	(1.22)	(0.72)	(1.22)
Log(assets)			-0.00329***	-0.00913***	-0.00297***	-0.0103***
			(-3.03)	(-4.62)	(-2.62)	(-4.13)
F stat.	36.17	2.82	13.64	8.16	8.04	5.39
Prob. F	0.000	0.093	0.000	0.000	0.000	0.000
N	73872	61075	73829	61042	73829	61042

t statistics in parentheses (SE robust for heteroscedasticity)
* p<0.10, ** p<0.05, *** p<0.01

In the univariate OLS regressions, I find that repurchases are associated with a negative change in capital expenditures, R&D and employment. The linear dependence of changes in capital expenditures and R&D on share repurchases are always statistically significant at the 0.01 level, irrespective of the applied repurchase predictor variable. The negative relationship between employment and buybacks is less obvious from a statistical point of view. Still, the coefficients for the dummy variable for repurchases are negative and significant at the 0.01 level (see panel A of Table 17C). This indicates that, all else equal, firms with positive net repurchases on average cut employment in the subsequent years.

The results for the multivariate regression equations with added controls are reported in the third and fourth column of Table 17ABC. After the control variables are included, the relationship between investment and buybacks is more diffuse, but still negative. The positive coefficients for Tobin's Q and ROA show that growth opportunities and profitability are associated with increases in investment. At the same time, bigger firms (in terms of asset base) are inclined to slow down investment in later years. The last estimation model uses year dummies to increase the accuracy of the model. The majority of the year dummies have significant coefficients (not reported), which together with increasing coefficients of determination (R-squared) gives sufficient reason to belief that this estimation model is the best fitting model. A time plot of the average coefficients for the year dummies (average of all estimations) is presented in Figure 7.

Figure 7: Time plot of the average coefficient values for the year dummies in equations 3a and 3b: 1984-2014



I first discuss the relationship between repurchases and capital expenditures (Table 17A). Panel A presents the results for the estimation with the dummy variable for repurchases as main predictor variable of capital expenditures, panel B with the dummy for the start of a buyback program, and panel C for the relative scale of repurchases during the year. After the control variables are included, the relationship between capital expenditures and buybacks is more diffuse, but still negative. The negative effect of repurchases on investment is mostly larger for the longer interval period, but the power of the

test statistics usually decrease when the internal is longer (due to loss of observations and larger errors). The consequences of buybacks for capital expenditures are therefore economically larger in the long run, but the negative relationship is not per se stronger from a statistical point of view.

The interpretation of the coefficients in Table 17ABC is relatively straightforward. The estimated coefficient of -0.0118 for D_rep in column 5, panel A of Table 17A, indicates that a repurchasing firm invests on average 1.18% of lagged assets less in capital expenditures in the year after the repurchase (compared to the year before the repurchase), relative to non-repurchasing firms. Of course, this is on an all else equals basis. From the sixth column it becomes clear that the change in capital expenditures is lower when the third year after the repurchase is taken as point of measurement (-0.98%).

When a firm has positive buybacks in a certain year, while it did not have positive buybacks the previous year, it is seen as a buyback program starter (dummy value = 1). Panel B reports the regression results when the start of a buyback program is used as descriptor variable for changes in capital expenditures. The negative relation now is smaller for the short interval period (-0.80%), but stronger for the longer interval period (-2.56%). This makes economic sense, as a typical buyback program takes longer than a year to complete, and the consequences for investment will shift towards the long run.

Panel C reports the results for the regression with the continuous predictor variable "repurchase ratio", which is simply the net repurchases during a firm-year, scaled by lagged assets. The relationship between repurchases and investment policy is negative, and highly significant for the short interval period. On an all else equals basis, a one percent increase in net repurchases (scaled by assets) is associated with a 5.29% decrease (as of assets) in capital expenditures over the shorter time period and a 26.5% decrease (as of assets) in capital expenditures over the longer time period. Note that a 1% increase in relative net repurchases is a serious increase, as the average value for relative net repurchases (Rep_r) in a firm year is approximately 1.4% of asset value for the whole sample (see Table 10).

The coefficient of 0.00106 for D_rep in column 5, panel A of Table 17B, indicates that a repurchasing firm invests on average 0.106% of assets more in R&D in the year after the repurchase (compared to the year before the repurchase), relative to non-repurchasing firms. A negligible and insignificant positive relationship, but it still is counterintuitive. In the long run, I find a somewhat similar positive effect (1.12%), but both coefficients are not statistically significant. When the dummy for the start of a repurchase program is used as predictor variable I get results that are more in line with the main hypothesis that R&D expenses decrease (See Panel B). The rate of change of the conditional mean of R&D expenditures with respect to the start of a buyback program is estimated to be a negative 1% and a negative 1.58% for the two and four change period respectively. Both estimates are significantly different from zero. I did not detect statistically significant dependence of changes in R&D expenditures on the ratio of net repurchases (see Panel C).

The coefficient of -0.000524 for d_rep in column 5, panel A of Table 17C, indicates that a repurchasing firm reduces employment by 0.0524 employees per million dollars in assets in the year after the repurchase (compared to the year before the repurchase), relative to non-repurchasing firms. The long-term effect is bigger (-0.243 employees per million dollars in assets), but the changes in employees are not significantly different from zero at the 0.05 level. The coefficients of Rep_start in Panel B are also negative but not statistically significant either. The magnitude of the effect of an increase in relative repurchases on employment are more notable (-0.541 and -2.21 employees per million dollars in assets) when a relative measure of repurchases is used as predictor variable. The short-term effect of an increase in repurchases (as of assets) on employment is statistically significant at the 0.05 level, as can be seen in panel C of Table 17C.

One must be cautious when interpreting the results in this section as causal effects. The fact is that these regressions are subject to endogeneity concerns. Suppose a firm decides to increase investment efforts, then there will be less money left for payouts (reverse causality). Part of this concern is resolved by the chosen time frame in my regressions. The applied time interval for the change in investments is not equal to the year in which the repurchase took place (or did not take place). Another concern are omitted variables. The control variables capture part of the consequences on investment that cannot be attributed to repurchases, but to variation in growth opportunities, firm size and profitability. There is however still a solid chance that the observed changes in investment policy are due to external effects, which are not captured in my model (missing variables). In those cases, the models fail to capture a causal relation.

5.4. Sector results for the effect of share repurchases on investment

Table 18 reports the results for the multivariate estimation models with year dummies, which are estimated separately for each industry. The corresponding estimation equations can be found in Panel B of Table 9. Table 18A reports the effects of repurchases on capital expenditures, Table 18B displays the coefficients for R&D and Table 18C for employment. Note that only the coefficients for the relevant repurchase variables are displayed, while the models also use the controls and the year dummies as independent variables (coefficients not reported).

As can be seen in Table 18A, most coefficients for the repurchase variables are not statistically significant from zero. By splitting up the sample in sectors, the power of the regression estimations is actually reduced as there are less observations. If the t-test for a regression coefficient is not statistically significant, it is strictly speaking not appropriate to interpret the coefficient. The negative effects of repurchases on capital expenditures are statistically significant at the 0.05 level in most cases in the services sector, especially when a longer change interval is applied. A remarkable result is that the relationship between repurchases and future capital expenditures seems to be positive in the transport sector, although this finding does not find satisfactory statistical support. One can in fact not be sure that

the value of the corresponding parameter in the underlying regression model is not really zero (or even negative).

Table 18A: Fixed-effects (within) regression per industry (capital expenditures)

Table 18 reports the results for the (third) multivariate estimation model with year dummies, which are now estimated separately for each of the six industry groups. The corresponding estimation equations can be found in Panel B of Table 9. Only the coefficients for the relevant repurchase variables are displayed, the coefficients for the control variables and year dummies are not reported. Parameters are estimated using Ordinary Least Squared (OLS). Again, three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See first row of each panel.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See second row of each panel.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See third row of each panel.

Table 18A reports the effects of repurchases on capital expenditures, Table 18B displays the coefficients for R&D and Table 18C for employment. The number of observations (N) for each sector regression is reported directly below the coefficient.

Panel A: One year change in Capital Expenditures

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_cpx_a1	c_cpx_a1	c_cpx_a1	c_cpx_a1	c_cpx_a1	c_cpx_a1
D_rep	-0.00977	-0.000467	-0.0562**	-0.0143**	0.00153	-0.0134*
	(-0.58)	(-0.02)	(-2.05)	(-2.35)	(0.07)	(-1.66)
N	40307	431	5826	14752	5693	8527
D_start(rep)	-0.00627	-0.00181	-0.0221	-0.00577	-0.00483	-0.00412
	(-0.49)	(-0.18)	(-0.90)	(-1.47)	(-0.16)	(-0.39)
N	37080	388	5301	13144	5143	7808
Rep_r	-0.0672	-0.505	-0.168	-0.0396	-0.294	-0.0799
	(-0.41)	(-1.06)	(-0.93)	(-1.02)	(-1.02)	(-1.10)
N	40307	431	5826	14752	5693	8527

Panel B: Three year change in Capital Expenditures

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_cpx_a3	c_cpx_a3	c_cpx_a3	c_cpx_a3	c_cpx_a3	c_cpx_a3
D_rep	-0.0107	-0.00134	-0.0187	-0.0189**	0.0900	-0.00654
	(-0.18)	(-0.10)	(-0.28)	(-2.00)	(1.01)	(-0.35)
N	33960	347	4768	11678	4607	7131
D_start(rep)	-0.0295	-0.00979	-0.0339	-0.0115**	0.0234	0.0185
	(-0.41)	(-0.56)	(-0.42)	(-2.19)	(0.20)	(0.75)
N	31195	315	4353	10397	4152	6524
Rep_r	-0.300	0.113	-0.781	-0.0979	-0.567	-0.181
	(-0.52)	(0.48)	(-0.84)	(-1.56)	(-0.52)	(-1.03)
N	33960	347	4768	11678	4607	7131

t statistics in parentheses (SE robust for heteroscedasticity)

* p<0.10, **p<0.05, *** p<0.01

Table 18B: Fixed-effects (within) regression per industry (R&D)

Table 18 reports the results for the (third) multivariate estimation model with year dummies, which are now estimated separately for each of the six industry groups. The corresponding estimation equations can be found in Panel B of Table 9. Only the coefficients for the relevant repurchase variables are displayed, the coefficients for the control variables and year dummies are not reported. Parameters are estimated using Ordinary Least Squared (OLS). Again, three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See first row of each panel.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See second row of each panel.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See third row of each panel.

Table 18A reports the effects of repurchases on capital expenditures, Table 18B displays the coefficients for R&D and Table 18C for employment. The number of observations (N) for each sector regression is reported directly below the coefficient.

Panel A: One year change in R&D Expense

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_rd_a1	c_rd_a1	c_rd_a1	c_rd_a1	c_rd_a1	c_rd_a1
D_rep	0.00253	0.0193	-0.00113	-0.0153***	0.00167	0.000797
	(0.16)	(0.29)	(-0.33)	(-3.62)	(0.15)	(0.98)
N	30749	178	849	8218	804	5575
D_start(rep)	-0.0128**	-0.0437	-0.00232	-0.00588	0.000249	0.00162*
	(-2.33)	(-0.46)	(-0.60)	(-1.17)	(0.02)	(1.72)
N	28354	161	774	7298	721	5147
Rep_r	0.0556	-0.45	-0.0459	-0.0632**	0.095	-0.00361
	(0.38)	(-0.50)	(-0.85)	(-2.05)	(0.66)	(-0.53)
N	30749	178	849	8218	804	5575

Panel B: Three year change in R&D Expense

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_rd_a3	c_rd_a3	c_rd_a3	c_rd_a3	c_rd_a3	c_rd_a3
D_rep	0.0134	0.0789	-0.00346	-0.0253***	0.0864	0.00167
	(0.34)	(0.78)	(-0.72)	(-3.33)	(0.83)	(0.67)
N	25592	138	657	6241	607	4602
D_start(rep)	-0.0195**	0.0162	0.00414	-0.00868	0.0685	0.00127
	(-2.26)	(0.11)	(0.68)	(-0.98)	(0.51)	(0.72)
N	23556	126	602	5541	543	4251
Rep_r	0.0603	-0.337	-0.117	-0.172***	0.904	0.00921
	(0.17)	(-0.26)	(-1.56)	(-2.87)	(0.65)	(0.42)
N	25592	138	657	6241	607	4602

t statistics in parentheses (SE robust for heteroscedasticity)

* p<0.10, **p<0.05, *** p<0.01

Table 18B reports the estimated coefficients for the relationship between (future) R&D expenses and repurchases. Again, the services industry is the only industry where the results give sufficient support for the notion that repurchases made by firms result in lower investment. The estimated coefficients of -0.0153 for D_rep in panel A and -0.0253 in panel B, indicate that a repurchasing service firm invests on average 1.53% of asset value less in R&D in the year following the repurchase, and 2.53% in the third year following the repurchase. When the start of a buyback program is used to predict changes in R&D, the evidence suggests that manufacturing firms also lower R&D efforts after doing buybacks. For the remaining industries no reliable dependencies between R&D and repurchases are detected.

Table 18C: Fixed-effects (within) regression per industry (Employment)

Table 18 reports the results for the (third) multivariate estimation model with year dummies, which are now estimated separately for each of the six industry groups. The corresponding estimation equations can be found in Panel B of Table 9. Only the coefficients for the relevant repurchase variables are displayed, the coefficients for the control variables and year dummies are not reported. Parameters are estimated using Ordinary Least Squared (OLS). Again, three different predictor values for repurchases are used:

1. D_rep: Simple dummy variable for repurchases, with value 1 if net repurchases of firm i are positive in year t, otherwise the value is 0. See first row of each panel.
2. D_start (rep): Dummy variable indicating the start of repurchase activities, with value 1 if net repurchases of firm i are positive in year t and non-positive in the previous year, otherwise the value is 0. See second row of each panel.
3. Rep_r: Relative measure of the scale of the repurchase activities during a firm-year. Calculated as the net value of repurchases during a firm-year, divided by the beginning value of assets. See third row of each panel.

Table 18A reports the effects of repurchases on capital expenditures, Table 18B displays the coefficients for R&D and Table 18C for employment. The number of observations (N) for each sector regression is reported directly below the coefficient.

Panel A: One year change in Employment

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_emp_a1	c_emp_a1	c_emp_a1	c_emp_a1	c_emp_a1	c_emp_a1
D_rep	-0.000678	-0.00145**	-0.000562***	-0.00315***	-0.000106	-0.000436
	(-0.20)	(-2.11)	(-3.03)	(-2.67)	(-0.28)	(-0.47)
N	39638	413	5534	14345	5496	8403
D_start(rep)	-0.00213	-0.000449	-0.000660***	0.000873	-0.000415	-0.000428
	(-0.51)	(-0.51)	(-2.81)	(0.58)	(-0.83)	(-0.35)
N	36580	375	5054	12823	4984	7702
Rep_r	-0.0188	-0.0156	-0.00739***	-0.00898	-0.00685	-0.00783
	(-0.57)	(-1.24)	(-2.66)	(-1.18)	(-1.42)	(-0.93)
N	39638	413	5534	14345	5496	8403

Panel B: Three year change in Employment

	Manufacturing	Other	Resource	Service	Transport	Wholesale
	(1)	(2)	(3)	(4)	(5)	(6)
	c_emp_a3	c_emp_a3	c_emp_a3	c_emp_a3	c_emp_a3	c_emp_a3
D_rep	-0.00154	-0.00289	-0.000322	-0.00444**	0.00025	-0.00124
	(-0.25)	(-1.03)	(-0.82)	(-2.11)	(0.31)	(-0.56)
N	33427	335	4518	11308	4429	7025
D_start(rep)	-0.00378	-0.00726**	-0.000415	0.00167	-0.000686	0.000132
	(-0.51)	(-2.17)	(-0.81)	(0.71)	(-0.67)	(0.05)
N	30788	308	4134	10100	4009	6435
Rep_r	-0.0258	-0.00204	-0.00758	0.0059	-0.0114	-0.0185
	(-0.44)	(-0.04)	(-1.32)	(0.42)	(-1.16)	(-0.89)
N	33427	335	4518	11308	4429	7025

t statistics in parentheses (SE robust for heteroscedasticity)

* p<0.10, **p<0.05, *** p<0.01

Companies active in the resources sector seem to reduce capital expenditures and employment in the year directly after a repurchase. The negative relation between the repurchase variables and one year change in employment is observed and statistically significant for all three buyback proxies (See panel A of Table 18C). This effect does not persevere when the change in employment is measured over a four year time period. The relationship between buybacks and investment is weak in the manufacturing sectors. Even so, the manufacturing firms that start a buyback program do seem to lower R&D efforts by approximately 1.28% and 1.95% for the short and long time period respectively (See Table 18B). The statistical power of the test coefficients of the other sectors is insufficient to draw reliable conclusions for the relationship between repurchases and employment.

6. Conclusion and discussion

6.1. Summary and conclusion

One of the two purpose of this paper was to investigate the factors that drive the decision to repurchase company stocks, by looking at the effects of (changing) firm characteristics on the probability that a firm repurchases shares. Apart from this, the other major objective was to study the consequences of stock buybacks. The focus is on the relationship between repurchases and corporate investment, as measured by R&D expenditures, capital expenditures and employment. For this purpose, annual data of all NYSE, AMEX and NASDAQ constituents from North-America for the years 1984-2014 have been used, which resulted in a panel dataset with a total number of 92,901 firm-year observations for 8,340 unique firms.

Empirical tests show that buybacks are strongly related to several firm characteristics. Logistic regression analysis suggests that firms choose to repurchase shares when a range of conditions are met. I find a positive relationship between high profitability and operational cash flows and the use of buybacks. This makes economic sense, because buybacks are costly and preferably funded with internally generated cash. The evidence is also consistent with the agency costs theory, which posits that excess cash should be distributed to shareholders. Companies with large cash reserves show higher propensity to repurchase shares. The disciplining function of repurchases emerges in the negative relationship between leverage and the use of buybacks as well. Firms with conservative levels of debt are more inclined to repurchase shares. I also find support for the firm life cycle trajectory theorem, which posits that mature firms are confronted with a shrinking investment opportunity set. The larger and more mature firms in the sample are more inclined to use buybacks.

Furthermore, the empirical evidence suggests that companies are trading off investment for share repurchases. The evidence is consistent to the use of several different predictor values for repurchases: a repurchase dummy, a dummy indicating the start of a buyback program and a relative measure of repurchases (scaled to assets). I find that repurchases are associated with a negative change in future capital expenditures, R&D and employment. The negative relationship is observed over a one year period and over a longer three year period, which enables me to confirm the medium- to long-term presence of the effects as well. The negative relationship holds after controlling for growth opportunities, profitability and firm size and is present in the majority of the six investigated industries.

In earlier literature, several attractive features of buybacks have been identified that can explain this trade off. Signaling- and market timing theories suggest that buybacks are a powerful tool for managers to signal undervaluation. It is well documented that the announcement of a buyback program causes a temporary stock price pop, which can explain the wide range use in all investigated industries. For long, the general tendency was that buybacks are an innocent and more flexible means of paying out excess cash than dividends. This paper fuels the academic debate about the growing use of repurchases and its

consequences. The excessive use of buybacks is ultimately a form of disinvestment, possibly impeding the economy and hampering prosperity.

6.2. Limitations, discussion and future research

A key limitation in this paper is the use of annual data, which decreases the measurement accuracy of net repurchases and of other variables as well. The reliable measurement of repurchases is a difficult task anyway, due to the time difference between the announcement of repurchases and the point in time when the buyback program is actually executed. An improvement would be to use quarterly repurchase data, or to use exact repurchase announcement dates. Due to limited quarterly data availability and insufficient capacity or time to gather more sophisticated data, I did not opt for this. This would be a good direction for future research, as well as expanding the geographical scope to other regions than the United States. Future researchers are also advised to conduct research on sub periods. I would also welcome more evidence on the relationship between the use of repurchases and total payout. Does the growing use of buybacks imply that total payout increases as well?

When looking into the factors that influence the decision to repurchase shares, no significant effect was observed for the volatility of net income and the cost of stock option exercises. The market timing theory suggests that companies who repurchases shares exploit undervaluation, but I did not find support that buybacks are more common after a share price decline (proxied by annual stock return). The lack of an established relationship could also be the result of poor choice of proxies. Consider for instance market timing theories, which are hard to establish empirically when using annual return data.

Another flaw in my empirical analysis, is that no causal relationship of stock buybacks on corporate investment has been established. There is always a chance that the underlying relationship is affected by an omitted variable. Another potential problem is endogeneity and reverse causality. Differences in investment levels can for instance be explained by variation in appealing investment opportunities, instead of repurchases. I have equipped several strategies to address these problems, but they do not completely suffice from a statistical perspective. Do firms repurchase shares because they have no further investment opportunities, or do they actively trade-off valuable investment opportunities for the quick benefits of buybacks? In all honesty, I have not been able to find a statistically convincing and satisfactory answer to this question and my solution for endogeneity is not foolproof.

As can be seen in the methodology section, I used multiple techniques to address the endogeneity and selection problem. An alternative to my solutions would be to use a regression discontinuity design, but this is a rather difficult and technical method and outside the scope of this master thesis. The use of two-stage least squares could tackle the endogeneity problem. This is something that I looked into, but it turns out to be very difficult to find proper instruments. The relationship between repurchases and investments is one that could be described as a chicken and egg situation, but my results provide some evidence that cash is spent on repurchases that would otherwise be used to invest in the real economy.

For long, the prevailing idea was that buybacks are just a more flexible means of paying out excess cash than dividends. This paper contributes to the growing academic debate about the use of repurchases and its possible consequences for welfare. Policymakers should consider that the growing use of buybacks may come at the expense of corporate investment. In the end, this may slow down the economy. Now that tons of money are used in the monetary policy of quantitative easing (QE) to boost investment through lower interest rates, I would also advice policymakers and central banks to consider the effects of large scale buybacks.

7. References

Adam, T., & Goyal, V. K. (2008). The investment opportunity set and its proxy variables. *Journal of Financial Research*, *31*(1), 41-63.

Allen, F., Bernardo, A. E., & Welch, I. (2000). A theory of dividends based on tax clienteles. *The Journal of Finance*, *55*(6), 2499-2536.

Allen, F., & Michaely, R. (2003). Payout policy. *Handbook of the Economics of Finance*, *1*, 337-429.

Andriosopoulos, D., Andriosopoulos, K., & Hoque, H. (2013). Information disclosure, CEO overconfidence, and share buyback completion rates. *Journal of Banking & Finance*, *37*(12), 5486-5499.

Asquith, Paul, and Daniel Mullins, 1986, Signalling with dividends, stock repurchases and equity issues, *Financial Management 15*, 27–44.

Bagwell, L. S. (1992). Dutch auction repurchases: An analysis of shareholder heterogeneity. *The Journal of Finance*, *47*(1), 71-105.

Baker, M., & Wurgler, J. (2004). A catering theory of dividends. *The Journal of Finance*, *59*(3), 1125-1165.

Baltagi, Badi H. 2001. Econometric Analysis of Panel Data. Wiley, John & Sons.

Banyi, M., Dyl, E. A., & Kahle, K. M. (2005). Measuring share repurchases.

Bank of America Merrill Lynch (2014). BofA Merrill Lynch Fund Manager Survey Finds Investors Positioning Aggressively for Recovery in H2 (July 15, 2014). Retrieved from http://newsroom.bankofamerica.com/press-releases/economic-and-industry-outlooks/bofa-merrill-lynch-fund-manager-survey-finds-investo-3

Bartov, E., Krinsky, I., & Lee, J. (1998). Evidence on how companies choose between dividends and open- market stock repurchases. *Journal of Applied Corporate Finance*, *11*(1), 89-96.

Bens, D. A., Nagar, V., Skinner, D. J., & Wong, M. F. (2003). Employee stock options, EPS dilution, and stock repurchases. *Journal of Accounting and Economics*, *36*(1), 51-90.

Berk, J. B., Green, R. C., & Naik, V. (1999). Optimal investment, growth options, and security returns. *The Journal of Finance*, *54*(5), 1553-1607.

Billett, M. T., & Xue, H. (2007). The takeover deterrent effect of open market share repurchases. *The Journal of Finance*, *62*(4), 1827-1850.

Black, F. (1976). The dividend puzzle. *The Journal of Portfolio Management*, *2*(2), 5-8.

Blouin, J. L., Raedy, J. S., & Shackelford, D. A. (2011). Dividends, share repurchases, and tax clienteles: Evidence from the 2003 reductions in shareholder taxes. The Accounting Review, 86(3), 887-914.

Boudry, W. I., Kallberg, J. G., & Liu, C. H. (2013). Investment opportunities and share repurchases. *Journal of Corporate Finance*, *23*, 23-38.

Brav, A., Graham, J. R., Harvey, C. R., & Michaely, R. (2005). Payout policy in the 21st century. *Journal of financial economics*, *77*(3), 483-527.

Brockman, P., & Chung, D. Y. (2001). Managerial timing and corporate liquidity: evidence from actual share repurchases. *Journal of Financial Economics*, *61*(3), 417-448.

Bulan, L. T., & Subramanian, N. (2009). The firm life cycle theory of dividends. *Dividends and Dividend Policy, Baker KH (ed.). John Wiley & Sons, Inc.: Hoboken, NJ*, 201-213.

Comment, R., & Jarrell, G. A. (1991). The relative signalling power of Dutch- auction and fixed- price self- tender offers and open- market share repurchases. *The Journal of Finance*, *46*(4), 1243-1271.

Chamberlain, G. (1984). Panel data. *Handbook of econometrics*, *2*, 1274-1278.

Chan, K., Ikenberry, D. L., & Lee, I. (2007). Do managers time the market? Evidence from open-market share repurchases. *Journal of Banking & Finance*, *31*(9), 2673-2694.

Cheng, Y., Harford, J., & Zhang, T. T. (2015). Bonus-driven repurchases. *Journal of Financial and Quantitative Analysis*, *50*(03), 447-475.

Damadoran, A. (2014). Stock Buybacks: They are big, they are back and they scare some people! (September 22, 2014). *Musings on markets*. Retrieved from http://aswathdamodaran.blogspot.nl/2014/09/stock-buybacks-they-are-big-they-are.html

DeAngelo, H., DeAngelo, L., & Skinner, D. J. (2004). Are dividends disappearing? Dividend concentration and the consolidation of earnings. *Journal of financial economics*, *72*(3), 425-456.

DePillis, L. (2015). Why companies are rewarding shareholders instead of investing in the real economy (February 25, 2015). *The Washington Post.* Retrieved from https://www.washingtonpost.com/news/wonk/wp/2015/02/25/why-companies-are-rewarding-shareholders-instead-of-investing-in-the-real-economy/

Diggle, P. (2002). Analysis of longitudinal data. Oxford University Press.

Dittmar, A., & Field, L. C. (2015). Can managers time the market? Evidence using repurchase price data. *Journal of Financial Economics*, *115*(2), 261-282.

D'mello, R., & Shroff, P. K. (2000). Equity undervaluation and decisions related to repurchase tender offers: An empirical investigation. *The Journal of Finance*, *55*(5), 2399-2424.

Dobbs, R. & Rehm, W. (2005). The value of share buybacks. *McKinsey Quarterly (August 2005).* Retrieved from http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-value-of-share-buybacks

Fama, E. F., & French, K. R. (2001). Disappearing dividends: changing firm characteristics or lower propensity to pay?. *Journal of Financial economics*, *60*(1), 3-43.

Farre-Mensa, J., Michaely, R., & Schmalz, M. C. (2015). Financing payouts. *Ross School of Business Paper*, (1263).

Ginglinger, E., & Hamon, J. (2007). Actual share repurchases, timing and liquidity. *Journal of banking & finance*, *31*(3), 915-938.

Gruber, J. W., & Kamin, S. B. (2017). *Corporate Buybacks and Capital Investment: An International Perspective* (No. 2017-04-11). Board of Governors of the Federal Reserve System (US).

Grullon, G., & Ikenberry, D. L. (2000). What do we know about stock repurchases?. *Journal of Applied Corporate Finance, 13(1),* 31-51.

Grullon, G., & Michaely, R. (2002). Dividends, share repurchases, and the substitution hypothesis. *The Journal of Finance, 57*(4), 1649-1684.

Grullon, G., & Michaely, R. (2004). The information content of share repurchase programs. *The Journal of Finance, 59*(2), 651-680.

Gutiérrez, G., & Philippon, T. (2016). *Investment-less growth: An empirical investigation* (No. w22897). National Bureau of Economic Research.

Hanauer, N. (2015). Stock Buybacks Are Killing the American Economy. *The Atlantic (February 8, 2015)*. Retrieved from http://www.theatlantic.com/politics/archive/2015/02/kill-stock-buyback-to-save-the-american-economy/385259/

Hellevik, O. (2009). Linear versus logistic regression when the dependent variable is a dichotomy. *Quality & Quantity, 43*(1), 59-74.

Hosmer Jr, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). Applied logistic regression (Vol. 398). Chapter 9 and 10. John Wiley & Sons.

Hribar, P., Jenkins, N. T., & Johnson, W. B. (2006). Stock repurchases as an earnings management device. *Journal of Accounting and Economics, 41*(1), 3-27.

Jagannathan, M., Stephens, C. P., & Weisbach, M. S. (2000). Financial flexibility and the choice between dividends and stock repurchases. *Journal of financial Economics, 57(3),* 355-384.

Jagannathan, M., & Stephens, C. P. (2003). Motives for multiple open-market repurchase programs, *Financial Management* 32, 71-91.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review* 76, 323-329.

Jolls, C. (1998). *Stock repurchases and incentive compensation* (No. w6467). National bureau of economic research.

Kahle, K.M., 2002. When a buyback isn't a buyback: open market repurchases and employee options. *Journal of Financial Economics* 63, 235–261.

Kato, H. K., Lemmon, M., Luo, M., & Schallheim, J. (2005). An empirical examination of the costs and benefits of executive stock options: Evidence from Japan. *Journal of Financial Economics, 78*(2), 435-461.

Lazonick, W., & O'sullivan, M. (2000). Maximizing shareholder value: a new ideology for corporate governance. *Economy and society, 29*(1), 13-35.

Lazonick, W. (2014). Profits without prosperity. *Harvard Business Review, 92*(9), 46-55.

Lazonick, W. (2015). Stock buybacks: From retain-and-reinvest to downsize-and-distribute. *Center for Effective Public Management at Brookings*.

Lee, D., Shin, H., & Stulz, R. M. (2016). *Why Does Capital No Longer Flow More to the Industries with the Best Growth Opportunities?* (No. w22924). National Bureau of Economic Research.

Li, K., & McNally, W. J. (1999). Open market versus tender offer share repurchases: a conditional event study. *University of British Columbia, Finance Working Paper*, (98-2).

Lie, E. (2005). Operating performance following open market share repurchase announcements. *Journal of Accounting and Economics*, *39*(3), 411-436.

Lintner, J. (1956). Distribution of Incomes of Corporations Among Dividends, Retained Earnings, and Taxes. *The American Economic Review, 46(2)*, 97-113

Long, J. Scott (1997). Regression Models for Categorical and Limited Dependent Variables. Thousand Oaks, CA: Sage Publications.

Louis, H., & White, H. (2007). Do managers intentionally use repurchase tender offers to signal private information? Evidence from firm financial reporting behavior. *Journal of Financial Economics*, 85(1), 205-233.

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

Modigliani, F., & Miller, M. H. (1961). Dividend policy, growth, and the valuation of shares. *Journal of Business* 34, 411–433.

Porter, M. E. (1991). Capital disadvantage: America's failing capital investment system. *Harvard business review*, *70*(5), 65-82.

Rabe-Hesketh, S., & Skrondal, A. (2008). *Multilevel and longitudinal modeling using Stata*. STATA press.

Rubin, D. B. (1976). Inference and missing data. *Biometrika*, 581-592.

Skadden (2013). Share Repurchases. *Corporate Finance Alert (February 2013)*. Retrieved from https://www.skadden.com/newsletters/Corporate_Finance_Alert_Share_Repurchases.pdf

Stephens, C. P. and Weisbach, M. S. (1998). Actual Share Reacquisitions in Open-Market Repurchase Programs. *The Journal of Finance*, *53*, 313–333

The Economist. (2014). Share buy-backs, the repurchase revolution (September 13, 2014). Retrieved from http://www.economist.com/news/business/21616968-companies-have-been-gobbling-up-their-own-shares-exceptional-rate-there-are-good-reasons

Vermaelen, T. (1981). Common stock repurchases and market signaling. *Journal of Financial Economics 33*, 139–183.

Vermaelen, T. (2006). Share repurchases can be a good deal. *Financial Times (October 19, 2006)*. Retrieved from https://www.ft.com/content/86993f38-5f7c-11db-a011-0000779e2340

Von Eije, H., & Megginson, W. L. (2008). Dividends and share repurchases in the European Union. *Journal of Financial Economics*, *89*(2), 347-374.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: Journal of the Econometric Society*, 817-838.

Zhang, H. (2005). Share price performance following actual share repurchases. *Journal of Banking & Finance*, *29*(7), 1887-1901.

8. Appendix

7.1. Figures

Figure 1: Investment and buybacks as ratio of GDP: United States from 1984-2014 (External source: Gruber & Kamin, 2017)

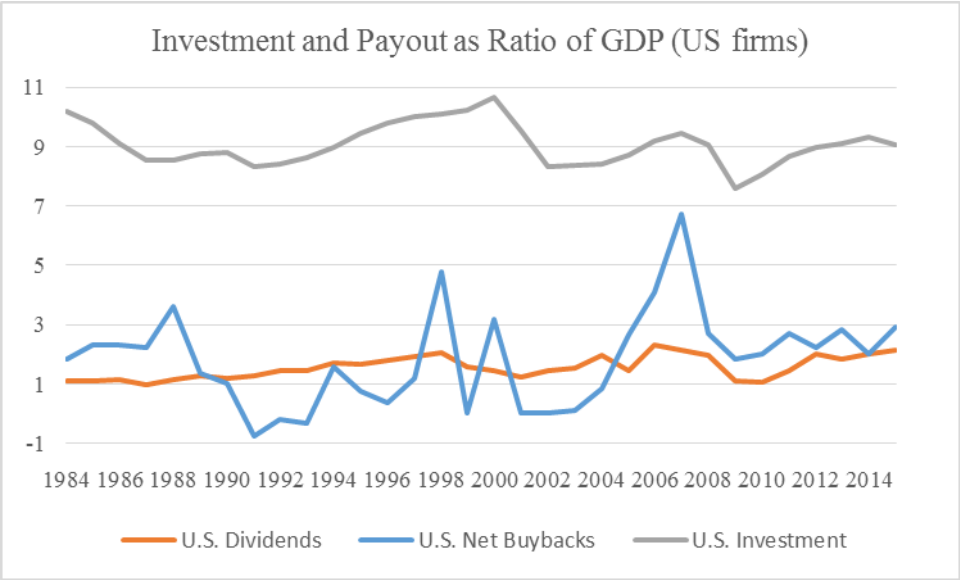
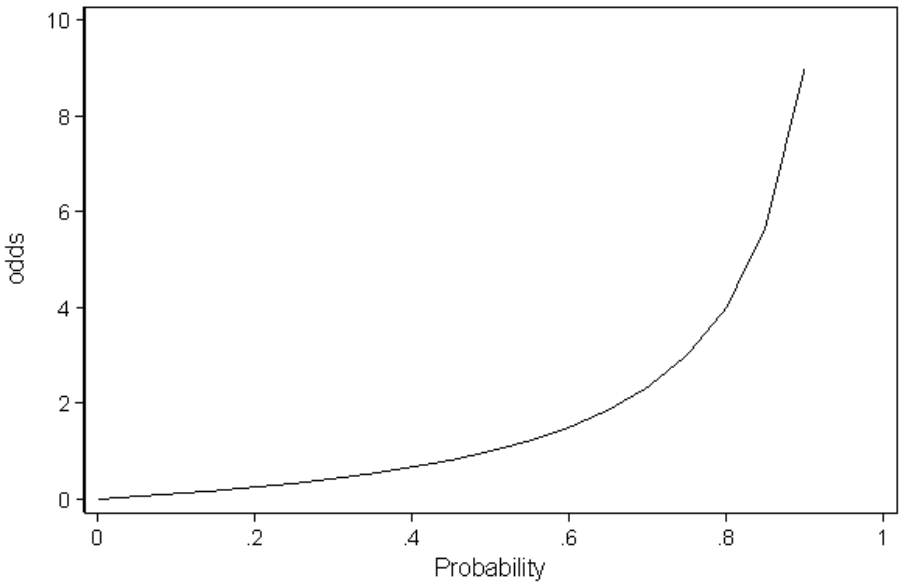


Figure 2: Plot of odds against probabilities



Example: If the probability of a repurchase by firm i in year t is 0.8, then the probability of not doing a repurchase is 0.2. The odds of a repurchase are then defined as 0.8/0.2 = 4.

Figure 3: Interpretation of odds ratio (doubling odds)

Before doubling odds		After doubling odds	
Probability	Odds	Odds	Probability
10%	0.11	0.22	18%
20%	0.25	0.5	33%
30%	0.43	0.86	46%
40%	0.67	1.33	57%
50%	1	2	67%
60%	1.5	3	75%
70%	2.33	4.67	82%
80%	4	8	89%
90%	9	18	95%

Notes:
- Odds = p/(1-p)
- Odds ratio coefficient of 2 means that a one-unit increase in x doubles the odds that Y is 1
- Doubling odds is not the same as doubling probability:
- If p is close to 0, then doubling odds is almost the same as doubling probability
- If p is close to 1, then doubling the odds is almost the same as halving 1-p

Figure 4: aggregate dividends and stock buybacks of all firms: 1984-2014

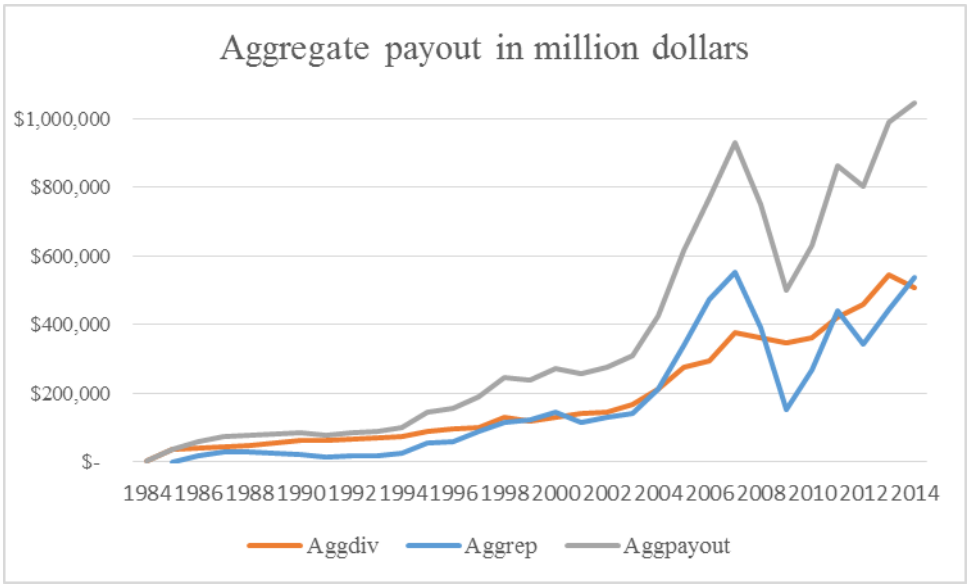


Figure 5: Average dividends, repurchases and payout per firm: 1984-2014

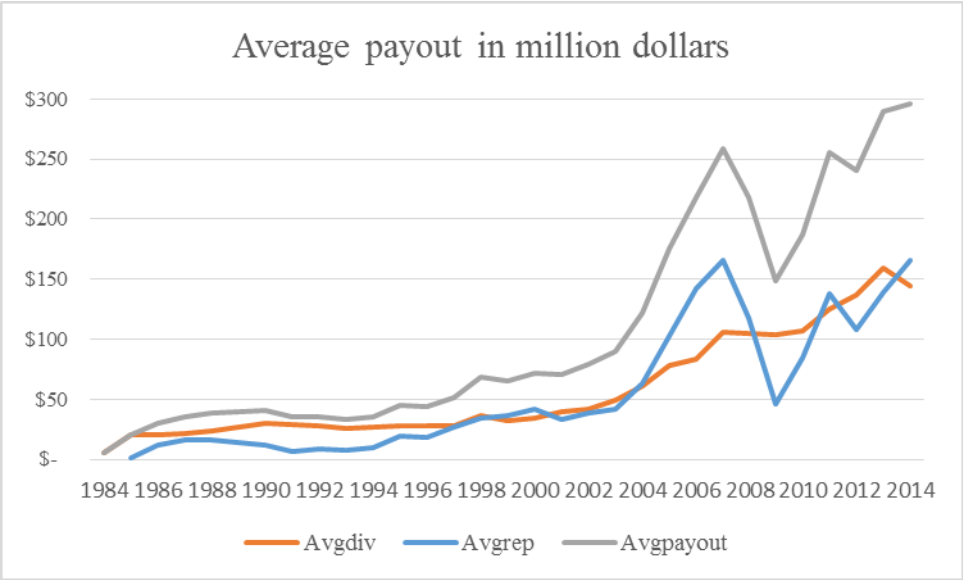


Figure 6: Average dummy values for dividends, repurchases and payout: 1984-2014

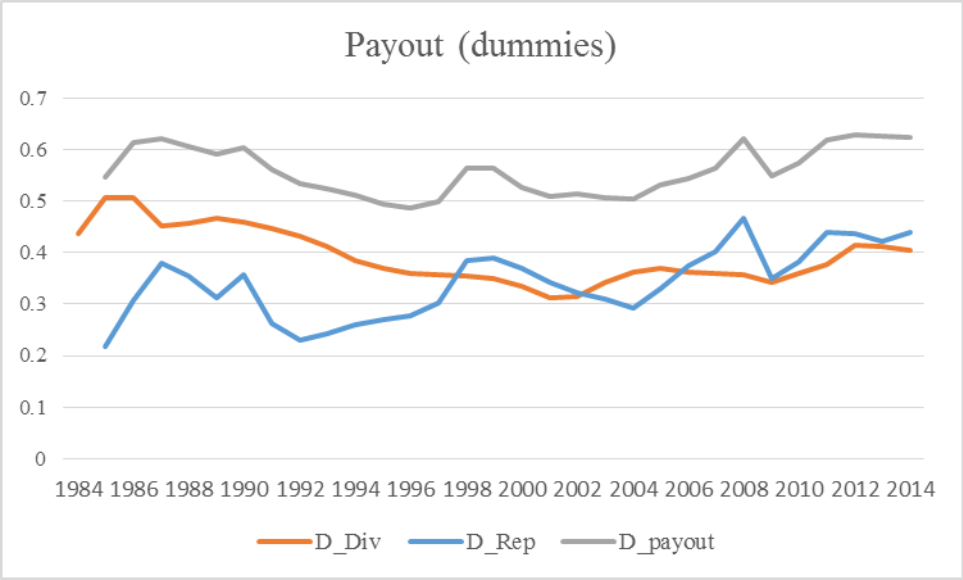
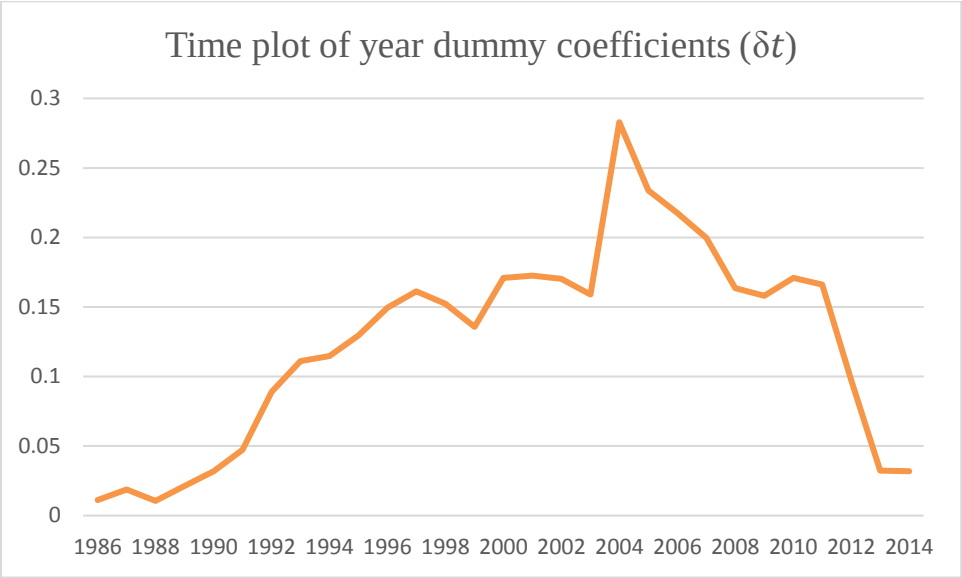


Figure 7: Plot of the average coefficient values for the year dummies in equations 3a and 3b: 1984-2014



7.2. Tables

Table 1: Hypotheses

This table lists the hypotheses regarding the motivations for using buybacks that are formulated in section 2.4. These are based on the literature review and are tested using logit regressions.

Hypothesis	Proxy
1. Companies will do buybacks when they have high earnings	ROA
2. Companies will do buybacks when they have volatile earnings	Vol_income (past 3 years)
3. Companies will do buybacks when they have high operating cash flows	CFO_A ratio (scaled to lagged assets)
4. Companies will do buybacks after a share price decline	Stock Return (previous year)
5. Companies will do buybacks when leverage is low	Debt ratio end of last year
6. Companies will do buybacks when they are prone to high agency costs	Cash rate end of last year
7. Companies will do buybacks when the cost of stock option exercises is high	Option_R (previous year)
8. Companies will do buybacks when there are limited investment opportunities	Tobin's Q
9. Companies will do buybacks when they have a big asset base	Asset value

Table 2: Variables and derivation/computation

Variables	Description	Unit
A. ID variables		
Ticker	Ticker symbol (ID) for firm	
Year	Fiscal year	
Period	Quintiles of year (1984-1993 = 1, 1994-1999 = 2, 2000-2004 = 3, 2005-2009 = 4, 2010-2014 = 5)	
SIC	Standard Industry Classification Code	
Sector	Grouping variable based on SIC Code (Service, Resource, Wholesale & Retail, Manufacturing, Transportation & Public Utility, Administration & Other)	
B. Firm Characteristics		
MVE	Market value of total equity for each company (end of year)	Millions
BVE	Book value of total equity for each company (end of year)	Millions
Assets	Book value of total assets for each company (end of year)	Millions
Liabilities	Book value of total liabilities for each company (end of year)	Millions
Cash	Cash and short-term investments for each company (end of year)	Millions
Cash rate	Ratio of cash and short-term investments over total assets	%
MTB	Market to Book Ratio (MVE over BVE) for each company	Ratio
Tobins Q	Tobin's Q (market value of equity over total assets)	Ratio
Debt ratio	Debt ratio (total liabilities over total assets)	Ratio
Book lever	Book leverage (total liabilities over book value of equity)	Ratio
Market lever	Market leverage (total liabilities over market value of equity)	Ratio
Turnover	Turnover/Sales (net)	Millions
Vol_turnover	Standard deviation of last 3 year values of turnover, divided by turnover	Volatility
Income	Net income (loss)	Millions
Vol_Income	Standard deviation of last 3 year values of net income, divided by net income	Volatility
CFO	Cash flow from operating activities	Millions
CFO_A ratio	Cash flow from operating activities over beginning total assets	Ratio
NCF	Net cash flow (cash flow from operating, financing, and investment activities)	Millions
NCF_A ratio	Net cash flow over beginning total assets	Ratio
Vol_cf	Standard deviation of last 3 year values of net cash flow, divided by net cash flow	Volatility
EPS	Earnings per share (basic)	Ratio
EPS Diluted	Earnings per share (diluted)	Ratio
Dilut	Dilutive effect on EPS	%
Option	Implied option expense (decrease in net income due to expense of stock based compensation, f.e. stock options)	Millions
Option_R	Implied option expense as % of net income	%
ROA	Return on assets (net income over beginning total assets)	Ratio
ROE	Return on equity (net income over beginning book value of equity)	Ratio
C. Payout Variables		
Rep	Net repurchases during the year (treasury stock method or retirement method)	Millions
D_Rep	Dummy repurchase (value 1 if net repurchases for firm i in year t is positive, otherwise 0)	Dummy
D_Start(rep)	Dummy variable for start of repurchase activities (value 1 if net repurchases for firm i are positive in year t and non-positive in the previous year, otherwise the value is 0.	Dummy
Rep_R	Repurchase ratio (as % of beginning total assets)	%
Div	Total (non-stock) dividend payments during the year (income statement)	Millions
D_Div	Dummy Dividend (value 1 if dividend for firm i in year t is positive, otherwise 0)	Dummy
Div_R	Dividend Ratio (as % of beginning total assets)	%
Payout	Total Payout (repurchases and dividends)	Millions
D_Payout	Dummy Payout (value 1 if D_Rep = 1 or D_Div = 1, otherwise 0)	Dummy
Payout_R	Payout Ratio (as % of beginning total assets)	%

D. Investment variables		
Capex	Capital expenditures during the year	Millions
Capex_A ratio	Capital expenditures during the year (as % of total beginning assets)	%
Capex_S ratio	Capital expenditures during the year (as % of sales/turnover)	%
C_cpx_a1	Capital expenditures one year after the repurchases, minus capital expenditures the year before the repurchase, scaled by assets lagged by one year	%
C_cpx_a3	Capital expenditures three years after the repurchases, minus capital expenditures the year before the repurchase, scaled by assets lagged by one year	%
R&D	R&D expenditures during the year	Millions
R&D_A ratio	R&D expenditures during the year (as % of total beginning assets)	%
R&D_S ratio	R&D expenditures during the year (as % of sales/turnover)	%
RD_C(t)	Change in R&D (over period t)	%
C_rd_a1	R&D expenditures one year after the repurchases, minus R&D expenditures the year before the repurchase, scaled by assets lagged by one year	%
C_rd_a3	R&D expenditures three years after the repurchases, minus R&D expenditures the year before the repurchase, scaled by assets lagged by one year	%
Employees	Amount of employees per company	Thousands
Empoyees_A	Amount of employees per million in assets	Exact
C_emp_a1	Number of employees one year after the repurchases, minus number of employees the year before the repurchase, scaled by assets lagged by one year	Emp_A
C_emp_a3	Number of employees three years after the repurchases, minus number of employees the year before the repurchase, scaled by assets lagged by one year	Emp_A
E. Other variables		
Price	Closing share price	Dollars
Stock Return_(t)	Stock return over period t	%
Ret (mkt)	Annual market stock return (weighted of sample)	%