Are stock buybacks crowding out real investment? Empirical evidence from U.S. firms*

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Abstract

We investigate the role of stock buybacks in the decline of investment for U.S. non-financial firms from 1992 - 2017. We show that shareholder value maximization, fueled by stock-based manager compensation, has led U.S. firms to divert resources from real investment to share repurchases to increase stock prices. Using micro-data from U.S. firms balance sheets and manager compensation, we estimate two dynamic panel data models: (i) to analyze the effects of share repurchases on capital investment; (ii) to examine the interaction between stock-based CEO pay and the likelihood of share repurchases. We find that stock buybacks have a negative effect on capital investment with this effect being stronger among large firms, operating in non-competitive markets. Moreover, an increase in stock options make firms more likely to repurchase shares. Our findings suggest that stock-based compensation creates incentives for managers to focus on increasing shareholder value by repurchasing shares at the cost of declining real investment and long-run growth.

Keywords: Share repurchases, stock options, investment, shareholder value, firm data

JEL Codes: C23, D20, G11, G31, G35

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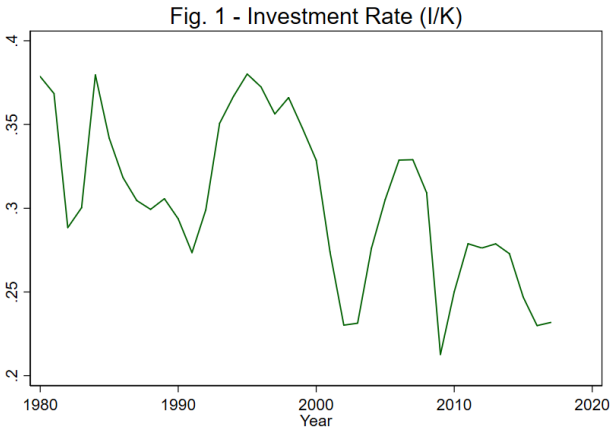
1 Introduction

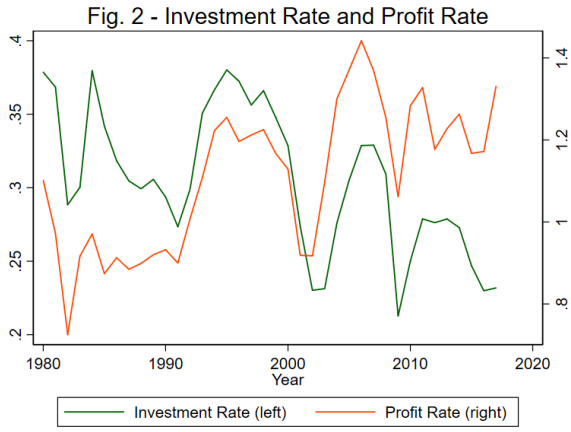
A spectre is haunting the U.S. economy - the spectre of stock buybacks.

In a March 2014 letter to the executives of 500 S&P companies, Laurence Fink, BlackRock's CEO, warns that "in the wake of the financial crisis, many companies have shied away from investing in the future growth of their companies. Too many companies have cut capital expenditure and even increased debt to boost dividends and increase share buybacks."[1] Yet, by looking at most recent figures, it seems that corporate executives of U.S. firms did not give much thought of Mr Fink's concerns.

In fact, according to a Goldman Sachs report, in 2018 the management board of 500 S&P companies will authorize the execution of $1 trillion in stock buybacks, up 53% from 2017 and far exceeding the record-$850 billion in 2007. Analysts argue that the upsurge in share repurchases can be largely explained by tax savings and repatriation of overseas profits triggered by Trump's tax reform introduced in November 2017 - economic resources that, instead of financing new investment projects, are flowing into shareholders' pockets.

Over the last four decades, the investment rate of U.S. firms has been constantly slowing down. As shown in Figure 1, the annual growth rate of gross capital stock for 1000 S&P non-financial companies was around 32% in the 1980s and declined steadily up to 26% in the 2010s.



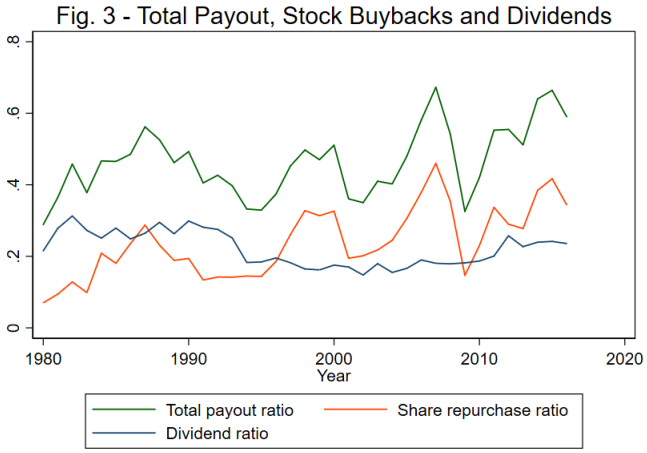


Yet, from Figure 2, it emerges that the decline in physical investment has occurred despite a high and increasing profit rate, with this gap getting wider after the dot-com crash of the early 2000s and, to a greater extent, after the financial crisis. Meaning that, in the last two decades, U.S. business sector has been systematically under-investing with respect to profitability.

Furthermore, if we look at the evolution of the gross payout ratio in Figure 3, we notice that, as investment was faltering, U.S. firms have been distributing an increasing share of profits to shareholders. The total payout (green line) almost doubled from 33% in 1995 to 60% in 2016. In this figure, it is also

[1] The text of letter sent by Larry Fink, BlackRocks chairman and CEO, encouraging a focus on long-term growth strategies is available online: http://online. wsj. com/public/resources/documents

clearly shown that the rise in payout ratio is primarily driven by the increase in stock buybacks (orange line), which, since the mid-90s, have increased on average by 20 percentage points – from 14% to 34% –, whereas dividend payment (blue line) remains roughly constant around 20% of net earnings over the entire period.



This evidence arises a set of fundamental questions: why should U.S. firms prefer to distribute cash to shareholders by repurchasing shares instead of investing in capital assets? Did the shift towards share-based executive compensation change managers' incentives structure in favor of short-term market valuation? What is the role of expectations of financial investors on the future development of stock price in influencing firm's investment decisions?

The aim of this paper is to empirically investigate whether shareholder value maximization, fueled by stock-based manager compensation, has led U.S. firms to divert resources from capital investment towards share repurchases to increase stock prices. In fact, by simultaneously increasing the demand of shares and reducing the supply of total shares outstanding, stock buybacks are expected to positively affect share price [2]. With a substantial part of total compensation consisting in stocks and stock options, managers have a personal interest in increasing shareholder value by repurchasing shares at the cost of declining investment and long-run growth.

This "crowding out" hypothesis was primarily put forth by Lazonick and O'sullivan (2000). They argue that the increasing orientation towards shareholder value, fostered by both institutional and organizational changes occurred in the '80s, made it possible the shift in management strategy from "retain-and-reinvest" to "downsize-and-distribute": if firms used to retain and reinvest most of their profits in the production, from then on they have become increasingly encouraged to downsize the labor force and distribute earnings to shareholders by means of dividends and stock buybacks. Such changes fundamentally consisted in: at institutional level, the development of markets for corporate control and

[2] This ultimately depends on the market reaction, and thus on investors' expectations, to a share repurchase announcement, whose effect in the literature is not so clear, especially regarding the length and size of it with respect to firms characteristics and market structure [REF].

the increasing role of investment funds (pension funds, hedge funds, etc) in the equity markets; at organizational level, the introduction of share-based remuneration scheme for managers. These corporate governance and institutional reforms, firmly advocated by agency theorists such as Fama and Jensen (1983), were primarily intended to reconcile managers and shareholders' interests and thus to induce managers to run the business according to the view of shareholder value, that is maximizing the market value of equity, instead of focusing on the long-run growth of the company

In this paper, we investigate the effect of shareholder value orientation, as expressed by an increase in stock buybacks and share-based remuneration schemes, on firms investment decisions. Using micro-data from U.S. firms balance sheets and manager compensation, we estimate two panel data models: (i) an investment model to analyze the effects of share repurchases on capital investment; (ii) a share repurchase model to examine the interaction between stock-based CEO pay and the likelihood of share repurchases. The investment model is estimated using the Arellano-Bond GMM estimator, which allows to control for both unobserved heterogeneity and the endogeneity problem arising from the dynamic setting; whereas for the share repurchase model we estimate a Random Effect-Tobit regression, which is particularly suitable in case of censored dependent variables.

We find that share repurchases have a negative effect on capital investment, with this effect being stronger among large firms operating in non-competitive markets. We also find that an increase in exercised and unexercised stock options makes firms more likely to repurchase shares.

Our findings suggest that stock-based compensation creates incentives for managers to focus on shareholder value by repurchasing shares, with this coming at the cost of lower investment. Therefore, maximizing shareholder value may have ambiguous effects on the firm's performance: on one hand, by encouraging managers to undertake repurchase programs, it boosts firm's market valuation, leading to a higher manager and shareholder's wealth, at least in the short-term; on the other hand, by subtracting resources that could be invested in capital assets, it undermine firm's productivity and wages, lowers competitiveness and may eventually hamper profitability and market valuation in the medium or long-term.

This evidence is intended to serve as empirical motivation for a macro-financial agent-based model aimed at exploring how changes in firm's objective function and investment decisions (e.g. increasing shareholder value orientation) affects emerging macroeconomic dynamics, with a special focus on growth, financial stability and distribution (van Treeck (2008), Riccetti, Russo, and Gallegati (2016)) Moreover, that framework would also allow: at micro level, to model and analyze how the role of heterogeneous expectations of financial investors (e.g. speculative vs patient) on the future development of stock price influence managers' decision between investment and stock buybacks (Dawid, Harting, and van der Hoog (2018)); at macro level, to explain how the long-term decline in investment and the persistent shortage in aggregate demand is compatible with stock price inflation and increasing payout ratio, bringing some

insights to the "stagnation-financialization" puzzle (Foster and McChesney (2012)).

2 Literature review

2.1. Theoretical framework

There's been a huge debate in economic research around the advantages and disadvantages of shareholder value maximization as fundamental principle of corporate governance.

The first scholars to advocate the need for and the importance of shareholder value maximization have been Fama and Jensen (1983) and Jensen (1986). To solve agency problems related to the conflict of interests between shareholders and managers "open corporations", i.e. publicly listed companies, would need to implement mechanisms of control that would allow to constrain manager's power and induce her to run the business according to the view of shareholder value. The rational is the following: in so far as the share price reflects the discounted value of expected future stream of cash flow, all internal decisions undertaken by the organization should be aimed at maximizing the market value of equity. In this way, shareholder value maximization is not only the primary goal of corporate governance, but also the ultimate measure to assess company's success.

Fama and Jensen (1983) point out that these mechanisms of control may either be internal (or organizational), i.e. under control of the organization, or external (or market-based), i.e. out of control of the organization but potential target of government regulation. The former are associated to the board of directors appointed by shareholders and the adoption of stock-based remuneration schemes; the latter consist in the creation of highly efficient stock markets (or market for take over), which would act as a disciplinary force over manager behavior. By realigning managers and shareholders' interests, these mechanisms of control are meant to limit agency problems and make the company more efficient and competitive. In light of this, agency theorists considered the shift in corporate governance towards shareholder value orientation as a way for the U.S. firms to get back on the path of growth after the economic crisis of the 1970s and the increasing competition coming from international markets, e.g. Japan.

Lazonick and O'sullivan (2000) and Lazonick (2014) call into question the agency theory approach by arguing that the increasing shareholder value orientation, fostered by those institutional and organizational changes advocated by agency theorists and eventually occurred in the '80s, made it possible the shift in management strategy from "retain-and-reinvest" to "downsize-and-distribute". If in the post-World War II period U.S. firms used to retain and reinvest most of their profits in the production, thereafter the predominance of shareholder value orientation has encouraged them to downsize the labor force and distribute profits to shareholders by means of stock buybacks and dividend payment. Therefore, in their view, the shift in investment strategy from productive assets towards stock buybacks might

explain, on one hand, the slowdown of real investment and growth rate, and, on the other hand, the growth in corporate payout ratio, the increased firms' market valuation, the rise in income inequality between shareholders and managers vs workers.

2.2. Empirical literature

The prolonged period of stagnation that is characterizing the development of global economy in the aftermath of the Great Recession has reinvigorated the research interest in the driving forces behind investment and growth. As we have seen in Figure 1 and 2, the investment rate in the U.S. economy had been slowing down even before the financial crisis, while in the same period profitability and market valuation were growing. This evidence appears to contradict traditional theories of investment based on Tobin's Q and financial constraints.

Gutiérrez and Philippon (2016) distinguish between two broad categories of explanation for low investment: "theories that predict low investment *because* they predict low Tobin's Q and theories that predict low investment *despite* high Tobin's Q". Considering that investment has been weak relative to market valuation, the authors believe that the second group of theories requires a deeper investigation. Among them, the recent empirical literature has paid particular attention to the following hypotheses: weak aggregate demand, uncertainty, market concentration and financialization.

Bond, Klemm, Newton-Smith, Syed, and Vlieghe (2004) highlight that, in case of persistent bubbles in stock market, the standard Q-ratio is affected by measurement errors which cast doubt on its explanatory power; in this case, cash flow variables may provide additional information to explain corporate investment. Yet, the interpretation of cash flow variables is not always straightforward, in that the latter can be seen as a measure of either financing constraints (Fazzari, Hubbard, and Petersen (1987)) or expected future profitability not captured by Tobin's Q (Bond, Klemm, Newton-Smith, Syed, and Vlieghe (2004)). To disentangle the effects of cash flow, financing conditions and expected profits, the authors test the effects of professional earnings forecasts from IBES database. Based on a sample of 700 publicly traded UK companies, the results show that, once they control for analysts forecasts, cash flow variable becomes insignificant. Meaning that, rather than financing constraints, such a variable reflects the expectations on future profits that are not captured by Tobin's Q. Yet, when alternative cash-flow measures, such as sales growth, are considered, the estimated coefficient turns out to be still positive and significant.

In the literature on investment, the variable sale is typically treated as proxy for aggregate demand. Recently, many empirical works have emphasized its role in explaining the decline in investment, especially after the Global Financial Crisis (see Bond, Rodano, and Serrano-Velarde (2015) on Italian manufactoring sector; Bussière, Ferrara, and Milovich (2015) on a set of 22 advanced economies).

All the theories of low investment presented above emphasize the role of real factors in harming

investment, such as weak demand, low expected profits, high uncertainty, etc. Little regard has been paid to financial factors, except for financing constraints that, as we have seen, have played only a limited role. However, it should be noted that the secular decline in the investment rate has occurred in a context of global financial deepening. This unusual coexistence between economic stagnation and financial expansion led many scholars to question the relationship between the real and the financial sector of the economy, with a particular focus on the impact that the development of capital markets had had on ownership structure, corporate governance and investment decisions by publicly traded companies, both in developed and, even to a lesser extent, developing countries.

Stockhammer (2004) has a leading role in initiating the empirical analysis on the link between "financialization" and investment.[3] In his paper, first he develops a micro theory of firm to explain how the development of financial markets, by shifting the balance of power towards shareholders, has changed management priorities and firm's investment decisions, leading to a lower desired growth rate in favour of short-term profits and market valuation; secondly, building on this theoretical framework, he carries out an empirical investigation of the effects of financialization – captured by 'rentier income', i.e. the ratio of interest and dividends gained from the financial sector over value added – on capital accumulation in four advanced economies, finding that rentier income has had a negative impact on investment especially in Anglo-Saxon countries, while this effect is lower in Germany and France.

Following Stockhammer (2004), Van Treeck (2008) builds a Post-Keynesian growth model to study how the increasing shareholder value orientation affects capital accumulation. Yet, contrary to Stockhammer, Van Treeck focuses on the role played by dividend payments to shareholders, finding evidence that higher payout ratio has undermined capital investment in the US, with this effect being particularly stronger for the period 1980-2004, especially during the New Economy boom.

It should be noted that both Stockhammer and Van Treeck's models are grounded on a time series framework and estimated using country-level data for a number of advanced economies. Orhangazi (2008) analyzes the financialization hypothesis using firm-level data from U.S. non-financial corporations, by examining the two channels through which financialization could affect investment: on the one hand, he tests whether an increase in rental income arising from financial opportunities, by changing manager's incentives structure, would hamper investment; on the other hand, he examines whether the increased payments to financial sector would constrain investment by decreasing available internal resources. To disentangle these two effects, the author employs two different financial variables: (i) *financial profits*, that is the amount of income gained from financial operations, measured by the sum of interest income and equity in net earnings; (ii) *financial payouts*, that is the total payments to the financial sector, given by the sum of interest expense, cash dividends and stock buybacks. The regression results show that

[3] According to a widely-cited definition by Epstein (2005), in broad terms, by financialization it is meant "the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies."

financial payouts have had a negative effect on investment, no matter the type of industry and firm size, whereas the impact of financial profits is negative for large firms but positive for small ones, suggesting that the latter may use proceeds from financial activities to finance real investment. More recently, the financialization hypothesis has received further support from Davis (2018) for the US business sector and Tori and Onaran (2015) for the UK case.

In the empirical works mentioned above, the role of financialization is mainly captured by the flow of financial payments and financial income as reported in the firms' balance sheets, consisting in the sum of interests and dividends that firm payout to or earn from the financial market. Yet, in Figure 3 we have seen that the rise in payout ratio of U.S. corporations is primarily driven by the increase in stock buybacks, which since the mid-90s have systematically overcome dividend payment, becoming the primary method to payout shareholders.[4] For this reason, we believe that a deeper investigation on the causes and effects of stock buybacks should deserve more attention.

Gutiérrez and Philippon (2016); Gutierrez and Philippon (2017) investigate the effects of increasing concentration and common ownership on investment and stock buybacks for U.S. companies. The idea is that firms operating in non-competitive markets do not face the threat of entry firms and thus have weak incentive to innovate and invest. Moreover, those firms whose shares are held by institutional investors – i.e. quasi-indexer institutional ownership – are more focused on short-term market capitalization rather than long-run growth: by fueling a short-termist view, common ownership put pressure on managers to create value for shareholders by increasing payout ratios and financial investment at the cost of lower real investment. In fact, the authors claim that, despite they invest less, "these firms spend a disproportionate amount of free cash flows buying back their shares" (Gutierrez and Philippon (2017)).

Furthermore, corporate finance literature on stock buybacks provides valuable insights on the economic motivations behind the decision to repurchase shares and their effects on real and financial variables.

There are several explanations which describe the reasons why a firm should decide to repurchase its shares: the price support hypothesis, according to which firms execute share repurchase programs to boost share price, also in presence of overvalued equity, and generate abnormal returns (Liu and Swanson (2016))[5]; the free cash flow hypothesis, which states that repurchases serve to distribute cash flow in excess to mitigate potential over-investment by management, and thus firms tend to increase cash payouts in response to deterioration of growth prospects (Jensen (1986); Grullon and Michaely (2004); Lee and Suh (2011)); signaling (or information content) hypothesis, according to which firms, by repurchasing shares, send signals about future profitability to investors when markets are incomplete

[4] In Europe, dividend payment remains the preferred method to remunerate shareholders, though, since the late 1990s, stock buybacks have dramatically increased also among European firms (Sakinc (2017).

[5] This notions is also embraced by the famous American investor Warren Buffet, who in his 2000 Berkshire letter states: "repurchases are all the rage, but too are all too often made for an unstated and, in our view, ignoble reason: to pump or support the stock price".

(Massa, Rehman, and Vermaelen (2007)).

Furthermore, Bhargava (2013) studies the dynamic inter-relationship between CEO pay, share repurchases and investment, finding that stock-based remuneration schemes, such as exercised and granted options, increase firm's propensity to repurchase shares, whereas the latter causes a reduction in real investment, such as R&D and capital assets.

Almeida, Fos, and Kronlund (2016) examine the impact of EPS forecast on the likelihood of repurchases and the consequent effect on the real investment. The results show that the probability of repurchasing is higher for those firms that would just miss the EPS forecast in absence of a repurchase program, confirming the idea that repurchases are chosen as a strategic operation to support share prices. Moreover, they conclude that EPS-motivated repurchases are detrimental to real investment, meaning that those firms typically do buybacks to meet EPS forecast with resources that could be invested in employment, R&D and capital expenditure.

The present paper attempts to build a bridge between the literature on investment and the one on share repurchases. On the one hand, we examine whether the increasing shareholder value orientation has altered investment decisions by U.S. non-financial corporations, by testing the effects of stock buybacks on investment and seeing under which conditions (e.g. time period, firm size and market structure) this relationship holds true; on the other hand, we empirically investigate the key factors behind the decision to repurchase shares, with a special focus on the role played by stock-based CEO pay in affecting manager's incentives and time horizon.

3 Descriptive evidence

To explore the relationship between investment, share repurchases and stock-based compensation, we start by comparing the mean of selected variables between different groups of firms: repurchasing versus non-repurchasing firms and option-paying versus non-option-paying firms. In addition, we compute t-tests to check whether such differences are statistically significant.

Table 1: Repurchasing vs Non-repurchasing firms, t-test. 1980-2017

	(1) Repurchasing m1	(2) Non-repurchasing m2	(3) Diff m2-m1
Re-investment rate	0.37	0.44	0.07***
Profit rate	0.17	0.15	-0.02***
Dividend rate	0.10	0.08	-0.02***
Cash/Assets	0.16	0.18	0.02***
Market-to-Book	2.91	2.53	-0.37***
EPS	1.72	0.90	-0.82***
Observations	15835	15264	31099

From Table 1 we notice that, on average, repurchasing firms have higher profit rate (+2%) but lower re-investment rate (-7%) with respect to non-repurchasing firms. Meaning that, although they earn more, they re-invest less. Where does the extra surplus go? Apparently to shareholders. Indeed, repurchasing firms also tend to pay more dividend (+2%) and accumulate less cash holdings (-2%). Consequently, it is not accidental that repurchasing firms report better financial performance, as reflected by the higher market valuation and EPS, in percentage points, +15% and +91% respectively. In summary, share repurchasing firms tend to retain and reinvest a lower share of profit than non-repurchasing firms, despite of their higher profitability and market valuation. Moreover, the higher dividend ratio and lower cash holdings seem to suggest that, consistent with the free cash-flow hypothesis, most profitable companies tend to distribute cash flow in excess to shareholders by repurchasing shares in order to mitigate the probability of over-investment.

Table 2: Options paying vs Non-option paying firms, t-test. 1980-2017

	(1) Option paying m1	(2) Non-option paying m2	(3) Diff m2-m1
Re-investment rate	0.34	0.43	0.08***
Opeating Surplus/Asset	0.19	0.15	-0.04***
Share Repurchase ratio	0.21	0.09	-0.12***
Market-to-Book	3.58	2.36	-1.21***
EPS	2.06	1.00	-1.06***
Dividend rate	0.09	0.09	-0.00
Cash/Asset	0.17	0.17	0.00
Observations	9270	21829	31099

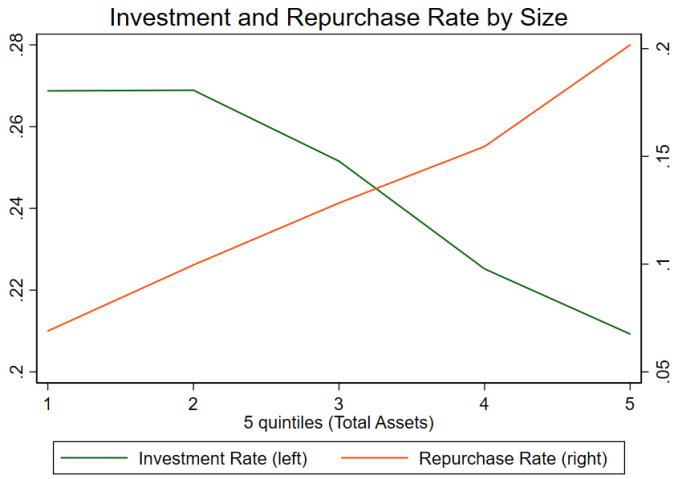
Table 2 shows the difference in mean between option-paying vs non-option paying firms, with the

corresponding significance level from the t-test. Similarly to repurchasing firms, stock option-paying firms on average have a higher operating surplus (+4%) but a lower re-investment rate (-8%) than their counterparts. Moreover, share repurchases are considerably higher (+12%) among firms paying stock options to CEOs. Consistent with our hypothesis, this evidence supports the idea that stock-based compensation is associated to larger stock buybacks – this hypothesis will be tested in the regression model. It should not come as a surprise that, in so far as they repurchase more shares, option-paying firms exhibit also significantly higher values of market valuation (+51%) and EPS (+106%), signaling that such firms are more committed to the creation of shareholders value. Finally, the differences in average dividend and cash holdings are insignificant between the two groups. To sum up, we observe similar characteristics in investment policy and operating performance between repurchasing and option-paying firms, vis-à-vis their respective counterparts. As well as their repurchaser peers, option-paying firms retain and re-invest a lower share of profits than non-option paying firms, despite higher profitability and market valuation. There seems to be no substantial differences in dividend and cash holdings, whereas share repurchases are significantly higher among those firms that pay stock options to managers.

In the figure below average investment and share repurchase rate by size quintiles are compared, where size is defined by firm's total asset. This figure shows that the investment rate is monotonically decreasing along firms size, whereas repurchase rate is monotonically increasing. Therefore, on average, small firms have a higher investment rate than large firms – respectively 27% against 20% – and tend to repurchase a lower amount of shares – less than 1% of operating surplus in contrast to 20% spent by largest firms. One can interpret these figures by arguing that small firms invest more because of higher growth opportunities than large firms which, conversely, have reached a mature phase with declining growth prospects. The market structure in which those firms operate is also important, if we consider that large firms tend to be concentrated in less competitive markets, where the decline in competition would allow them to adopt collusive behavior to defend their market position, resulting in lower incentives to invest and innovate.

From Table 3 we can also notice that, on average, the largest firms not only have a lower investment rate and a higher repurchase rate, but also a higher profit rate, a higher leverage ratio and lower share of assets kept as cash holdings.

From this evidence, it emerges that the increased amount of internal and external resources accumulated by largest firms is not used to finance new investment, neither kept as liquid financial assets, but is distributed to shareholders by means of stock buybacks; an hypothesis that we will empirically test later in the regression model.



Data: 1695 S&P Compustat non-financial firms

Table 3: Sample mean of selected variables by firm size, 1980-2017

Size	Investment Rate	Repurchase Rate	Profit Rate	Cash/Asset	Leverage Ratio	Market-to-Book
1 Smallest	.27	.07	.14	.23	.17	2.26
2	.27	.10	.17	.21	.17	2.50
3	.25	.13	.17	.18	.20	2.60
4	.24	.15	.18	.13	.26	2.90
5 Largest	.20	.20	.17	.12	.28	3.38
N	31026	31026	31026	31026	31026	31026

4 Data

4.1 Data description

To analyze the relationship between capital investment, share repurchases and stock-options, two different data sets are used: S&P Compustat for annual firms data and ExecuComp for annual manager compensation data.

The main data source is Standard and Poor's Compustat. We start with all firm-year observations of the U.S. publicly listed companies for the period of 1980-2017. Then we exclude financial (SIC codes 6000-6999) and utility (SIC codes 4000-4999) companies, because they are subjected to a specific regulatary framework. Moreover, we require the dependent variables (capital expenditure and share repurchase), as well as some main explanatory variables (market-to-book ratio, sales, cash dividend), to have non-missing and non-negative values. Firm-level data are known to be characterized by the presence of large outliers. To tackle this issue, we adopt a twofold strategy: first, all variables included in the regression model are winsorized, that is, observations falling into the upper or lower 1% or more of each variable's distribution are dropped; second, we exclude firms with permanently negative operating profits, which is a signal of unusual financial troubles. In addition, we require firms to have at least 4 years of life to exclude newly born firms whose operating performance might be impaired with respect to the average firm. After the cleaning process, the resulting data set consists of 31,099 firm-year observations across

1695 firms and 38 years, from 1980 to 2017.

The ExecuComp database provides information about managers' personal characteristics and compensation by type of income from 3671 firms by 1992. In order to compare the two data sets, manager data are rearranged by firm: for each variable the yearly average of top five executives by firm is computed. This method permits to compare ExecuComp with Compustat annual data on firms by using firm's identifier (code 'gvkey') to match common firm-year observations. Following Bhargava (2013), the focus is restricted on the top five executives. Indeed, they are likely the most influential individuals in the corporate governance, those who undertake the relevant decisions concerning the business model and the investment strategy of the company. Top five executives are defined by ranking all the company's managers by income (salary plus bonus) and keeping those with the five highest scores. Given the extremely high variance in stock options across firms, the same data screening process used for Compustat data is applied. In this case, because the distribution of stock options is highly skewed towards the left – meaning that many firms do not use stock-based compensation at all – we drop observations only in the upper 1% of the distribution. Except for in-the-money stock option, whose observations falling into the bottom 1% are also cut, given the presence of highly negative values in the left-tail of the distribution. Finally, we exclude missing values for the main explanatory variables included in the regression model, that is exercised stock options, unexercised stock options and in-the-money vested options. The final data set consists of 3,671 firms across 26 years, for a total of 43,659 time-year observations.

Then the Compustat and ExecuComp data sets are merged using firm identifier and year. Of the total 61,627 firm-year observations, only 13,131 are matched after merging the two data sets, consisting in 1006 Compustat firms exhibiting non-missing values of stock-options for the period of 1992-2017. This is the data set used to estimate our regression models.

Some considerations about the size and the nature of the panel data might be useful. Firstly, it is possible that our panel data is not very representative of the entire population of U.S. firms but is likely to over-represent large firms.[6] Consequently, it is important to bear in mind that our conclusions apply especially to large public corporations. Nevertheless, to prove that the empirical relationship between investment and share repurchases is robust to wider samples of firms, we estimate the investment model - in which stock options are not included - also using pre-merger Compustat firm data which starts from 1980 and comprises both options-paying and non-options-paying firms. Subsequently, contrary to other works (cfr. Bhargava (2013)), we use an unbalanced panel data in order to avoid the risk of sample bias arising from a balanced panel.

The table of summary statistics of the regression variables is available in the Appendix.

[6]This is due essentially to two reasons: (i) large firms can afford to pay stock options to corporate managers more than what small firms can do; (ii) private non-listed companies are a priori excluded from Compustat data set.

5 Model

5.1 Investment model: Definition of variables

Let us start by describing the main variables included in the regression model of investment.[7] The investment model is given by

$$(I/K)_{i,t} = \beta_0 + \beta_1(I/K)_{i,t-1} + \beta_2(REP/TS)_{i,t-1} + \beta_3(X)_{i,t-1} + \eta_t + \mu_i + \epsilon_{i,t} \tag{1}$$

The fact that investment is an intrinsically dynamic phenomenon leads us to estimate a dynamic panel data. In fact, because firms make investment decisions based on expectations of future returns which in turn are affected by past performances, we expect capital stock to slowly adjust to changing economic conditions. The inclusion of the lagged dependent variable on the right-hand side captures the dynamics of the changes in capital to its optimal level, while the first lag of the explanatory variables reflects the role of past performance on the current investment decision.

The dependent variable is the investment rate, given by the ratio of gross capital expenditure (CAPEX) over beginning-of-the-year capital stock (L.PPENT); this is a measure of the annual growth rate of capital stock, before depreciation. The main explanatory variable is the share repurchase ratio, that is the gross repurchase (PRSTKC) over the lagged total common shares outstanding (CSHO). We also employ an alternative, more formally correct, measure of share repurchase according to the simulations by Banyi et al. (2008), that is gross share repurchase (PRSTKC) minus preferred stock (PRSK) over lagged total book assets (AT). In line with the empirical literature on investment, we include a set of independent variables ($X_{i,t-1}$) from the firms balance sheets as additional explanatory variables of investment.

First of all, the following cash flow variables are considered: sales (SALES), as a proxy for capacity utilization to capture the effects of effective demand (Fazzari and Mott 1986) and operating surplus (OIBDP = "operating income before depreciation"), which might both explain financing constraints (Fazzari et al. 1987) or expected future profitability (Bond et al. 2004); both variables are scaled by lagged capital stock (L.PPENT). As an alternative measure of operating performance, ROA is also considered, that is net income (OIADP-XINT-TXT = operating surplus before depreciation minus taxes and interest expenses) over lagged book asset.

Second, to analyze the effects of financing constraints on investment which are not captured by cash flow variables we include the leverage ratio, that is the ratio of total debt (the sum of short (DLC) plus long (DLTT) term debt) scaled by lagged book asset. Debt-ratio – total debt over the sum of debt plus market value of equity [REF] – and interest expense – interest and related expense (XINT) over lagged book asset – are also considered.

[7] Compustat variable's label is in brackets

Moreover, we measure company's market valuation with Tobin's Q and Market-to-Book ratio. Following Gutiérrez and Philippon (2016), Tobin's Q is defined as the market value of equity plus book value of total asset (AT) minus book value of equity divided by book value of total assets, where the market value is common shares outstanding (CSHO) times the closing stock price at the end of the year (PRCC_F) and the book value of equity is total assets (AT) minus total liabilities (LT). The Market-to-Book ratio is simply market value of equity over book value of equity as defined before. Then, a set of time year dummies is included to control for macroeconomic shocks.

Since we are mostly interested in the relationship between share repurchase and investment, the variables just described are treated as control, pointing to firm characteristics and operating performance that in some way necessarily affect firm's investment decisions and, as such, must be included in every model specification; leaving them out would cause a problem of endogeneity due to omitted variables.

Yet, there might be alternative explanations of the recent slump in investment which are not captured by our regressors. To test the economic relevance of these hypotheses and to check whether the effects of share repurchase remain significant, we estimate alternative model specifications including additional explanatory variables. For instance, it is argued that the recent slowdown of physical investment can be explained by the rise of intangible assets brought about by technological change and ICT revolution (Döttling, Ladika, and Perotti (2018)). We test the intangible hypothesis using two different variables: investment in intangible assets, that is the ratio of intangible asset (INTA) over lagged total assets; investment in R&D (XRD), defined as R&D expenditure over lagged total assets.

Furthermore, we examine the effects of market concentration on investment in that a decline in competition could put lower pressure on firms to invest, in so far as the enhanced market power would allow them to maximize profit by increasing prices. To this end, we compute the commonly used Herfindahl index, which stands for the market share of a firm – in terms of sales and market value – with respect to its industry. The sales Herfindhal index is given by the sum of the squares of firm's sales over total industry sales, where the industry is defined by taking the first two digits of the SIC code (Standard Industrial Classification).

5.2 Investment model: Estimation and results

Our econometric strategy is the following: first we estimate the investment model to analyze the effects of share repurchases on capital investment; second, we estimate the share repurchase model to examine the interaction between share repurchases and stock options. The rationale is that firstly we want to prove that the increase in share repurchases, by taking away resources that could be invested in capital assets, have an adverse effect on real investment; secondly, proved that this effect actually exists, we want to study the determinant factors behind the firm's decision to repurchase, focusing on the role played by stock-based manager compensation. If this second relationship is also verified, we will be led

to conclude that stock-based manager compensation encourages managers to focus on the maximization of stock price by repurchasing shares at the cost of declining real investment.

We estimate the investment equation (1) using a dynamic panel data model. We motivated this choice in Section 2.3. Here we present the techinque used to estimate the model. We start by estimating an Ordinary Least Square (OLS) and a Fixed-effects (FE) models. Both these models are incosistent: in the OLS model the lagged dependent variable is positively correlated with the fixed effects in the error term, leading to upward biased estimate; by applying the mean-deviation transformation, the FE estimator removes time-invariant individual effects, but it does not eliminate the "dynamic panel bias" (Nickell 1981) stemming from the negative correlation between the transformed lagged dependent variable and the transformed error term (Roodman 2009), leading to downward bias estimate. Yet, as Bond points out (2002), the fact that the estimated coefficients are biased in two opposite directions constitutes a useful check in that it defines the range whithin which a consistent estimate should lie.

To overcome the endogeneity problem, the first-differenced Arellano-Bond GMM estimator is used. This estimator has at least three advantages that make it a suitable estimation technique for the investment models. First, it allows to eliminate individual effects by taking the first difference from the model equation. Second, the source of endogeneity is removed by instrumenting the lagged dependent variable with its own lags which are uncorrelated with the error term but correlated with the variable. Moreover, this method is particularly suitable when the model contains non-strictly exogenous explanatory variables. This is very likely to be the case in our investment model where it is reasonable to assume that firm's cash flow, operating performance and financial strategy are endogenous to investment decisions. In that case, potentially endogenous independent variables are treated in the same way of the lagged dependent variables: their lags will be available as instrumental variables and thus enter the instrument set.

One problem associated with the first-differenced GMM estimator is that it amplifies the number of missing values which, in the case of unbalanced panel data with gaps, could lead to a non-negligible loss of information and efficiency. This motivates the use of "forward orthogonal deviation" (FOD) estimator as an alternative estimation technique, which rather than subtracting the previous observation from the current value, it substracts the average of all future avaiable observations of the variable. Consequently, only the last observation of the sample will be lost.

Table 4 shows the regression coefficient of the investment model. The first thing to notice is that the coefficients of the lagged dependent variables in the two GMM modes – columns 3 and 4 – fall within the range defined by the estimates of the OLS and FE models, indicating that these models are not only consistent but also well specified. Secondly, as expected, we note that share repurchase enters the regression with a negative sign, which is highly significant in three out of the four models, and most

Table 4: Investment Model, 1992-2017

	(1) OLS	(2) FE	(3) diff-GMM	(4) fod-GMM
L.Investment/Capital Stock	0.447***	0.203***	0.216***	0.407***
	(0.0164)	(0.0213)	(0.0666)	(0.0471)
L.Sales/Capital Stock	0.00112***	0.00320***	0.00164	0.000619
	(0.000253)	(0.000666)	(0.00234)	(0.00102)
L.Opeating Surplus/Capital Stock	0.0189***	0.0230***	0.0272**	0.0119*
	(0.00265)	(0.00434)	(0.0109)	(0.00719)
L.Leverage/Assets	-0.124***	-0.141***	-0.523***	-0.260***
	(0.0118)	(0.0205)	(0.124)	(0.0489)
L.Market-to-Book ratio	0.00593***	0.00815***	0.00271	0.00706***
	(0.000672)	(0.000902)	(0.00293)	(0.00145)
L.Share Repurchase ratio	-0.00465***	-0.00150	-0.0138**	-0.0108***
	(0.00108)	(0.00131)	(0.00586)	(0.00339)
Observations	10842	10842	9147	10842
Number of firms		990	960	990
R^2	0.475	0.276		
Time effects	yes	yes	yes	yes
Instruments			163	290
p-value Hansen test			0.583	0.198
p-value A-B test (AR2)			0.124	0.275

Standard errors in parantheses. * < 0.1 ** < 0.5 *** < 0.01

importantly, in both consistent models. This means that greater share repurchases result in lower capital investment in the following period. Now let us focus on the results of our first consistent model, i.e. the first-differenced GMM model in the third column. In this model the second lag of the dependent variables and the first lag of the independent variables are included in the instrument set and then collapsed, to limit the number of instruments. Therefore, the lagged dependent variable is considered endogenous while the explanatory variables predetermined; the total number of instruments is 163. The estimation shows that operating surplus is positively correlated with investment rate, while leverage and share repurchase are negatively correlated. Sales and Market-to-Book ratio are not statistically significant. As previously argued and as shown in the box below the table, first-differenced GMM model suffers from lower number of observations due to the fact that gaps in unbalanced panel data are magnified after first-differencing. This effect can be avoided using forward orthogonal deviation estimator, whose regression coefficients are shown in column 4. In this model all variables are treated as endogenous, with the second and third lags entering the instrument set. We can see that not only the sign of the *share repurchase*, *leverage*, *operating surplus* are unchanged, but also the *market-to-book ratio* turn out to be both positve and significant, while *sales* remains insignificant. The latter becomes significant only by adding up to seven lags in instrument list; yet, one should be careful to include so many lags because the power of Hansen test of joint validity of instruments decreases as the number of intruments increases.

As robustness check, we estimate different panel data models based on different time period and firm size. The first two columns of Table 5 shows the regression results of the investment model for the decade before and after the financial crisis of 2007-8. These models are estimated using the forward orthogonal

deviation (FOD) GMM estimator, which proved to be more efficient amongst the consistent estimators in case of unbalanced panel data with gaps.

By looking at the results in Table 5, we can see that the estimated coefficients of share repurchases are negative and statistically significant in both models, indicating that the negative effects of share repurchases on investment are robust to different time periods: the decade before and after the 2007-8 sub-prime mortgage crisis. Interestingly, we also notice that the significance of the coefficients of *operating surplus* and *sales* varies across time periods: in the pre-crisis period operating surplus plays a significant role in driving investment while sales is insignificant; after the financial crisis, in the aftermath of the Great Recession, the fall in aggregate demand, captured by sales variables, drives drown investment, whereas profits recovers faster and becomes uncorrelated to investment. This evidence confirms the hypothesis that, especially after the financial crisis, weak aggregate demand is a key factor in explaining low investment (Bond, Rodano, and Serrano-Velarde (2015); Bussière, Ferrara, and Milovich (2015)). Moreover, these results provide support to the notion of missing link between profit-investment (Stockhammer, 2005; van Treeck 2008), which was also observable in Figure 2.

The columns 3 and 4 in Table 5 show the estimates of investment model for large (3) and small (4) firms, which are defined, respectively, by the top and the bottom quintile of firms' total assets. Unsurprisingly, the coefficient of share repurchases is a highly significant for large firms while it is insignificant for small firms. Meaning that stock buybacks tend to be more common and more detrimental for investment among large firms, while they have no significant effects among small firms. This result could have been partially deduced from Table 3 revealing that largest firms, on average, have spent 20% of their operating surplus between 1980-2017, contrary to the 0.7% of smallest firms. In addition, we can see that the determining factors of investment decisions vary substantially across firm size: among large firms, *operating surplus* and *leverage* are significant predictors of investment, whereas among small firms investment are more dependent on *sales* and *market-to-book ratio*. These results might be interpreted in the following way: small firms rely more on domestic aggregate demand and investment opportunities than large firm, whose investment are more sensitive to profits and financing conditions and less sensitive to sales and market valuation.

One may reasonably argue that investment are also influenced by alternative factors which are not present in the previous model. If this is the case, the estimates of the independent variables would be biased in that omitted variables falling in the error term may partly explain the effect on investment which is wrongly attributed to the included variables. To avoid this risk, alternative model specifications are also analyzed.

In the empirical literature on investment increasing attention has been posed on the role played by intangible assets and market concentration.

Table 5: Investment Model - Robustness check: Time and firm size

	(1) pre-crisis ('98-'08)	(2) post-crisis (08-'17)	(3) Large firms	(4) Small firms
(Investment/Capital Stock)$_{t-1}$	0.368***	0.249***	0.395***	0.242***
	(0.0599)	(0.0578)	(0.0561)	(0.0831)
(Sales/Capital Stock)$_{t-1}$	0.001	0.003**	-0.001	0.004***
	(0.00109)	(0.00128)	(0.00150)	(0.00100)
(Operating Surplus/Capital Stock)$_{t-1}$	0.016**	0.014	0.022**	-0.001
	(0.00845)	(0.00903)	(0.0106)	(0.0112)
(Leverage/Assets)$_{t-1}$	-0.207***	-0.156**	-0.171*	-0.183*
	(0.0575)	(0.0634)	(0.100)	(0.0949)
(Market-to-Book)$_{t-1}$	0.007***	0.006***	0.002	0.008
	(0.00187)	(0.00205)	(0.00194)	(0.00517)
(Share Repurchase/Total Shares)$_{t-1}$	-0.010**	-0.007*	-0.016***	-0.001
	(0.00442)	(0.00323)	(0.00589)	(0.0141)

Clustered standard errors in parantheses. * < 0.1 ** < 0.5 *** < 0.01

It is argued that the rise of intangible assets brought about by the ICT revolution may potentially explain the reason why U.S. firms are employing a decreasing amount of fixed capital, leading to a slump in physical investment (Döttling, Ladika, and Perotti (2018)). To test this hypothesis we include the ratio of intangibles over total assets in our regression model. The results in column 1 of Table 6 show that intangible assets have a negative effect on capital investment, but this is not significant, while the coefficient of share repurchases remain negative and statistically significant. Similar results are obtained if R&D expenditure instead of intangibles is employed. Therefore, the first impression is that the rise of intangibles assets did not play a crucial role in the decline of physical investment.

Another widely discussed explanation of the recent slump in investment in U.S. economy points to the adverse effect of the increased market concentration on firms' propensity to invest (Gutiérrez and Philippon (2016)). The idea is that a decline in competition could put lower pressure on firms to invest, in so far as the enhanced market power would permit to maximize profit by increasing the price. Therefore, if this hypothesis is correct, we would expect the coefficient of market concentration to have a negative sign – market concentration is given by Herfindahl-Hirschman index, as defined in the previous section. Indeed, by looking at the regression results in column 2 of Table 6, this is actually the case: not only the coefficient of market concentration is negative and statistically significant, but the size of the coefficient is also huge, suggesting that market structure is a relevant predictor of investment decisions.

We also test the cross-effect of market concentration and share repurchases on investment. Indeed, it is possible that firms operating in more concentrated industry tends to accumulate extra surplus from rent activities and, consequently, will be more oriented to distribute cash to shareholders by means of share repurchases. This idea was already stressed by Jensen (1986) in his "free cash flow hypothesis", according to which agency costs are higher in presence of non-competitive markets in that oligopolistic

Table 6: Investment Model - 1992-2017, Intangibles & Market Concentration

	(1) diff-GMM	(2) diff-GMM	(3) diff-GMM
L.Investment/Capital Stock	0.229***	0.246***	0.247***
	(0.0748)	(0.0569)	(0.0546)
L.Sales/Capital Stock	-0.000483	0.000793	0.000643
	(0.00266)	(0.00222)	(0.00221)
L.Opeating Surplus/Capital Stock	0.0354**	0.0337***	0.0355***
	(0.0146)	(0.0102)	(0.0101)
L.Leverage/Assets	-0.532***	-0.294***	-0.352***
	(0.183)	(0.0703)	(0.0869)
L.Market-to-Book	0.00336	0.00734***	0.00582**
	(0.00391)	(0.00194)	(0.00234)
L.Intangible assets/Total assets	-0.141		
	(0.167)		
L.Share Repurchase/Total Shares	-0.0196**		
	(0.00920)		
L.Concentration (HHI)		-0.533***	
		(0.194)	
Conc_0×Repurchase			-0.00880**
			(0.00448)
Conc_1× Repurchase			-0.201*
			(0.121)
Observations	8335	9179	9147
Number of firms	953	961	960
R^2			
Time effects	yes	yes	yes
Instruments	167	143	167
p-value Hansen test	0.659	0.131	0.512
p-value A-B test (AR2)	0.0109	0.975	0.919

Clustered standard errors in parantheses. * < 0.1 ** < 0.5 *** < 0.01

firms come across substantial economic rents or quasi-rents which should be distributed to shareholders to avoid over-investment problems. In these cases, Jensen argues, "monitoring by the firm's internal control system and the market for corporate control are more important". To compute the cross-effect of repurchase and concentration, we take the cross product of the two variable, with the latter being a dummy that takes value one if the firm falls in the top quintile of Herfindahl-Hirschman distribution and zero otherwise. The results in column 3 of Table 6 show that the coefficient of share repurchases is negative and significant regardless of market structure. Yet, the size of the coefficient is significantly higher in case of highly concentrated markets (when the concentration dummy is equal to one). This evidence provides support to the idea that the negative relationship between share repurchases and capital investment is stronger among firms operating in less-competitive markets.

5.3 Share repurchase model: Definition of variables

To analyze whether stock-based manager compensation makes U.S. firms more likely to buyback more stocks, the following share repurchase model is estimated:

$$(REP/TS)_{i,t} = \beta_0 + \beta_1(OPT/TS)_{i,t} + \beta_2 X_{i,t} + \eta_t + \mu_i + \epsilon_{i,t} \tag{2}$$

Contrary to the investment model, the share repurchase model is a static (non-linear) panel data model. The reasons for this choice are twofold, one theoretical and the other methodological. First, there is evidence that share repurchases are made at 2-3 years interval (Stephen and Weinsbach, 1998). Therefore, it is unlikely that the decision to repurchase today is affected by repurchases made in the previous year. In this sense, stock buyback do not follow a dynamic process, but are an instantaneous choice driven by managers' desire to boost stock prices and create short-term gains for shareholders. In the end, the flexibility in terms of dollar amount involved and the timing of announcement is precisely what makes stock buybacks a preferred method to payout shareholders with respect to dividend payment, at least in the U.S. since the mid-90s (Brav, Graham, Harvey, and Michaely (2005)). Second, the endogeneity and the initial condition problems arising from a dynamic setting are more tricky to handle in a non-linear (Tobit) regression model, as we will see below. As regards the regression variables, the dependent variable is the share repurchase ratio (REP/TS), as previously defined, while as main explanatory variables (OPT/TS) three different measures of stock options are employed – all scaled by beginning-of-the-year common shares outstanding –: exercised option (OPT_EXER_VAL), that is the value realized on option exercise; unexercised option (OPT_UNEX_EXER_EST_VAL), that is the value of unexercised exercisable options; in-the-money vested option (OPT_UNEX_EXER_EST_VAL), that is the estimated value of in-the-money unexercised exercisable options, or, in other words the estimated value of the money a manager would earn had she exercised her option. The last two variables are

of particular interest for our purpose. In the literature (Chen and Wang (2012)), they are used as a proxy for "manager hubris", that is, manager's degree of over-confidence about future equity returns: as over-confident managers expect stock returns to increase in the future, they will delay the exercise of stock-options and in the meanwhile repurchase shares to boost share prices and get even higher returns in the next periods. Similarly to the investment model, a set of independent variables reflecting firm characteristics is included, as well as time year and industry dummies.

5.4 Share repurchase model: Estimation and results

To investigate the relationship between share repurchases and stock-based compensation, we estimate the equation (2) using a static panel data model. For each measures of stock options considered – exercised options, unexercised options and in-the-money vested options – two different models are estimated: a Random Effects (RE) and a Tobit regression model. The RE model delivers more efficient estimates than FE model if individual effects are uncorrelated with the regressors. It is reasonable to assume that this is the case if we consider that repurchasing and option-paying firms are a homogeneous subset of the total population of firms. Moreover, it is important to bear in mind that the repurchase variable exhibits a significant number of zero observations, meaning that many firms do not buyback stocks at all. In this case, it is inappropriate to restrict our attention to only positive observations by using a linear model (Verbeek (2008)). The discontinuity in the distribution of the dependent variable can be captured by censored dependent variable approach, such as Tobit regression model. Indeed, the Tobit model describes on one hand the probability of the dependent variable to be non-zero, on the other hand the expected value of the dependent variable given that it is positive. We also estimate a third model combining both approaches described above in an unique regression equation, that is a Random Effect-Tobit model.

The regression results of the share repurchase model are collected in Table 7. From the first three rows we can immediately see that *exercised* and *unexercised options* are always significant and positively associated with share repurchase, while *in-the-money options* is insignificant in the RE model, but turns significant in the Tobit model. Thereby, our initial expectations seem confirmed: stock-based compensation makes U.S. firms more likely to repurchase shares. By looking at the coefficient of other explanatory variables, we also notice that *Market-to-Book ratio*, *EPS* and *ROA* enter with positive sign and are always statistically significant. This provides evidence to the hypotheses that repurchases are undertaken to support share price (Liu and Swanson (2016)) and to meet EPS forecasts (Almeida, Fos, and Kronlund (2016)).

Moreover, every regression model reports a negative and statistically significant relationship between stock buybacks and *Cash/Asset*, indicating that a decrease in cash liquidity is associated with an increase in likelihood of repurchases. This result is in line with the free cash-flow hypothesis, according to which

Table 7: Reg1. Share Repurchase Model, 1992-2017

	(1) RE	(2) RE	(3) RE	(4) Tobit	(5) Tobit	(6) Tobit
Exercised Options	0.00182**			0.00410***		
	(0.000840)			(0.00135)		
Unexercised Options		0.0137**			0.0392***	
		(0.00574)			(0.00944)	
In-the-money Options			0.000255			0.00136*
			(0.000440)			(0.000697)
Market-to-Book	0.0960***	0.100***	0.0982***	0.120***	0.129***	0.120***
	(0.0123)	(0.0122)	(0.0128)	(0.0174)	(0.0172)	(0.0179)
EPS	0.196***	0.198***	0.197***	0.268***	0.278***	0.271***
	(0.0150)	(0.0151)	(0.0153)	(0.0281)	(0.0283)	(0.0286)
ROA	0.680*	0.746**	0.732**	3.549***	3.723***	3.659***
	(0.359)	(0.360)	(0.359)	(0.755)	(0.764)	(0.762)
Cash/Assets	-0.711***	-0.692***	-0.687***	-0.908***	-0.904***	-0.875***
	(0.129)	(0.125)	(0.127)	(0.202)	(0.197)	(0.200)
Dividend/Assets	-1.661	-1.689	-1.791	-3.894**	-3.933**	-3.980**
	(1.166)	(1.172)	(1.170)	(1.738)	(1.749)	(1.771)
Leverage/Assets	-0.209*	-0.229*	-0.207*	-0.503**	-0.554**	-0.498**
	(0.124)	(0.124)	(0.124)	(0.215)	(0.216)	(0.215)
Size	0.151***	0.158***	0.149***	0.217***	0.233***	0.214***
	(0.0175)	(0.0186)	(0.0177)	(0.0249)	(0.0262)	(0.0250)
var(e.rep_ts)				2.817***	2.816***	2.823***
				(0.130)	(0.130)	(0.130)
Observations	10235	10235	10235	10235	10235	10235
Number of firms	971	971	971			
R^2 overeall	0.293	0.292	0.291			
Time effects	yes	yes	yes	yes	yes	yes
Log-Likelihood				-15606.3	-15598.0	-15613.8
pseudo-R^2				0.0988	0.0993	0.0984

Standard errors in parantheses. * < 0.1 ** < 0.5 *** < 0.01

firms are likely to distribute cash-flow in excess to shareholders to mitigate agency costs and potential over-investment by management.

Furthermore, the negative coefficient of *leverage* seems to contradict the idea that U.S. firms borrow money to finance new repurchase programs instead of financing physical investment. Yet, the effects of leverage deserves further investigation which is beyond the scope of this paper.

Finally, size matters and is positively associated with shareholders, meaning that larger firms tend to repurchase more shares, as was also shown in Table 3.

Table 8 reports the regression results of the share repurchase model using a Random Effect-Tobit model. This is a combination of the two approaches outlined before in an unique estimator which, at the same time, allows to control for censored dependent variable and unobserved heterogeneity, given that individual effects are randomly distributed. The results are similar to the ones observed in Table 7, with *exercised* and *unexercised options* being positively and significantly associated with repurchases, while *in-the-money options* insignificant, as well as *dividend payment*.

Table 8: Reg2b. Share Repurchase Model, 1992-2017

	(1) RE-Tobit	(2) RE-Tobit	(3) RE-Tobit
Exercised Options	0.00160** (0.000752)		
Unexercised Options		0.0138** (0.00675)	
In-the-money Options			0.000412 (0.000397)
Market-to-Book	0.0728*** (0.0108)	0.0765*** (0.0107)	0.0763*** (0.0110)
EPS	0.234*** (0.0103)	0.237*** (0.0102)	0.237*** (0.0104)
ROA	2.907*** (0.431)	2.978*** (0.431)	2.968*** (0.431)
Cash/Assets	-1.196*** (0.150)	-1.173*** (0.150)	-1.167*** (0.150)
Dividend/Assets	-0.616 (1.089)	-0.639 (1.088)	-0.816 (1.097)
Leverage/Assets	-0.587*** (0.140)	-0.609*** (0.140)	-0.585*** (0.140)
Size	0.302*** (0.0228)	0.309*** (0.0233)	0.300*** (0.0229)
Observations	10235	10235	10235
Number of firms	971	971	971
R^2 overeall			
Time effects	yes	yes	yes
Log-Likelihood	-14766.7	-14766.9	-14768.9
pseudo-R^2			
Rho	0.303	0.303	0.305

Standard errors in parantheses. * < 0.1 ** < 0.5 *** < 0.01

In summary, we find evidence that stock-based management compensation is an important motive for share repurchases. Of the alternative measures of stock options adopted in the analysis, exercised and unexercised exercisable options are highly significant in every estimated models, while in-the-money options have a lower explicative power once controlled for unobserved heterogeneity. Moreover, we find that share repurchases are positively and significantly associated with Market-to-Book ratio, EPS and ROA. Consistent with price support (Liu and Swanson (2016)) and signaling hypotheses (Massa, Rehman, and Vermaelen (2007); Chen and Wang (2012)), these finding reveals that firms with higher market valuation and better financial performance are more likely to repurchase shares. Yet, the negative coefficient of cash holdings variable leads us to question the validity of the free cash flow hypothesis, according to which firms distribute cash in excess to that required to fund profitable investments (Jensen (1986); Lee and Suh (2011)). Combining this result with the evidence from Table 1, it seems that U.S. firms are more likely to finance share repurchases programs with non-reinvested operating surplus instead of using cash holdings. Not even leverage can be considered a preeminent source of founding for stock buybacks, given that it enters with a negative sign in every regression models. However, considerations on the financing of stock buybacks programs would deserve a more detailed study, which is beyond the scope of this work.

6 Conclusion

Stock buybacks might be considered as a mode of utilization of surplus which allows to distribute free cash flow to shareholders – alternatively to dividend payment – and to support share price by informing investors about company's undervaluation – though the market might react in different ways to such announcements. In light of the above interpretations, stock buybacks can be broadly viewed as an engine for shareholder value maximization, by transferring income to shareholders through dividend payments and stock buybacks and inflating the stock price.

In this paper we explore the motives behind shareholder value maximization and its effect on firm's investment decisions. It is argued that, in a context of weak aggregate demand, the tendency to maximize shareholder value, fueled by stock-based manager compensation, has encouraged firms to divert resources from real investment towards stock buybacks to boost stock prices.

This is due to the fact that stock buybacks, by simultaneously increasing the demand of shares and reducing the supply of total shares outstanding, are expected to increase stock prices. With a substantial part of total compensation consisting in stocks and stock options, managers have a personal interest in creating value for shareholders by repurchasing shares with resources that could be invested in productive activities, such as capital expenditure, R&D and employment.

In the econometric section, therefore, our goal is not only to find whether and under which condi-

tions there exists a negative relationship between capital investment and stock buybacks, but also to understand the key factors behind the decision to repurchase shares.

We find that stock buybacks have a negative effect on capital investment, both before and after the financial crisis, ans especially among large firms operating in highly concentrated industry. Moreover, the probability to repurchase shares is positively associated with stock options, confirming the idea that share-based compensation can influence managers' time horizon and incentive structure, by making them more focused on short-term capital gains for shareholders instead of long-run company's growth (Stockhammer (2004)). This hypothesis is also supported by the positive relation between firm's market valuation and share repurchases, which suggests that firms undertake share repurchase programs to support share price.

In the end, from the evidence discussed above one could infer that that shareholder value maximization may have ambiguous effects on firm's performance: on the one hand, by encouraging managers to repurchase shares, it boosts stock price, leading to a in the short-run increase in managers and shareholders' wealth; on the other hand, by subtracting resources that could be invested in the future growth of the company, it leads to lower investment, and thus lower productivity and wages, undermining long-run competitiveness and growth, with indirect adverse effect both on aggregate demand and stock price. To understand which effects prevail in the medium-long run is a theoretical question which should be addressed in a structural (macro)dynamic model, which is the scope of the next chapter.

From an empirical perspective, further research is needed to investigate the engines of financialization of non-financial corporations, which in this paper is defined as the tendency to maximize shareholder value. In particular, this paper sheds light on the role of organizational factors – e.g. the shift towards share-based remuneration – in aligning manager and shareholders' interests and thus affecting firm's investment decisions. However, a more complete picture of the phenomenon at stake would require a discussion of the role played by institutional factors, such as the predominance of investment funds in the ownership structure – the so called "shareholder activism" – in orienting the management towards short-term view instead of the future growth of the company.

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7 Appendix

Table 9: Summary Statistics, 1992-2017

Variable		Mean	Std. Dev.	Min	Max	Observations
Investment/l.Capital	overall	.2755226	.2202772	0	1.405282	N=13131
	between		.1627881	.0347161	1.199221	n=1008
	within		1698172	-.4183661	1.49936	T-bar=13.0268
Sales/l.Capital	overall	10.89269	16.75242	.2695035	101.4943	N = 13131
	between		16.70522	.2725111	101.4943	n = 1008
	within		6.758624	-59.17667	96.09325	T-bar = 13.0268
Operating Surplus/l.Capital	overall	1.254541	1.694654	-2.691603	9.571048	N = 13131
	between		1.571133	-2.318099	9.571048	n = 1008
	within		1.000607	-8.931476	10.124	T-bar = 13.0268
Leverage/l.Assets	overall	.2117312	.180841	0	.7826437	N = 13111
	between		.1531881	0	.7485911	n = 1008
	within		.1106644	-.3051703	.9310447	T-bar = 13.0069
Market-to-Book	overall	3.950975	4.207393	.1005536	29.8311	N = 13115
	between		3.022311	.3081198	23.08858	n = 1008
	within		3.185117	-18.34694	30.68529	T-bar = 13.0109
Share repurchase/Tot. Shares	overall	.9026933	1.518543	0	7.410381	N = 13091
	between		.92524	0	6.540037	n = 1007
	within		1.228272	-5.637344	7.894656	T-bar = 13