Growth Opportunities, Cash Holdings and Payout Policy

Daniel A. Rettl*
Vienna Graduate School of Finance

November 23, 2011

Abstract

This paper uses a set of natural experiments in U.S. patent legislation to explore how changes in growth opportunities translate into adjustments of cash- and payout policy. When faced with a value-decreasing shock to their portfolio of growth options, firms respond by reducing their cash holdings. They do so primarily through increased payouts, and in particular, repurchases of stock. This is good news in light of agency theories of free cash flow, as it suggests that managers return cash to shareholders when investment opportunities decline. On the other side, when a firm's growth opportunities improve, managers respond by increasing their cash balances alongside their spendings for research and development. These increases seem to be partly funded by significant equity issuing. Overall, this paper argues that the precautionary motive plays a central role for cash policy decisions of growth firms.

JEL classification: G31, G32, G35

*daniel.rettl@vgsf.ac.at

1 Introduction

The revival of direct cash holdings in corporate liquidity management has increasingly received attention in recent years. Over the last three decades, the average cash-to-assets ratio of U.S. firms more than doubled, reaching levels in excess of 20 percent (see Bates, Kahle, and Stulz (2009)). Moreover, this secular increase is not concentrated among large firms, but present in all size quantiles of public corporations.

An important question that arises with this observation is whether the recent tendency to stockpile cash is beneficial from a shareholder's point of view. Depending on the managerial motive at work, cash balances can be used to extract private benefits or prevent underinvestment problems. At the same time, the answer to the above question has implications that go well beyond their mere consequences for shareholder value. If agency motives explain a large part of the increase in cash holdings, what can we conclude about the effectiveness of corporate governance mechanisms? Moreover, have innovations in executive compensation failed to further align managerial incentives with shareholder value maximization? On the other hand, how do we reconcile the development of derivatives markets and more elaborate risk management systems with an increasing relevance of precautionary motives in causing cash accumulation?

The main objective of the present paper is to distinguish between these predominant motives for cash retention. To do so requires choosing an empirical framework that overcomes some of the major obstacles imposed by studying simultaneously determined corporate policy choices. While we have seen substantial progress in the modeling of cash retention decisions in recent years (see Gamba and Triantis (2008), Nikolov and Whited (2010), or Bolton, Chen, and Wang (2011)), there remain considerable opportunities for improvements in the empirical literature. The present paper's major contribution lies in empirically relating exogenous variation in investment opportunities, which are a major building block in corporate finance theory, to managerial motives of cash retention. Exploring competing predictions for the response of cash balances and payout policy decisions, I show that precautionary motives are likely to explain why growth firms accumulate cash, both today, and 30 years ago.

Absent a thoroughly tailored empirical test design, it becomes difficult to make causal inference based on the relation of growth opportunities and cash holdings. Consider, for example, the argument made by Shyam-Sunder and Myers (1999), who assume that there is no direct causal relationship between the two variables. When firms raise funds in a way

that is consistent with a pecking order, positive shocks to cash flow result in higher balances of cash, all else being equal. At the same time, because high cash flow firms are often expected to be more profitable in the future, they tend to have high market-to-book ratios. Consequently, a positive relationship between common proxies of growth opportunities and cash holdings may be a result of spurious correlation. Thus, and notwithstanding the cross-sectional evidence in favor of this positive relationship (see e.g. Opler, Pinkowitz, Stulz, and Williamson (1999), Harford (1999), and Bates, Kahle, and Stulz (2009)), the causal relation between growth opportunities and cash holdings remains largely unexplored.

Exogenous variation in the investment opportunity set represents the key ingredient of the identification strategy employed in this paper. I use several Supreme Court rulings which are related to patent protection as quasi-natural experiments, assuming that patentability and growth opportunities are closely related. To consider the motives for cash accumulation, I jointly examine responses of cash policy, payout policy, investments, and debt policy to these legal events. Applying a difference-in-difference methodology, the analysis builds on differences between firms whose commercial success relies on the patentability of their innovations, and a matched sample of firms with similar characteristics and cash balances.

The first case, KSR vs. Teleflex, was decided in April 2007, and is used to analyze today's importance of motives for cash accumulation. The case relates to the interpretation and determination of obviousness in the context of patent litigation. Witherspoon (1980), and Durie and Lemley (2008) suggest that obviousness, or the lack thereof, is probably the most important and debatable condition for patentability. After the ruling was announced, many patent lawyers and academics raised concerns that the decision would significantly aggravate the patentability of many products, give judges more flexibility in dismissing patent infringement lawsuits, and reduce the value of firms' growth opportunities.

In response to the decision, I find that affected firms reduce both their cash holdings and their investments relative to control firms. At the same time, these firms increase their payouts to equityholders, and in particular, their stock repurchases. In combination, these findings suggest that growth firms which have accumulated significant levels of cash tend to return some of this cash to shareholders when their investment opportunities decline. When corporate cash retention is mostly driven by agency costs of free cash flow, it seems unlikely that firms return cash and reduce investments in the present scenario. To the contrary, examining cash litigation outcomes, Blanchard, Lopez-de Silanes, and Shleifer (1994) report that especially firms with poor investment opportunities tend to retain their rewards,

increase managerial compensation, and make diversifying acquisitions. In addition, the negative relationship between growth opportunities and payout ratios is consistent with evidence provided by Fenn and Liang (2001), who explore the how corporate payouts relate to market-to-book ratios.

To explore motives for cash holdings in the early 1980s, I consider two Supreme Court decisions that extended the concept of patentability to a series of new technologies. In Diamond vs. Chakrabarty, and Diamond vs. Diehr, the Supreme Court granted patent protection to generically modified micro-organsims, and business methods that involved running computer programs. The cases were decided in June 1980, and March 1981, respectively. The two decisions significantly improved the value of growth opportunities for many research active firms, and in particular for firms in the biological products, manufacturing and software industries.

In this setup, I show that affected firms significantly increase both their cash holdings and research and development expenses when measured relative to a control group. At the same time, they slightly reduce their payouts to equityholders. Even though evidence on the reduction of total payouts is weaker then in the first case and lacks statistical significance, the reduction in share repurchases remains significant. It is important to note in that context that share repurchases, the major channel through which firms adjusted their payouts after the Supreme Court rulings, have only become a prominent method for distributions after the SEC provided safe-harbor regulations in its Rule 10b-18 of 1982. The infrequent use of repurchases in the pre-treatment period of the Diamond cases might thus explain why the payout results are somewhat weaker in this case. At the same time, affected firms issue significantly more equity then their not-affected counterparts. In sum, firm behavior is again consistent with precautionary motives. Following an increase in investment opportunities, cash balances are adjusted upward by means of reducing net payouts to equity holders. The active equity issuing behavior furthermore indicates that treated firms frequently interact with external capital markets. Under a prevalence of agency motives, firms typically attempt to avoid the associated monitoring that is related to the issuing of securities (see Easterbrook (1984)).

The analysis of this paper is also implicitly related to the literature that examines whether patent protection encourages innovation and promotes economic growth. This relationship is not a trivial one. While stronger patent protection provides technology leaders with more freedom and time to explore and commercialize their inventions, it may simultaneously discourage research and investments by technology followers. However, the

evidence presented for the average firm in this paper indeed suggests that the relationship is a positive one.

The remainder of the paper is structured as follows. The next section briefly reviews theoretical motives of cash holdings. Moreover, it provides predictions of how corporate policy variables change in the context of variation in growth opportunities and discusses the existing empirical evidence. Section 3 introduces the Supreme Court cases in more detail, and presents the data and sample selection strategy. Section 4 proceeds with a discussion of the empirical methodology used throughout the paper, and provides estimation results. I explore several robustness checks for the relationship between growth opportunities and cash holdings in Section 5. Section 6 provides concluding remarks.

2 Hypothesis development and prior empirical research

2.1 Motives for holding cash

The theoretical literature provides several explanations for why corporations may accumulate cash.

When external financing is associated with issuance costs, the accumulation of cash can be beneficial and desirable from the point of view of a firm's shareholders. Gamba and Triantis (2008) develop a model in which optimal levels of cash, in addition to debt financing and investment decisions, is endogenously determined by managers who maximize shareholder value. The optimal cash policy results from a tradeoff between taxable interest income and debt issuance costs associated with the funding of new investment opportunities.

Access to capital markets can be costly in several respects. Direct costs include underwriter commissions, legal fees, and expenses associated with regulatory reporting requirements. Moreover, Myers and Majluf (1984) demonstrate how indirect costs can result from asymmetric information between corporate insiders and external capital markets, even in the absence of agency conflicts. In states of the world where these costs are high, firms may be forced to forgo otherwise profitable investment opportunities.

From an efficiency perspective, changes in growth opportunities, and concurrent variations in the need for future financing capacity, induce precautious managers to adjust corporate cash balances. Firms with better investment opportunities hold more cash to avoid being financially constrained in the future, while firms with poor investment oppor-

tunities optimally choose to maintain lower levels of cash. Building on this precautionary motive, the first hypothesis relates changes in growth opportunities to changes in corporate cash holdings and can be summarized as follows:

> Hypothesis 1: When cash accumulation is driven by precautionary motives, changes in growth opportunities are positively related to changes in cash holdings.

Agency costs of free cash flow provide an alternative rational for cash accumulation. Entrenched managers prefer to retain cash because it is equivalent to unconstrained liquidity. As such, they can use cash to implement manager-specific investment agendas, thereby creating private benefits that may accrue on several dimensions. On that note, Amihud and Lev (1981) suggest that managers benefit from diversifying acquisitions by reducing their human capital risk, which is generally considered undiversifiable. Easterbrook (1984) argues that by funding investment outlays with retained cash, managers prevent frequent interaction with capital markets and exposure to its associated monitoring efforts. Furthermore, managerial benefits can also stem from higher compensation which is granted to managers of larger corporations, a motive discussed by Murphy (1985), or result from empire building activities, as is proposed by Jensen (1986).

Under these premises, growth opportunities bear little direct relation to the decision to stockpile cash. While agency problems are generally considered to be more severe in firms with weaker investment opportunities, entrenched managers' motives for preferring to hold cash are not affected by changes in corporate growth opportunities. Moreover, to maintain their benefits associated with firm size, managers strictly prefer reducing cash balances by increasing investment outlays, even if this means realizing value decreasing projects. In contrast, under the precautionary savings hypothesis, the firm only invests in projects that increase shareholder value, given its portfolio of investment opportunities. Thus, cash reductions, which are optimal following a decline in growth opportunities, are achieved through payouts to equityholders. The second hypothesis summarizes this notion by relating changes in growth opportunities to adjustments in payout policy:

> Hypothesis 2: When cash accumulation is driven by precautionary motives, and changes in growth opportunities affect optimal cash levels, adjustments of cash balances are achieved by modifying corporate payout policy.

These two hypothesis highlight how the sensitivity of cash holdings and payout policy decisions with respect to changes in growth opportunities can be used to differentiate between precautionary motives and agency motives. Under the precautionary motive, firms with declining growth prospects reduce their cash balances by returning capital to equityholders. On the other side, agency problems become more pronounced when firms have poor growth opportunities and managers reduce cash balances by expanding investments.

The model of Gamba and Triantis (2008) is based on the dynamic investment model of Hennessy and Whited (2005), and features the same mechanisms resulting in optimal investment. As such, it predicts that when investment opportunities are more valuable, firms invest at a higher rate. Unless valuable investment opportunities are in conflict with manager-specific projects, which can be an additional source of managerial benefits that is discussed by Shleifer and Vishny (1989), agency problems do not distort the realization of value increasing investments. When growth opportunities become less valuable, however, entrenched managers have a preference for value decreasing overinvestment. The relationship between growth opportunities and investment rates that is derived under the precautionary motive and that can be contrasted with alternative predictions under agency motives is captured in the third hypothesis:

> Hypothesis 3: When cash accumulation is driven by precautionary motives, and firms optimally determine their payout policies and investments, growth opportunities are positively related to investment rates.

Finally, under both the precautionary motive and the agency motive, growth opportunities are related to the employment of debt. When growth opportunities increase, precautious managers employ lower leverage ratios to retain future borrowing capacity. Moreover, when a firm holds more growth opportunities, it has larger expected costs of financial distress, which in turn are positively related to its leverage ratio. In an agency cost framework, as pointed out by Jensen (1986), debt has the potential to reduce managerial discretion about free cash flow by requiring regular debt payments. Thus, managers are less free in accumulating and eventually investing cash when it is not in the best interest of shareholders. These agency cost are typically considered to be most severe for firms with low growth opportunities. Hence, both theories predict that leverage ratios decline when growth opportunities become more valuable, leading to the fourth hypothesis.

HYPOTHESIS 4: Both precautionary motives and agency motives predict a negative relationship between growth opportunities and leverage ratios.

As such, this last hypothesis is not a suitable candidate for distinguishing between the two alternative motives that lead to cash accumulation. However, it is nonetheless useful to also consider this last hypothesis. An empirical relation between growth opportunities and debt ratios that is inconsistent with this hypothesis would render questionable interpreting the overall evidence as being in favor of precautionary motives.

2.2 Prior empirical research

In recent years, corporate cash holdings, their determinants, and implications for firm value have received increasing attention in the empirical literature. A number of papers produce evidence that seems consistent with predictions of the precautionary motive. In their early study, Opler, Pinkowitz, Stulz, and Williamson (1999) show for a large sample of U.S. firms that, on average, financially constrained firms and firms which face riskier cash flows hold more cash. Furthermore, they also show that proxies for growth opportunities, i.e. market-to-book ratios, are positively related to the level of corporate cash balances. In a related analysis, Mikkelson and Partch (2003) examine whether firms with persistent policies of large cash holdings experience poor operating performance relative to comparable firms. Their sample firms do not seem to be adversely affected by above average cash retention rates, which leads Mikkelson and Partch to conclude that, consistent with predictions of the precautionary motive, their high cash holdings are optimal and support investment and growth.

Brown and Petersen (2011) examine the role of cash holdings for a sample of growth firms. Proposing that liquidity is especially valuable for firms with high research and development expenses, they provide evidence that cash holdings are used to buffer R&D spendings from transitory financing shocks. The critical friction in their argument are costs associated with adjustments of R&D investments. These adjustments are not optimal, but are a consequence of limited financing capacity. Consistent with the idea that young firms are particularly vulnerable to liquidity shocks, the authors show that increases in cash holdings are especially pronounced for young firms with high R&D expenses, and almost not present for firms which do not engage in R&D.

The marginal value of cash should be especially high for firms that anticipate valuable investment opportunities. Faulkender and Wang (2006) provide evidence that is consis-

tent with this prediction. They compute the marginal value of cash for financially constrained firms relative to financially unconstrained firms. The difference is especially high for firms with low levels of internal funds but good investment opportunities. Pinkowitz and Williamson (2007) confirm these results by showing that the marginal value of cash is significantly higher for growth firms. Complementing the arguments of Brown and Petersen (2011), Pinkowith and Williamson note that the timing of investment decisions may be more uncertain for firms in growth industries, which can explain the higher value attached to cash holdings.

In the context of share issuances, McLean (2011) shows that cash savings have become a major refuge for equity issuance proceeds in recent years. Moreover, the author provides firm level evidence that proxies for precautionary motives are associated with increases in the share issuance - cash savings relationship. The time series trend in measures of precautionary motives suggest a similar conclusion. In particular, R&D spendings and cash flow volatility increased over the sample period in accordance with the increasing retention of issuance proceeds.

Finally, Almeida, Campello, and Weisbach (2004) provide a model in which precaution motivates financially constrained firms to retain more cash out of their cash flow. While they also provide empirical evidence of a positive relation between cash flow and cash holdings, Riddick and Whited (2009) question existing results on the grounds of misaddressed measurement error problems. In related work, Acharya, Almeida, and Campello (2007) formulate the idea that the correlation between cash flow and growth opportunities is an important determinant of cash holdings, which they interpret as realization of hedging needs. In their model, the propensity to save cash of of cash flows is higher for firms with a low correlation of investment opportunities and cash flow. The authors document empirically that this relationship is especially strong for financially constrained firms.

The role of agency conflicts in explaining cash accumulation has been examined in two ways. A series of paper studies the behavior of firms that receive cash windfalls. In the presence of agency problems, firms should retain more of their additional cash flow, and eventually increase investment spendings. Consistent with this view, Blanchard, Lopez-de Silanes, and Shleifer (1994) show that firms with poor investment opportunities are more likely to retain cash received after a won or settled lawsuit. Moreover, these firms are also found to make diversifying acquisitions and increase their level of managerial compensation. Bates (2005) studies cash retention decisions in the context of asset sales, providing mixed evidence. The retention decision in his sample is positively related to growth opportunities,

pointing more towards a precautionary motive. At the same time, investment rates of retaining firms are consistently higher than investment rates of comparable firms, even after controlling for differences in financial constraints, which suggests that there is an agency motive at work.

The second strand of papers examines the value of cash holdings in light of agency problems. As noted by Myers and Rajan (1998), liquid assets are transferable into private benefits at lower costs than physical assets. Thus, when agency conflicts become more severe, retained cash become less valuable to shareholders. This prediction is supported by Pinkowitz, Stulz, and Williamson (2006), Kalcheva and Lins (2007), and Dittmar and Mahrt-Smith (2007), who related the value of cash to measures of corporate governance and investor protection. Both poor investor protection at the country-level and weak governance structures at the firm-level lead to significant valuation discounts for accumulated cash. Yun (2009) examines the relation between agency costs, cash holdings and governance in the context of cash and credit lines. For a sample of manufacturing firms, the author shows that the removal of takeover threats leads firms with poor governance to switch from credit lines to direct cash holdings. Consequently, poorly governed managers increase their discretion over internal liquidity and probably obtain higher private benefits. Masulis, Wang, and Xie (2009) complement these findings without relying on governance indices or proxies for the degree of investor protection. Building on differences between voting rights and cash flow rights in dual-class companies, they show that as the disproportionality between control rights and cash flow rights increases, cash holdings, which are more prone to misuse, receive lower valuations.

Taking a completely different approach, Nikolov and Whited (2010) examine the effect of agency conflicts on cash holdings in a structural model. In their neoclassical dynamic investment framework, agency costs appear in the two forms of private benefits from empire building and the ability to steal liquid assets from the firm. Interestingly, the calibrated model suggests that while managerial incentives to build empires are rather weak, managers do have the ability to steal liquid assets. Thus, to obtain private benefits, managers attempt to hold more cash, which they can consequently divert from the company. This behavior leads to a 22 percent increase in cash holdings and corresponds to a 6 percent loss to equityholders.

3 Sample Selection and Data

3.1 Supreme Court cases on patentability

The patentability of innovations is an important factor which determines investment decisions of research intensive firms, especially in light of their high fixed costs. At the same time, the value of these firms' growth opportunities depends on whether and how long exclusivity allows for high cash flows to be generated by potentially patentable inventions. Thus, changes in legislation that affect patentability are especially relevant for the evaluation of growth opportunities and future investment decisions. In general, the degree of patent protection can be affected in multiple ways. For example, Gallini (2002) reports that patent protection can be adjusted by extending protection to additional subject matter, altering the power of patent holders in infringement lawsuits, or changing the term of patents. More fundamentally, legislators can also adjust the definition of what constitutes a patentable invention.

To qualify for patentability, an invention needs to be new, useful and nonobvious. Of these three criteria, the nonobviousness requirement is considered to be the most critical and debatable condition for patentability (see e.g. Witherspoon (1980) and Durie and Lemley (2008)). That is, an invention must not simply be new and useful, but sufficiently innovative so that it would not have been obvious to a person with ordinary skill in the art. In fact, Allison and Lemley (1998) document that among all patent rules, obviousness accounts for the highest number of rejections concerning the validity of patents. In an often cited case, *KSR International Co. v. Teleflex Inc.*, the U.S. Supreme Court unanimously decided on April 30, 2007, that the Federal Circuit had been too rigid in determining nonobviousness. In what is generally considered a landmark case in patent law, despite not providing a new test for obviousness, the court emphasized that the analysis of nonobviousness should be more flexible and take into consideration the individual circumstances of a particular case.

While legal scholars provide mixed empirical evidence on the impact of the decision, they uniformly acknowledge that patent lawyers and practitioners believed that the decision could make it more difficult to obtain patents in the future.[1] The case was also covered extensively by the business press, stressing the potentially negative impact on research intensive industries of what the Financial Times called "one of the most important

[1] See e.g. Simic (2009) suggesting that the decision had little impact on patent rejection rates and Mojibi (2010) for evidence of significant changes in patent rejection rates.

intellectual property cases in recent years".[2]

The second series of Supreme Court decisions is related to the question of what constitutes patentable subject matter. In two decisions, the court extended the realm of patentable inventions to micro-organisms and software. In particular, in *Diamond v. Chakrabarty*, decided on June 26, 1980, the court found that generically modified micro-organisms can be patented. Building on this biotechnology decision, the case of *Diamond v. Diehr*, decided on March 3, 1981, is often described as turning point for the availability of patent protection for software related business methods. In contrast to the KSR case, these two decisions significantly improved the value of growth opportunities in certain industries. For example, Marciniszyn (1987) reports that investment rates in biotechnology sharply increase in the early 1980s, leading to the establishment of many new biotechnology companies. By allowing these firms to hold patents, the court has significantly improved the commercial potential within the industry. Similarly, Nimtz (1981) analyzes the implications of the Diamond v. Diehr decision. He concludes that the case strengthens firms' endeavors to file software related patent applications, reduces costs incurred due to software duplication and lack of standards, and eventually improves productivity of software programmers. Taken together, these three cases can be thought of as quasi-natural experiments that altered the value of corporate growth opportunities for firms which rely on patent protection.

Exogeneity of the shock used as quasi-natural experiment is an important assumption for the validity of difference-in-difference estimation. If regulatory changes or court decisions are anticipated by a large number of firms in the treated population, the estimator will fail to measure the event's effect on the variables in question. The Supreme Court cases chosen for the present analysis help to mitigate these concerns in the following ways. First, and in contrast to political decision makers, justices on the federal level are appointed for life and are not permitted to accept gifts or payments in support. Thus, in theory, their decision making should not be affected by considerations that are related to reelection concerns or campaign budgets. In practice, Federal Justices may still be exposed to insistent lobbying by particular industries or other potential interest groups. In the particular case of patent law, however, two economically strong groups have opposing interests, which al-

[2]Press coverage includes, among others, articles in the Wall Street Journal, Financial Times, New York Times, Washington Post, St. Louis Post, Chicago Sun-Times, Bosten Globe, Economist, and Forbes. Immediate coverage in legal publications include the New York Law Journal, Michigan Law Review, and New Jersey Law Journal.

leviates extensive one-sided lobbying either for or against patent protection. Consider for example the case of drug manufacturers, where producers of branded drugs are in favor of stronger patent protection, whereas generic drug manufacturers argue in support of weaker patent protection. These constellations are by no means the norm in every sector of the economy. The financial sector and its efforts to promote deregulation represent a prominent counterexample of one-sided lobbying that benefits from the industry's extensive financial resources but is not confronted by a similarly organized countermovement.[3]

Moreover, the particularities of the Supreme Court decisions used in the present paper make them especially suitable candidates for quasi-natural experiments. The two cases that extended patentable subject matter were both decided with a close 5-4 majority in favor of the applicant. Arguable, the outcome of cases that are decided with a small majority are less likely to be anticipated than unanimous decisions. Consequently, the KSR ruling, being made unanimously, was probably more likely to be somewhat anticipated. While the Supreme Court decided to take up the case in June 2006, an evaluation of the oral arguments heard in late November 2006 might have already pointed to disagreement with the Federal Circuit's line of argumentation. However, there was still ample uncertainty about how far the court would go in reversing prior legal practices. Moreover, predicting how the Supreme Court will rule is generally a very difficult task, even when interpreting notes published from the oral hearings. Therefore, and in light of the short time period that elapsed between the oral hearing in November 2006 and the announcement of the decision in April 2007, it seems somewhat plausible to assume that corporations did not significantly adjust their policies in anticipation of the KSR decision.

As is common in natural experiments, it is important to realize that any test in such a framework is always a joint test of the specific hypothesis under study and the experiment's conjectured impact on the main causal variable. In the context of the present paper, this means that testing for a causal impact of changes in growth opportunities on cash holdings implies testing whether changes in patent law affect the value of growth opportunities in the first place. Concluding this section, I present arguments and evidence from the prior literature, the business and legal press, and from the stock market in support of the conjectured positive relation between patentability and growth opportunities.

Measuring the strength of patent protection by the degree of inimitability granted by patents, Markman, Espina, and Phan (2004) report that stronger patent protection is

[3] In this example, the opposing group should consist of all taxpayers who ultimately have to bail out financial institutions.

positively related to the introduction of new products, a proxy for growth opportunities. Becker and Stromberg (2011) show that this relationship is especially strong for firms which patent for the first time. In light of these findings, the Diamond cases seem to generate a sample of affected firms that is particularly likely to face significant increases in growth opportunities. Moreover, Lerner (1994) shows that patent scope, an alternative measure of the degree of patent protection, is positively related to firm value. For R&D intensive firms, growth opportunities typically account for a large part of their market value, implying that Lerner's findings can be viewed as indirect evidence of a positively relationship between patentability and growth opportunities. Bloom and Reenen (2002) confirm these results using citation weighted patent stock as a measure of the amount and importance of patents.

Following the KSR decision, many business practitioners and legal experts discussed the implications of patent protection for the value of corporate growth opportunities. A large fraction of patents are granted for minor modifications of existing technologies, or the combination of known elements. Yet, these patents represent an important part of the commercialization potential of many innovations. While modest changes in patent legislation are unlikely to affect the patentability of major technological advances, they may have a major impact on the value of the large pool of patents granted for less innovative improvements. Consider for example the common practice of patent life cycle management among pharmaceutical companies. In order to extent the period of commercial exclusivity, pharmaceutical firms often apply for new patents after slightly modifying the production process or individual compounds of a drug towards the end of the initial patent term. Effectively, they attempt to increase the ex-ante value of their growth opportunities that are related to the development of new drugs. When these types of strategies become harder to implement, which is an often cited consequence of the KSR decision, affected firms see the value of their growth opportunities decline.

The stock market's reaction to the changes in patent legislation provides another indication of how the value of corporate growth opportunities responds to these events. For the three cases presented above, the market's reaction is consistent with the idea of stronger patent protection improving the value of investment opportunities, while weaker patent protection reduces their value. A more detailed analysis of announcement returns is presented in section 4.3. Moreover, the event study findings in the present paper are consistent with results of Hall and MacGarvie (2006), who analyze the market's reaction to the Diamond v. Diehr decision. They document a positive, albeit not significant, overall abnormal return for a small sample of software firms.

Notably, the impact of changes in patentability on growth options may potentially differ between a technology leader and technology followers. On the one hand, a technology leader significantly improves the value of its growth opportunities once exclusive excess to a new technology is secured via a patent. On the other hand, the value of a follower's growth options probably declines at the same instance. Eventually, which of these forces dominates remains an empirical question. While the increase in value for technology leaders stems from their ability to generate quasi-monopoly rents when the commercialization of a new invention is successful, followers move from potentially competitive markets to either costly inventing around the protected technology or licensing agreements. In many cases, it seems likely that the first effect dominates on average, which is also supported by the empirical evidence discussed above.

3.2 Sample Selection

As the two natural experiments are relatively far apart, two different treatment and control groups have to be constructed. In both cases, the main goal is to select firms that are significantly affected by the respective Supreme Court decision, i.e. firms whose growth opportunities decreased in value following the KSR case, and firms whose growth opportunities increased in value as a response to the Diamond decisions.

The first sample, denoted as the KSR sample in what follows, is constructed by assuming that when patentability is an important element of corporate strategy, the firm's CEO will discuss patent related aspects in greater detail in annual reports. Similarly, when patentability plays little role for a firm's current operations and growth opportunities, less space should be devoted to discussing patents in annual corporate filings. To operationalize this idea, the KSR sample is constructed by classifying all 10-K filings published on SEC's Edgar Database in 2007 with a text search algorithm. Of a total of 12352 filings, 83 percent are published in the first or second quarter, thus representing the fiscal year 2006. The text search algorithm is a simple line count that obtains the number of lines containing the term "patent" in every 10-K report. The sample of patent holders (the treatment group) is constructed by choosing all firms with a line count in excess of 50. In total, 462 firms fulfill this criterion, of which 425 can be assigned a unique Compustat identifier.[4] The final sample then consists of 377 firms for which balance sheet data is available in the period from 2005 to 2009. The single largest group of firms (129) comes from the pharma-

[4]Compustat's global vantage key is used as identifier.

ceutical sector (SIC codes 2833 - 2835), followed by manufacturers of biological products (85, SIC codes 2836). Measuring and analyzing instrument producers (SIC codes 3800 - 3899) account for the third largest block of firms (57), followed by producers of electrical equipment and components (38, SIC codes 3600 - 3699). The analysis of the sample's industry composition shows that the majority of firms assigned to the treatment group by the selection procedure stems from research intensive manufacturing industries. Thus, the obvious alternative of choosing firms based on industry classification is likely to result in a similar treatment group.

The potential control group consists of all firms with no more than 10 counts of lines containing "patent" in their 10-K filing. Then, using nearest neighbor matching with replacement, up to a maximum of three control firms are assigned to each firm in the treatment group. In contrast to studies in which firms self-select into the treatment group, for example by choosing to use a particular type of financing such as junk bonds in the study of Lemmon and Roberts (2010), assignment of firms to the treatment group is relatively exogenous in the present setting. It seems realistic to assume that the choice of a firm's business model typically occurred many years before the KSR case was decided. Several firm characteristics are used for matching, where each variable is measured as of 2006.

Table 1 summarizes the results of the Probit regression which is used to compute propensity scores. Variables included in the regression are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), intangible assets, goodwill, and depreciation scaled by total assets (Intan, Gdwl, DP, respectively), the firm's age measured as the number of years for which data is available in Compustat (Age), a manufacturing and a service industry dummy (Manuf and Service, respectively), acquisition expenses scaled by total assets (Acq), a rating and an investment grade rating dummy (Israt and Igrat, respectively), and cash and equivalents scaled by total assets (Cash). Moreover, the regression contains state fixed effects to capture variation in attractiveness for research intensive firms to allocate headquarters in particular states. New Jersey, for example, is known to be an attractive domicile for pharmaceutical corporations. Most variables contribute to determining treatment status. Notable exceptions are profitability, payout policy variables and acquisition expenses. Control firms are then determined based on their propensity score obtained from the Probit regression. This procedure, however, leads to large differences

in cash holdings between the treatment and control samples. Because cash holdings are of particular interest in this study, control firms are required to report cash holdings that are within one standard deviation of mean cash holdings of treated firms. Applied in addition to minimizing the distance between propensity scores, this criterion largely eliminates differences in cash holdings between the two samples. Table 2 compares the distributions of propensity scores between treated firms and matched firms. Overall, matched firms exhibit slightly higher propensity scores, but the two distributions seem fairly similar. The last two rows of Table 2 further contrast propensity scores of the treatment group with those of all potential control firms. The sum of propensity scores, adjusted for the different number of firms, is only about $\frac{1}{6}$ of the sum of propensity scores of treated firms. Finally, Table 3 reports descriptive statistics of the treatment group and the control group after matching. Using a relatively large number of variables for matching, only a few differences remain. Two of these variables, profitability and dividend payments, are not found to be significant contributers to the matching regression.

One advantage of the difference-in-difference methodology is that it is also applicable when treatment and control groups differ with respect to individual firm characteristics. Of central importance for identification is the assumption that absent treatment, the time dynamics of treated and untreated firms are characterized by a common trend.[5] Because the counterfactual of not receiving treatment is unobservable for treated firms in the treatment period, the common trends assumption can only be tested in the pre-treatment time period (see e.g. Roberts and Whited (2011)). The first three columns of Table 7 report test results for the KSR sample. In particular, for investment policy variables, payout policy variables, and financial policy variables, the growth rate of a specific variable is compared between treatment and control group. With the exception of net equity issues and dividends, there is no significant difference between treatment group and control group with respect to the pre-treatment trend of any of the policy variables to be studied.[6]

The second sample, denoted as the Diamond sample in what follows, is constructed by choosing firms in industries that are potentially affected the most by the two decisions, and comparing them with a matched sample. Unfortunately, annual reports are only available from 1993 onwards, so that the selection strategy used to construct the KSR sample cannot

[5]This assumption is often referred to as "common trends" assumption.

[6]The t-test requires that the distribution of the difference between two variables, or the two variables are normally distributed. For most of the variables in Table 7, this is not the case. The Wilcoxon rank-sum test does not require normality and should be used for inference in the present case.

be applied analogously. As the two decisions mostly relate to biotechnology and software, the treatment group consists of all firms with SIC codes 2836 (biological products), 7372 (services - prepackaged software), and 2833 - 2835 (pharmaceutical manufacturers). The last group is included in the treatment group because it is somewhat related to biological products. Moreover, software applications may play a role in the production process of drugs. Supporting this view, Bessen and Hunt (2007) note that most software patents are actually assigned to manufacturing firms, and only relatively few firms from the software industry actually obtain patents. With the short life-cycle of many software trends, patent protection might not be a first order aspect of rent protection for software producers. In total, the treatment group consists of 1085 firms.

The potential control group consists of all remaining manufacturing firms (SIC codes 2000 - 4000, excluding the industries of the treatment group). As before, nearest neighbor matching with replacement is used to assign up to three firms to each treated firm. The matching procedure is then implemented analogously to the KSR sample. Table 4 shows results of the Probit regression. Variables included in the regression are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), and cash and equivalents scaled by total assets (Cash). As the treatment group is selected based on industry classifications, industry dummies are not included in the regression. Moreover, limited availability of rating information makes the inclusion of rating group dummies infeasible. Control firms are then again determined based on their propensity score obtained from the Probit regression. To alleviate differences between treatment and control firms, the natural logarithm of total sales of a control firm is furthermore required to be within one standard deviation of the equivalent characteristic of the corresponding treated firm. As can be seen in Table 6, this procedure ensures that the two groups of firms are similar with respect to their size and market-to-book ratios. Despite the good match of propensity scores between the two groups, as reported in Table 5, some differences in firm characteristics remain. On average, treated firms have sightly higher cash holdings. However, cash is not a significant determinant of treatment status. Two important determinants of treatment status, the natural logarithm of total assets and firm profitability, are also found to differ between treatment and control groups. I show in the section on robustness that these differences do not affect the results obtained in the main analysis of the following section.

Finally, analysis on the validity of the "common trends" assumption is presented in the last three columns of Table 7. Except for short term debt issues, all variables are found to have a comparable growth rate over the period from 1977 to 1979. Again, this is an important prerequisite for the validity of the difference-in-difference analysis, which is presented in the next section.

4 Methodology and Results

4.1 Difference in Difference Estimation

The main challenge in testing for a causal relation between growth opportunities and corporate policy decisions lies in the unobserved nature of the investment opportunity set. I apply a differences-in-differences methodology to infer this relationship by using changes in patent legislation as exogenous shocks to investment opportunities of a sample of research intensive firms. The baseline regression model to estimate the treatment effect is specified as follows:

$$y_{it} = \alpha + \beta_1 \cdot Patent\ User_i + \beta_2 \cdot After\ Treat_{it} + \beta_3 \cdot Patent\ User_i \cdot After\ Treat_{it} + \epsilon_{it} \quad (1)$$

In the above equation, the dependent variable y_{it} is equivalent to the corporate policy variable of interest and is measured for firm i at time t. To alleviate the potential impact of time series correlation, all pre-treatment and all post-treatment observations are averaged into two single data points (see Bertrand, Duflo, and Mullainathan (2004)). Hence, t can be thought of as taking only two values, one corresponding to the period prior to the modification of patent legislation, and a second value for the period thereafter. $Patent\ User_i$ is an indicator variable that is 1 if a firm belongs to the treatment group of firms whose business strategy relies on the patentability of its products. $After\ Treat_{it}$ is an indicator variable that is 1 if firm i's observation is from the period in which the modified patent legislation is in place. As usual, ϵ_{it} is an error term.

When using the KSR ruling as natural experiment, average quarterly observations over the period ranging from Q22005 to Q32007 are used to compute pre-treatment values. Even though the difference in difference methodology is not prone to common shocks as long as treatment and control units respond in a similar manner, I use only observations from Q42007 to Q42008 to obtain post-treatment values. I do so in an attempt to circumvent a potential impact of the market turmoil caused by Lehman Brothers' bankruptcy on my

results. As noted before, I combine the two Diamond cases into the setting of a single natural experiment. While it is also possible to disentangle the two events and use them as separate experiments, this approach would require a more cautious analysis of firms that are affected by only one of the two decisions, and those firms that are affected by both. Using yearly observations, pre-treatment values are equivalent to mean sample values over the period 1978 - 1979. Analogously, post-treatment values are obtained by averaging over observations from 1982 - 1983.

No further control variables are included in the baseline specification as measurable heterogeneity between treated firms and control firms is eliminated during the matching stages. Nonetheless, I consider the robustness of my inference from the baseline model by augmenting Equation 1 with several firms characteristics and firm dummies in Section 5. All reported t-statistics are heteroscedasticity robust. To alleviate the effect of outliers, all variables are truncated at 0.5 and 99.5 percent of their respective distributions.

4.2 Main Results

4.2.1 Response of Cash to Changes in Growth Opportunities

To test the first hypothesis of a causal direct effect of changes in growth opportunities on cash holdings, I follow Brown and Petersen (2011) and examine changes in cash and equivalents. Difference in difference estimation results are presented in Panel (a) of Table 8 for the KSR case, and Panel (a) of Table 9 for the Diamond cases. In the aftermath of the KSR decision, affected firms significantly enhance their cash reductions as a response to reduced growth opportunities. The point estimate of the effect is an average -2.4 percentage points quarterly difference, which is highly significant at the 1% level. Following the Diamond rulings, firms increase their cash additions when their portfolio of growth opportunities appreciates in value. The point estimate is an average 11.7 percentage points yearly difference, which is significant at the 5% level. Interestingly, changes in growth opportunities do seem to have a relatively symmetric impact on changes in cash holdings. The average yearly effect of -9.6 percent in the KSR case is comparable in absolute magnitude with the average yearly effect documented for the Diamond cases.

In sum, the evidence on cash holdings is consistent with the first hypothesis. It furthermore complements previous studies that document a positive cross-sectional correlation between proxies of growth opportunities and cash balances by making a causal claim. Exogenous variation in the value of corporate growth opportunities causes firms to adjust

their cash policies in a way that is consistent with predictions of a precautionary motive. In contrast to the present analysis, similar inference from cross-sectional regressions is problematic because correlations may be driven by joint dependencies on a third variable. As pointed out by Shyam-Sunder and Myers (1999), when firms make financing decisions according to a pecking order, cash flow innovations are positively related to cash balances. At the same time, cash flow innovations may proxy for future profitability, which is reflected in market values. In such an environment, market-to-book ratios, a commonly used proxy for corporate growth opportunities, will be positively correlated with cash holdings, even absent any direct relation between the two variables. Identifying exogenous variation in investment opportunities, which is part of the identification strategy in the present paper, thus helps identifying direct causal dependencies between growth options and corporate cash holdings.

From a more comprehensive perspective, financial flexibility is not necessarily restricted to cash holdings and investments in marketable securities. A growing body of literature emphasizes the importance of lines of credit for corporate risk and liquidity management (see e.g. Ivashina and Scharfstein (2010). At the same time, credit lines and cash holdings may not be perfect substitutes in every state of the world, and differ on a few dimensions. Notably, corporations typically pay fees for the unused portion of their credit lines. Two major differences are that credit lines are funds conditional on the sponsoring banks' ability to provide these funds, and that credit lines come with restrictive covenants. Direct cash holdings, while disadvantageous from a tax perspective, are unconditional funds which are not linked to any covenants. In the wake of the financial crisis, as reported by Ivashina and Scharfstein (2010), many firms indeed drew down their credit lines to secure their access to cash. Moreover, in a recent study, Ippolito and Perez (2011) study whether undrawn credit lines and cash holdings are substitutes. They show that growth firms are especially likely to substitute between the two sources of liquidity.

In principle, it is possible that the observed adjustments in cash balances are accompanied by offsetting changes in credit lines. However, in light of the findings of Ippolito and Perez (2011), it should be noted that the median small growth firm in the present study, given its high level of cash holdings, is not likely to significantly rely on credit lines, or the undrawn portion thereof. To assume a reverse substitution between cash holdings and credit lines for treated firms is therefore questionable to begin with. Second, relating to the evidence provided by Yun (2009), firms in which agency conflicts gain in importance have a tendency to shift from lines of credit to cash. When the relative importance of agency

problems is negatively related to the amount of available investment opportunities, treated firms should attempt to increase their cash holdings in the aftermath of the KSR ruling. Clearly, this assertion is not supported by the empirical evidence.

4.2.2 Response of Payout Policy to Changes in Growth Opportunities

Given the evidence on changes in cash holdings presented before, I next turn to examining the second hypothesis that relates changes in investment opportunities to corporate payout policy. Results for total payouts, defined as the sum of cash dividends and share repurchases scaled by total non-cash assets, as well as for both individual components are presented in Panel (b) of Table 8 and Table 9. Following the decline in growth opportunities after the KSR decision, treated firms are found to increase their total quarterly distributions by an average of 0.6 percentage points (see Table 8). This number, when measured relative to the pre-treatment level of total payouts, represents a remarkable increase of about 75 percent, which is significant at the 5% level. Moreover, unreported analysis reveals that the increase entirely stems from the change in payouts of treated firms. Payout rates for firms in the control group remain stable during the entire sample period. Examining the individual components of total payouts, the second row of Panel (b) shows that dividend payment are not affected by the change in growth opportunities. This result is consistent with evidence on the reluctance of managers to cut corporate dividends and their use of more flexible share repurchases for temporary payout policy adjustments (see e.g. Liu, Szewczyk, and Zantout (2008) and Jagannathan, Stephens, and Weisbach (2000)). The effect of changes in growth opportunities on corporate distributions is mostly concentrated in share repurchases, as shown in the third row of Panel (b). Share repurchases, of which open market repurchases account for the largest fraction, are considered to be a flexible method of returning cash to shareholders. In light of evidence suggesting that there is uncertainty about the long-term consequences of many Supreme Court rulings (see e.g. Gennaioli and Shleifer (2007a) and Gennaioli and Shleifer (2007b)), it seems plausible to expect that firms primarily adjust the repurchase channel of their payout policy.

At the same time, net equity issues are reduced significantly, declining by a quarterly average of 12.7 percentage points. This reaction is entirely driven by treatment firms which reduce their previously high issuance rates, while control firms' issuing activities remain remarkably stable. Overall, however, while both types of firms are net issuers of equity, is should be noted that there is only weak evidence on the validity of the common trends

assumption. Thus, differences in equity issuing behavior may be driven by factors that are unrelated to the Supreme Court's ruling and its impact on growth opportunities.

The decisions of the Diamond cases, in contrast, are considered to have improved the productivity of investments and increased the value of growth opportunities. The point estimate of the effect of changes in growth opportunities on total distributions, as reported in Panel (b) of Table 9, is negative and thus consistent with expectations. However, statistically, the coefficient is not significantly different from zero. Breaking up the analysis into cash dividends and share repurchases (reported in the second and third row of Panel (b)), reveals that treated firms significantly cut their share repurchases. This behavior is again consistent with predictions of the precautionary saving motive. The resulting difference between the average treated firm and the average control firm of -0.4 percentage points is, however, only slightly significant with a p-value of 0.058. This finding is nonetheless remarkable given that share repurchases only started to become a popular means for cash distribution after the SEC introduced rule 10b-18 in 1982. Adhering to a set of trading rules, corporations where given a safe harbor for purchasing their own shares in open market transactions. Amidst sharply rising share repurchase volumes in the early 1980s, treated firms reduce payouts to equityholders to foster cash accumulation in response to increasing growth opportunities.

The evidence further suggests that net equity issues, for which it seems reasonable to assume that the common trends assumptions holds in this case, are significantly increased. The point estimate amounts to 12.2 percentage points. It seems that firms finance a significant portion of their increase in cash holdings by issuing equity. The increase in equity issues is also consistent with Brown, Fazzari, and Petersen (2009), who show that stock markets can be an important source of funding for R&D investments.

In sum, the evidence presented on the relation between growth opportunities and payout policy supports the second hypothesis. Since a reduction of accumulated cash can be achieved through multiple channels, an analysis of payout policy is especially suitable for distinguishing between competing theories of cash holdings, assuming that the first hypothesis holds. Previous studies, including Blanchard, Lopez-de Silanes, and Shleifer (1994), Harford (1999), and Bates (2005) have documented that cash rich firms tend to reduce their cash balances by increasing investment expenditures related to acquisitions. The evidence in the present paper points at a different direction. Instead of considering cash retention decisions in response to positive cash flow shocks, I examine payout policy responses in light of exogenous shocks to investments opportunities. For cash rich firms that

engage in research and development activities, payout policy clearly plays an important role for adjusting cash balances. As such, shareholders of these firms should be more confident that managerial preferences to stockpile cash are driven by a precautionary motive, and are beneficial from their point of view as they help alleviate distortions in optimal investment policy.

4.2.3 Response of Investments to Changes in Growth Opportunities

This section examines whether and how investment decisions are adjusted as a response to changes in the value of growth opportunities. The four measures of investment used in the analysis are changes in non-cash assets, capital expenditures, acquisitions, and research and development expenses. Each investment measure is scaled by start of period non-cash assets.

As is shown in Panel (a) of Table 8, and consistent with hypothesis 3, firms also reduce their investment activities as response to the KSR decision. However, adjustments are not homogeneous between different measures of investments. Firms significantly reduce their asset growth rates and their capital expenditures. Moreover, while treated firms are found to reduce their research and development expenses, the coefficient estimate is not statistically significant. This could be due to firms' reluctance to reduce their R&D spendings, which are associated with high adjustment costs. Brown and Petersen (2011) propose that firms hold cash to buffer shocks to their R&D expenses because it is costly to fire highly qualified workers and loose their expertise. Similarly, acquisitions are not affected by the change in growth opportunities. On explanation for this finding could be that acquisitions are more strategic investments which are less sensitive to short term uncertainty. On the other hand, one could expect that firms increase their acquisitions of companies that already hold patents, thereby reducing their exposure to the risks of future patent applications. However, this alternative hypothesis is also not supported by the data.

The Diamond cases provide a slightly different picture, presented in Panel (a) of Table 9. Here, the most pronounced positive change in investments is found in research and development expenses, averaging 14.3 percentage points. Neither acquisitions, capital expenditures, nor asset growth show a coefficient that is significantly different from zero. While the coefficient sign of asset growth is positive and thus consistent with theoretical predictions, the coefficient estimate of capital expenditures and acquisitions even turns

negative. Thus, it seems that in the wake of increasing growth opportunities in new technologies (which is mostly true for biotechnology), firms respond by extensively increasing their research budgets.

4.2.4 Response of Debt Ratios to Changes in Growth Opportunities

Finally, I examine how growth opportunities are related to leverage ratios. Even though hypothesis 4 has limited power to distinguish between precautionary motives and agency motives, it is nonetheless an important exercise to consider the empirical validity of the hypothesis. Evidence that is inconsistent with the predicted negative relationship between investment opportunities and debt ratios would call into question the major conclusions drawn from the findings described before.

Panel (c) of Table 8 reports results of the difference-in-difference estimation for the KSR sample. Following the decision's negative impact on corporate growth opportunities, treated firms are found to increase their leverage ratios. In economic magnitudes, the increase is 4.9 and 6.9 percentage points for market leverage and book leverage, respectively. When considering market leverage, it is noteworthy that the increase stems from the reaction of treated firms. In contrast, for book leverage, treated firms retain their level of leverage, while control firms significantly reduced their book leverage. Finally, it should be noted that some of these leverage results fail to be insensitive to including firm fixed effects, which will be discussed in the robustness section.

Turning to the case of increasing growth prospects, Panel (c) of Table 9 documents that both market and book leverage decline in the years following the Supreme Court decisions. However, these decreases are not statistically significant and much smaller in economic magnitude, especially when measured relative to the pre-treatment average debt ratios. Finally, and similar to the KSR case, treated firms significantly reduce their net long-term debt issues, while short term debt issues are insensitive to the treatment. The decrease in long term debt for firms with lower growth options seems inconsistent with theoretical predictions at first sight. However, as debt issues are only one channel though which debt rations can be affected, it is important to analyze them jointly with equity issues and payout decisions to determine changes in financial leverage.

Concluding this section, the evidence on debt ratios is broadly consistent with hypothesis 4. This finding is reassuring when interpreting the joint validity of all four hypothesis as being in favor of the notion that precautionary motives matter for cash accumulation.

In addition, the leverage results in the present paper confirm earlier results of Goyal, Lehn, and Racic (2002). In the context of the U.S. defense industry, these authors use changes in government spendings and the fall of the iron curtain as quasi-natural experiments to analyses the effect of growth opportunities on debt ratios, and thus apply a comparable identification strategy.

4.3 Valuation

To assess whether the Supreme Court decisions actually lead to the implicitly assumed impact on corporate growth opportunities, I turn to equity values. Using stock prices, I compare price reactions of firms that I assume to be affected by the court decisions with returns of control firms. The KSR decision was announced on April, 30, 2007 and was immediately reported by various online news services. I therefore use this day as the announcement day. However, as the analysis of legal rulings may require some time, I report somewhat wider announcement day windows. It turns out that the results are not very sensitive to the size of the announcement window. Table 10 shows the difference between cumulative abnormal announcement returns of the treatment group and control group, obtained from a market model, and a three factor Fama French model. In unreported analysis, I find that abnormal announcement returns are also similar to those reported here when using a Carhart four factor model instead of a 3 factor model to estimate counterfactual normal returns. All price data for individual firms is taken from CRSP. Index data is obtained from Kenneth French's website.

I find that firms which are most likely to be affected by the KSR decision experience significant price declines. When measured relative to control firms, equity prices fall by 1.4 - 1.8 percentage points more over a symmetric 3 and 6 day event window, respectively. These differences are significant at the 1 percent level.[7] Thus, the market reaction is consistent with the overall opinion expressed by lawyers and patent experts in the business press, stressing the negative implications of the court's decision for firms which depend on patent protection.

The Diamond cases were decided on June, 16, 2006 (Diamond v. Chakrabarty), and March, 03, 1981 (Diamond v. Diehr). As shown in Table 10, announcement returns of treated firms are generally positive and larger in magnitude than announcement returns of

[7] I use the standard Wilcoxon rank-sum test to assess statistical significance. Normality assumptions required for inferences from t-tests do not hold in most cases for the present sample.

control firms. For the Chakrabarty decision, point estimates of the difference in announcement returns range from 1.6 to 4.8 percentage points. However, it should be noted that only estimates obtained by the 3-factor model are statistically significant (at the 5 percent level). Differences in announcement returns for the Diehr decision are found to be negative when estimated by the market model, and positive when estimated by the 3-factor model. Neither of these estimates is statistically different from zero.

In sum, while market evidence for the Diamond cases is somewhat weaker, it seems that the market responded positively to the conjectured increase in growth opportunities. Moreover, these findings are relatively robust with respect to the length of the estimation window (e.g. 200 days or 120 days) and the time buffer between estimation window and event window (e.g. 20 days or 40 days).

5 Robustness

A concern that arises with respect to the KSR case is that the event window partially overlaps with the financial crisis, and in particular, with the default of Lehman Brothers Inc. in September 2008. In principle, when the common trends assumption is valid, the financial crisis should not be a serious concern for the difference-in-difference estimation. Moreover, remaining difference between treatment and control group only matters insofar as it affects the common trends assumption in the variable under consideration. Unobserved differences can invalidate causal inference when the observed affect is driven by heterogeneous variation in the unobserved variable. To alleviate concerns related to the Lehman Brothers bankruptcy, I repeat all difference-in-difference regressions using the period including the third quarter of 2007, and excluding the last quarter of 2008 to compute post-treatment observations. Clearly, this alternative specification is pointless if the Lehman Brothers bankruptcy was largely anticipated. Several studies, however, suggest that the bankruptcy filing was a surprise for capital markets and serves as a suitable exogenous shock for quasi-natural experiments. For example, Aragon and Strahan (2009) use Lehman's failure to study whether hedge funds act as liquidity providers. Fernando, May, and Megginson (2011) use the Lehman collapse to document that firms derive value from investment bank relationships. Thus, it seems plausible to assume that the bankruptcy was not anticipated, or that market participants had assumed Lehman was too big to fail. Excluding the last quarter of 2008 should therefore help eliminate specific effects attributable to consequences of Lehman's failure as opposed to the impact of the Supreme

Court's ruling on growth opportunities. Table 11 provides regression results. Overall, the coefficients are qualitatively not affected by the adjustment. Moreover, all key coefficients remain significant. Ex-ante, as sample firms retain relatively large cash holdings prior to the Lehman failure, they might not be affected by deteriorating credit conditions as much as the average Compustat firm. This could explain why the particular shock may not be as relevant for the sample firms studied in the present paper.

Firms' reliance on cash holdings as liquidity backup may vary with the quality of their bank relationships, especially in times of financial turmoil. In particular, by maintaining close lending relations with a few financial institutions over an extended period, firms may be able to reduce information asymmetries and secure preferential access to liquidity from the bank lending channel. This could, in turn, reduce the desire to accumulate cash, and lead to a reduction in cash holdings relative to firms with weaker bank relations. To control for the effect of bank relations on cash policy, I include firm age as an additional control variable in the difference in difference regression specification. Firm age is used as a proxy for the quality of bank relations. Older firms are assumed to have stronger relations due to more frequent interaction with the banking sector over their lifetime in comparison to younger firms. All major findings remain unchanged and significant, which is why I abstain from reporting them in an additional table.

A third concern relates to the matching procedure of the Diamond sample, which proved to be not as adequate as the matching of the KSR sample. Thus, the next robustness check tests whether the main results of the difference-in-difference estimations for the Diamond sample are driven by remaining differences between treatment and control group. Two important determinants of treatment status are the natural logarithm of total assets and profitability, as can be seen from the Probit estimation reported in Table 4. The matching procedure fails to resolve differences in these two variables between treatment and control group (see Table 6). I therefore repeat all difference-in-difference estimations including these two variables as additional controls. In these regressions, any remaining difference in the variable of interest can then not be attributed to unobserved heterogeneity in either of the two variables. Table 12 shows that the inclusion of these additional control variables does not affect the main results presented before.

Agency costs of free cash flow become less of a concern as governance mechanisms within a firm become more effective. From this perspective, changes in cash holdings may also be a direct consequence of variation in a firm's corporate governance practices. Analogous to the case of bank relations, measures of governance quality can be used as additional

controls in the empirical model. Unfortunately, both the Gompers, Ishii, and Metrick (2003) Corporate Governance Index (GIM) and the Bebchuk, Cohen, and Ferrell (2009) Entrenchment Index are only available between 1990 and 2006, thus covering neither of the two time periods studied in the present paper. However, as noted by John and Litov (2010), these indices do not vary much over time and are thus only of limited use when analyzing short time periods. In general, being compiled only every two years, researchers typically assume that the quality of a governance system does not change much within a two year horizon. Moreover, analyzing transition frequencies of the GIM Index supports this observation. From 2004 to 2006, only 5.6 percent of all firms with index scores report an index change by more than 1 point, where the index values range from 1 to 19 in that period. Similarly, based on a scale from 0 to 6, the Entrenchment Index value for about 1.9 percent of all firms changes by more than 1 point between 2004 and 2006. Staggered boards are but one example of why governance is somewhat sticky in the short run. Thus, while I cannot directly control for governance quality, it seems unlike that possible modest governance changes over a short time horizon can explain all findings of this study.

Finally, to address further possible influences of unobserved variables, I include firm fixed effects into each difference-in-difference regression. Table 13 and 14 report estimated coefficients for the KSR sample and the Diamond sample, respectively. Except for leverage coefficients in the KSR sample, all sensitivities remain both economically and statistically significant. Moreover, the negative but insignificant reaction of research and development expenses to deteriorating growth opportunities that was documented for the KSR sample increased in magnitude from an absolute value of 2.8 percentage points to 3.5 percentage points and is now highly statistically significant. In sum, all major results seem to be robust with respect to the inclusion of remaining unobserved firm specific effects, which confirms that growth opportunities have a major impact on corporate policy decisions. In particular, the findings of this study suggest that cash policy and payout policy choices are more in line with precautionary motives for cash as opposed to explanations that are based on agency costs of free cash flow.

6 Conclusion

U.S. Supreme Court's decisions on patentability provide a set of natural experiments for exploring how changes in growth opportunities affect major corporate policy decisions, and in particular cash holdings and payout policy.

A thoughtful analysis of these relations is challenging because it requires identifying variation in a firm's investment opportunity set. The prior literature has used a large set of proxies for the value of a firm's growth opportunities to relate them to corporate decision making, including market-to-book ratios and research and development expenses. This paper proposes an alternative empirical approach that does not rely on computing a concrete proxy for growth opportunities. Instead, firms are sorted into treatment and control groups based on how much their business models rely on patent protection. Moreover, cash holdings and measures of investment opportunities may be jointly determined by other firm outcomes such as cash flows. Hence, for causal inference, it is important to focus on exogenous shocks to growth opportunities when exploring their impact on policy decisions. For patent dependent firms, these shocks can be found in several significant changes of patent legislation, introduced by the U.S. Supreme Court in the early 1980s and in 2007.

Using these events, I show that an increase in growth opportunities results in increases in cash holdings as well as reductions in payouts to equity. The two experiments have opposing effects on growth opportunities, so that the consequences of increases and decreases in growth opportunities can be studied separately. I find that the effects on cash holdings and payout policy are relatively symmetric, i.e. a decrease in the value of the investment opportunity set is followed by reductions in cash holdings and increased payouts. These results suggest that for research and development intensive firms, cash holdings and payout choices seem to be more consistent with a precautionary motive as opposed to agency models of free cash flow.

Moreover, the paper contributes to the understanding of the link between uncertain investment opportunities and financial flexibility. Brown and Petersen (2011) argue that R&D investments are associated with high fixed costs and are difficult to adjust. Thus, firms accumulate cash to buffer profitability shocks. The evidence in the present paper is consistent with this perspective of cash applied to R&D firms. The growing attention that has been devoted to individual sources of financial flexibility such as cash holdings, short term investments and undrawn credit lines, calls for further research on how the investment opportunity set interacts with these different corporate decisions. It will help improve our understanding of what constitutes optimal cash policies and which type of financial flexibility is best suited for firms with different business models or at a different stages of their life cycles.

Implicitly, analyzing the relation between patent protection and investment into re-

search and development contributes to the broader discussion that relates to the economic benefits and costs of patentability. The evidence presented in this paper suggests that the degree of patent protection matters for firm-level investment activities. The positive relationship is especially pronounced for R&D spendings when firms are granted the basic permission to patent their innovations.

Finally, how can we reconcile the evidence in support of precautionary motives with recent advancements of risk management practices and the development of derivatives markets? For a start, it should be noted that the precautionary motive can have multiple dimensions. In the present analysis, precaution is directed towards avoiding underinvestment. At the same time, precaution can also relate to preventing liquidity triggered financial distress. Risk management techniques may be more relevant for addressing the this second issue. In a related manner, derivate instruments may be well suited to attenuate exposure to market wide liquidity shocks, but less appropriate for resolving firm specific investment holdup that is due to financing constraints. Moreover, for smaller growth firms, it may simply be too costly to maintain derivatives positions, so that cash is still a preferred tool in their risk management.

7 References

Acharya, V. V., H. Almeida, and M. Campello (2007): "Is cash negative debt? A hedging perspective on corporate financial policies," *Journal of Financial Intermediation*, 16(4), 515–554.

Allison, J. R., and M. A. Lemley (1998): "Empirical Evidence on the Validity of Litigated Patents," *AIPLA Quarterly Journal*, 26, 185–275.

Almeida, H., M. Campello, and M. S. Weisbach (2004): "The Cash Flow Sensitivity of Cash," *Journal of Finance*, 59(4), 1777–1804.

Amihud, Y., and B. Lev (1981): "Risk Reduction as a Managerial Motive for Conglomerate Mergers," *Bell Journal of Economics*, 12(2), 605–617.

Aragon, G. O., and P. E. Strahan (2009): "Hedge Funds as Liquidity Providers: Evidence from the Lehman Bankruptcy," *Working Paper*.

Bates, T. W. (2005): "Asset Sales, Investment Opportunities, and the Use of Proceeds," *Journal of Finance*, 60(1), 105–135.

Bates, T. W., K. M. Kahle, and R. M. Stulz (2009): "Why Do U.S. Firms Hold So Much More Cash than They Used To?," *Journal of Finance*, 64(5), 1985–2021.

Bebchuk, L., A. Cohen, and A. Ferrell (2009): "What Matters in Corporate Governance?," *Review of Financial Studies*, 22(2), 783–827.

Becker, B., and P. J. Stromberg (2011): "Fiduciary Duties and Equity-Debtholder Conflicts," *Working Paper*.

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Differences-in-Differences Estimates?," *Quarterly Journal of Economics*, 119(1), 249 – 275.

Bessen, J., and R. M. Hunt (2007): "An Empirical Look at Software Patents," *Journal of Economics and Management Strategy*, 16, 157–189.

Blanchard, O. J., F. Lopez-de Silanes, and A. Shleifer (1994): "What do firms do with cash windfalls?," *Journal of Financial Economics*, 36(3), 337–360.

Bloom, N., and J. V. Reenen (2002): "Patents, Real Options and Firm Performance," *Economic Journal*, 112(478), C97–C116.

Bolton, P., H. Chen, and N. Wang (2011): "A Unified Theory of Tobin'sq, Corporate Investment, Financing, and Risk Management," *The Journal of Finance*, 66(5), 1545–1578.

Brown, J. R., S. M. Fazzari, and B. C. Petersen (2009): "Financing Innovation and Growth: Cash Flow, External Equity, and the 1990s R&D Boom," *The Journal of Finance*, 64(1), 151–185.

Brown, J. R., and B. C. Petersen (2011): "Cash holdings and R&D smoothing," *Journal of Corporate Finance*, 17(3), 694–709.

Dittmar, A., and J. Mahrt-Smith (2007): "Corporate governance and the value of cash holdings," *Journal of Financial Economics*, 83(3), 599–634.

Durie, D. J., and M. A. Lemley (2008): "A Realistic Approach to the Obviousness of Inventions," *William & Mary Law Review*, 50, 989–1020.

Easterbrook, F. H. (1984): "Two Agency-Cost Explanations of Dividends," *American Economic Review*, 74(4), 650–59.

Faulkender, M., and R. Wang (2006): "Corporate Financial Policy and the Value of Cash," *Journal of Finance*, 61(4), 1957–1990.

Fenn, G. W., and N. Liang (2001): "Corporate payout policy and managerial stock incentives," *Journal of Financial Economics*, 60(1), 45–72.

Fernando, C. S., A. D. May, and W. L. Megginson (2011): "The Value of Investment Banking Relationships: Evidence from the Collapse of Lehman Brothers," *Working Paper*.

Gallini, N. T. (2002): "The Economics of Patents: Lessons from Recent U.S. Patent Reform," *Journal of Economic Perspectives*, 16(2), 131–154.

Gamba, A., and A. Triantis (2008): "The Value of Financial Flexibility," *Journal of Finance*, 63(5), 2263–2296.

Gennaioli, N., and A. Shleifer (2007a): "The Evolution of Common Law," *Journal of Political Economy*, 115, 43–68.

——— (2007b): "Overruling and the instability of law," *Journal of Comparative Economics*, 35(2), 309–328.

Gompers, P., J. Ishii, and A. Metrick (2003): "Corporate Governance And Equity Prices," *The Quarterly Journal of Economics*, 118(1), 107–155.

Goyal, V. K., K. Lehn, and S. Racic (2002): "Growth opportunities and corporate debt policy: the case of the U.S. defense industry," *Journal of Financial Economics*, 64(1), 35–59.

Hall, B. H., and M. MacGarvie (2006): "The Private Value of Software Patents," *Working Paper*.

Harford, J. (1999): "Corporate Cash Reserves and Acquisitions," *Journal of Finance*, 54(6), 1969–1997.

Hennessy, C. A., and T. M. Whited (2005): "Debt Dynamics," *The Journal of Finance*, 60(3), 1129–1165.

Ippolito, F., and A. Perez (2011): "Corporate Liquidity," *Working Paper*.

Ivashina, V., and D. Scharfstein (2010): "Bank lending during the financial crisis of 2008," *Journal of Financial Economics*, 97(3), 319–338.

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

Jensen, M. C. (1986): "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review*, 76(2), 323–29.

John, K., and L. P. Litov (2010): "Corporate Governance and Financing Policy: New Evidence," *Working Paper*.

Kalcheva, I., and K. V. Lins (2007): "International Evidence on Cash Holdings and Expected Managerial Agency Problems," *Review of Financial Studies*, 20(4), 1087–1112.

Lemmon, M., and M. R. Roberts (2010): "The Response of Corporate Financing and Investment to Changes in the Supply of Credit," *Journal of Financial and Quantitative Analysis*, 45(03), 555–587.

Lerner, J. (1994): "The Importance of Patent Scope: An Empirical Analysis," *RAND Journal of Economics*, 25(2), 319–333.

Liu, Y., S. H. Szewczyk, and Z. Zantout (2008): "Underreaction to Dividend Reductions and Omissions?," *The Journal of Finance*, 63(2), 987–1020.

Marciniszyn, J. M. (1987): "What Has Happened Since Chakrabarty?," *Journal of Law and Health*, 2, 141–156.

Markman, G. D., M. I. Espina, and P. H. Phan (2004): "Patents as Surrogates for Inimitable and Non-Substitutable Resources," *Journal of Management*, 30(4), 529–544.

Masulis, R. W., C. Wang, and F. Xie (2009): "Agency Problems at Dual-Class Companies," *The Journal of Finance*, 64(4), 1697–1727.

McLean, R. D. (2011): "Share issuance and cash savings," *Journal of Financial Economics*, 99(3), 693–715.

Mikkelson, W. H., and M. M. Partch (2003): "Do Persistent Large Cash Reserves Hinder Performance?," *The Journal of Financial and Quantitative Analysis*, 38(2), 275–294.

Mojibi, A. (2010): "An Empirical Study of the Effect of KSR v. Teleflex on the Federal Circuit's Patent Validity Jurisprudence," *Albany Law Journal of Science and Technology*, 20, 559–596.

Murphy, K. J. (1985): "Corporate performance and managerial remuneration : An empirical analysis," *Journal of Accounting and Economics*, 7(1-3), 11–42.

Myers, S., and R. G. Rajan (1998): "The Paradox of Liquidity," *Quarterly Journal of Economics*, 113(3), 733–771.

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

Nikolov, B., and T. M. Whited (2010): "Agency Conflicts and Cash: Estimates from a Structural Model," *Working Paper*.

Nimtz, R. O. (1981): "Diamond v. Diehr: A Turning Point," *Rutgers Computer and Technology Law Journal*, 8, 267–271.

Opler, T., L. Pinkowitz, R. Stulz, and R. Williamson (1999): "The determinants and implications of corporate cash holdings," *Journal of Financial Economics*, 52(1), 3–46.

Pinkowitz, L., R. Stulz, and R. Williamson (2006): "Does the Contribution of Corporate Cash Holdings and Dividends to Firm Value Depend on Governance? A Cross-country Analysis," *The Journal of Finance*, 61(6), 2725–2751.

Pinkowitz, L., and R. Williamson (2007): "What is the Market Value of a Dollar of Corporate Cash?," *Journal of Applied Corporate Finance*, 19(3), 74–81.

Riddick, L. A., and T. M. Whited (2009): "The Corporate Propensity to Save," *Journal of Finance*, 64(4), 1729–1766.

Roberts, M. R., and T. M. Whited (2011): "Endogeneity in Empirical Corporate Finance," *Working Paper*.

Shleifer, A., and R. W. Vishny (1989): "Management entrenchment: The case of manager-specific investments," *Journal of Financial Economics*, 25(1), 123–139.

Shyam-Sunder, L., and S. C. Myers (1999): "Testing static tradeoff against pecking order models of capital structure," *Journal of Financial Economics*, 51(2), 219–244.

Simic, E. (2009): "The TSM Test Is Dead! Long Live The TSM Test! The Aftermath Of KSR, What Was All The Fuss About?," *AIPLA Quarterly Journal*, 37(2), 227–256.

Witherspoon, J. F. (ed.) (1980): *Nonobviousness - the ultimate condition of patentability*. Bureau of National Affairs.

Yun, H. (2009): "The Choice of Corporate Liquidity and Corporate Governance," *Review of Financial Studies*, 22(4), 1447–1475.

8 Appendix - Variable Definitions and Tables

Size = Natural logarithm of Sales/Turnover (Net)

Sizea = Natural logarithm of Total Assets

Mtb = (Common Shares Outstanding * Price Close + Long Term

Debt Total + Debt in Current Liabilities + Preferred Stock (Capital) Total - Deferred

Taxes and Investment Tax Credit) divided by Total Assets

Profit = Operating Income Before Depreciation scaled by Total Assets

Div = Cash Dividends scaled by Total Assets
Rep = Purchase of Common and Preferred Stock scaled by Total Assets
Rnd = Research and Development Expense scaled by Total Assets
Intan = Total Intangible Assets scaled by Total Assets
Gdwl = Goodwill scaled by Total Assets
DP = Depreciation and Amortization scaled by Total Assets
Age = Firm age measured as the number of years for which data is available in Compustat
Manuf = An indicator equal to one if a firm's SIC code is between 2000 and 3999
Service = An indicatior equal to one if a firm's SIC code is between 7800 and 7899, or between 8700 and 8799
Aqc = Acquisitions scaled by Total Assets
Israt = An indicatior equal to one if a firm has a long-term rating
Igrat = An indicatior equal to one if a firm has a investment-grade long-term rating
Cash = Cash and Equivalents scaled by Total Assets

Change in cash and equivalents (Cash Growth)= (Cash and Equivalents $_t$ - Cash and Equivalents $_{t-1}$ / Total Assets $_{t-1}$
NC Asset Growth = (Total Assets $_t$ - Cash and Equivalents $_t$-(Total Assets $_{t-1}$ - Cash and Equivalents $_{t-1}$))/(Total Assets $_{t-1}$ - Cash and Equivalents $_{t-1}$)
Capex = Capital Expenditures scaled by Total Assets
Total Distr = (Cash Dividends + Purchase of Common and Preferred Stock) scaled by Total Assets

Net Equity Issues = (Sale of Common and Preferred Shares - Purchase of Common and Preferred Shares) scaled by Total Assets
N LT Debt Issues = (Long-Term Debt Issuance - Long-Term Debt Reduction) scaled by Total Assets
ST Debt Issues = (Debt in Current Liabilities $_t$ - Debt in Current Liabilities $_{t-1}$) / Total Assets$_{t-1}$

Book Leverage = (Long Term Debt Total + Debt in Current Liabilities) / Total Assets
Market Leverage = (Long Term Debt Total + Debt in Current Liabilities) / (Common Shares Outstanding * Price Close + Long Term Debt Total + Debt in Current Liabilities + Preferred Stock (Capital) Total - Deferred Taxes and Investment Tax Credit)

Table 1:
Probit Estimation Results - KSR Matching

This table presents Probit estimation results for the KSR case based on 2006 data. The dependent variable is one for treated firms, and zero otherwise. Explanatory variables are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), intangible assets, goodwill, and depreciation scaled by total assets (Intan, Gdwl, DP, respectively), the firm's age measured as the number of years for which data is available in Compustat (Age), acquisition expenses scaled by total assets (Acq), a dummy measuring the presence of an investment-grade long-term rating and a long-term rating (Igrat and Israt, respectively) and cash and equivalents scaled by total assets (Cash). Finally, state dummies are included as additional control variables.

	Estimate	t statistic	p-value
Intercept	-8.064	-0.004	0.997
Size	-0.122	-3.393	0.001
Sizea	0.375	8.849	0.000
Mtb	0.198	7.271	0.000
Profit	0.095	0.761	0.447
Div	-2.210	-1.363	0.173
Rep	-0.932	-0.873	0.383
Rnd	1.334	8.561	0.000
Intan	2.180	6.075	0.000
Gdwl	-1.458	-2.933	0.003
DP	3.360	2.710	0.007
Age	-0.015	-3.667	0.000
Manuf	1.237	10.251	0.000
Service	1.150	5.101	0.000
Aqc	-0.128	-1.225	0.220
Israt	-0.766	-3.761	0.000
Igrat	0.027	0.105	0.917
Cash	1.895	8.799	0.000

Table 2:
Propensity Score Comparison - KSR Matching

This table presents propensity score quantiles estimated from 2006 firm characteristics. As such, the matching is completed prior to the announcement of the KSR decision. The different groups of firms are companies which use the word "patent" at least 50 times in their annual report (Treatment) and a matched sample of firms with no more than 10 appearances of the word "patent" (Control). The last group (Control All) consists of all potential control firms prior to matching. The sum of propensity scores for the two control groups is adjusted to reflect the different sample sizes of each group.

	Sum	Q5	Q25	Mean	Median	Q75	Q95
Treatment	70.696	0.000	0.001	0.188	0.074	0.297	0.721
Control	87.146	0.000	0.004	0.231	0.137	0.429	0.682
Difference	-16.450	-0.000	-0.003	-0.044	-0.063	-0.133	0.039
–							
Control All	12.618	0.000	0.000	0.042	0.000	0.010	0.242
Difference	58.078	0.000	0.001	0.146	0.074	0.286	0.478

Table 3:
Summary Statistics - KSR Matching

This table compares characteristics of treatment group (T) and control group (C). Variables are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), intangible assets, goodwill, and depreciation scaled by total assets (Intan, Gdwl, DP, respectively), the firm's age measured as the number of years for which data is available in Compustat (Age), acquisition expenses scaled by total assets (Acq), and cash and equivalents scaled by total assets (Cash).

	Min	Q25	Median	Mean	Q75	Max	t-test	wilcoxon-test
Size T	-3.720	1.770	3.346	3.325	4.969	10.671		
Size C	-3.720	1.313	3.645	3.269	5.136	10.613	0.737	0.945
Sizea T	-1.884	3.720	4.582	4.790	5.675	10.673		
Sizea C	-3.101	3.218	4.683	4.662	5.818	10.673	0.279	0.421
Mtb T	0.859	2.216	2.929	3.405	4.426	6.947		
Mtb C	0.675	1.986	2.708	3.443	4.503	6.947	0.716	0.613
Profit T	-1.910	-0.393	-0.152	-0.232	0.078	0.337		
Profit C	-1.910	-0.391	-0.078	-0.203	0.106	0.337	0.286	0.031
Div T	0.000	0.000	0.000	0.004	0.000	0.251		
Div C	0.000	0.000	0.000	0.005	0.000	0.245	0.407	0.040
Rep T	0.000	0.000	0.000	0.012	0.000	0.233		
Rep C	0.000	0.000	0.000	0.009	0.000	0.233	0.211	0.509
Rnd T	0.000	1.000	1.000	0.976	1.000	1.000		
Rnd C	0.000	1.000	1.000	0.955	1.000	1.000	0.034	0.068
Intan T	0.000	0.000	0.044	0.141	0.214	0.758		
Intan C	0.000	0.004	0.056	0.121	0.193	0.625	0.061	0.242
Gdwl T	0.000	0.000	0.000	0.070	0.084	0.605		
Gdwl C	0.000	0.000	0.000	0.043	0.051	0.519	0.000	0.504
Dp T	0.000	0.016	0.029	0.037	0.047	0.225		
Dp C	0.000	0.021	0.031	0.043	0.048	0.245	0.006	0.015
Age T	0.000	4.000	9.000	10.605	14.000	55.000		
Age C	0.000	3.000	7.000	8.341	11.000	52.000	0.000	0.000
Aqc T	0.000	0.000	0.000	0.204	0.000	1.000		
Aqc C	0.000	0.000	0.000	0.192	0.000	1.000	0.604	0.599
Cash T	0.004	0.266	0.532	0.512	0.752	0.989		
Cash C	0.255	0.396	0.512	0.530	0.653	0.830	0.236	0.521

Table 4:
Probit Estimation Results - Diamond Matching

This table presents Probit estimation results for the Diamond cases based on average 1978 and 1979 data. The dependent variable is one for treated firms, and zero otherwise. Explanatory variables are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), and cash and equivalents scaled by total assets (Cash).

	Estimate	t statisitc	p-value
Intercept	-3.284	-37.804	0.000
Size	0.244	8.152	0.000
Sizea	-0.222	-7.254	0.000
Mtb	0.993	24.444	0.000
Profit	-1.206	-7.522	0.000
Div	-7.433	-3.731	0.000
Rep	-0.683	-0.311	0.756
Rnd	1.243	24.862	0.000
Cash	0.150	0.967	0.334

Table 5:
Propensity Score Comparison - Diamond Matching

This table presents propensity score quantiles estimated from 1978 and 1979 mean firm characteristics. As such, the matching is completed prior to the announcements of the Diamond decisions. The different groups of firms are companies with SIC codes 2833 - 2836 (pharmaceutical manufacturers and biological products), and 7372 (services - prepackaged software) (Treatment) and a matched sample of manufacturing firms with SIC codes 2000 - 4000, excluding the industries of the treatment group (Control). The last group (Control All) consists of all potential control firms prior to matching. The sum of propensity scores for the two control groups is adjusted to reflect the different sample sizes of each group.

	Sum	Q5	Q25	Mean	Median	Q75	Q95
Treatment	402.904	0.031	0.143	0.371	0.295	0.563	0.935
Control	381.733	0.031	0.143	0.352	0.296	0.564	0.747
Difference	21.171	0.000	0.000	0.019	-0.001	-0.001	0.188
–							
Control All	49.776	0.001	0.005	0.068	0.017	0.081	0.319
Difference	353.128	0.030	0.138	0.303	0.278	0.483	0.616

Table 6:
Summary Statistics - Diamond Matching

This table compares characteristics of treatment group (T) and control group (C). Variables are the natural logarithm of total sales (Size), the natural logarithm of total assets (Sizea), the market-to-book ratio (Mtb), operating profit scaled by total assets (Profit), dividends and repurchases scaled by total assets (Div and Rep, respectively), a dummy equal to one for firms that report non-zero research and development expenses (Rnd), and cash and equivalents scaled by total assets (Cash).

	Min	Q25	Median	Mean	Q75	Max	t-test	wilcoxon-test
Size T	-4.423	0.770	2.283	2.230	3.596	8.690		
Size C	-3.730	0.922	2.013	2.263	3.526	9.131	0.660	0.811
Sizea T	-1.575	1.002	2.308	2.415	3.504	8.581		
Sizea C	-1.053	0.781	1.687	2.138	3.319	9.799	0.000	0.000
Mtb T	0.443	1.418	1.866	1.955	2.350	4.769		
Mtb C	0.245	1.426	2.012	1.794	2.237	2.237	0.000	0.330
Profit T	-0.738	-0.124	0.086	-0.012	0.159	0.370		
Profit C	-0.189	-0.168	-0.008	0.003	0.141	0.350	0.095	0.000
Div T	0.000	0.000	0.000	0.004	0.003	0.076		
Div C	0.000	0.000	0.000	0.004	0.001	0.119	0.384	0.000
Rep T	0.000	0.000	0.000	0.005	0.006	0.086		
Rep C	0.000	0.000	0.000	0.009	0.007	0.092	0.000	0.027
Rnd T	0.000	0.500	0.952	0.747	1.000	1.000		
Rnd C	0.000	0.625	1.000	0.755	1.000	1.000	0.522	0.065
Cash T	0.000	0.062	0.144	0.207	0.290	0.909		
Cash C	0.000	0.047	0.124	0.167	0.250	0.679	0.000	0.000

Table 7:
Trend Comparison

This table compares growth rates of corporate policy choices between treatment group and control group. Growth rates are computed over the period from 2005 - 2007 for the KSR case, and over the period from 1977 - 1979 for the Diamond cases. Differences in the median of the respective distributions are denoted by Diff. P-values of t-tests and Wilcoxon-Rank sum tests are presented in the subsequent columns. Variables are defined in the Appendix.

Variable	KSR Case			Diamond Cases		
	Diff	t-test	wilcoxon-test	Diff	t-test	wilcoxon-test
Cash Growth	0.072	0.406	0.709	0.107	0.586	0.637
NC Assets Growth	0.066	0.256	0.360	0.720	0.495	0.260
Capital Expenditures	-0.081	0.709	0.346	0.025	0.797	0.709
Acquisitions	-0.069	0.222	0.128	0.018	0.359	0.345
RnD	0.046	0.921	0.176	0.070	0.359	0.393
Total Distr	-0.533	0.355	0.060	0.168	0.114	0.781
Dividends	-0.214	0.013	0.023	0.079	0.826	0.470
Repurchases	-0.441	0.376	0.230	0.361	0.478	0.109
Net Equity Issues	0.221	0.068	0.061	0.517	0.283	0.527
Book Leverage	-0.030	0.330	0.303	-0.054	0.219	0.588
Market Leverage	0.088	0.242	0.139	-0.074	0.319	0.568
N LT Debt Issues	-0.030	0.009	0.775	0.088	0.876	0.741
ST Debt Issues	0.004	0.909	0.542	0.643	0.142	0.013

Table 8:
Corporate Policy Responses to the KSR Case

The table presents difference-in-difference estimation results of the effect of changes in growth opportunities on changes in cash holdings, investments, payout policy variables, and financial policy variables for the KSR case. The diff-in-diff coefficient is equivalent to the treatment effect, where pre-treatment observations are mean sample values over the period Q22005 - Q32007. Post-treatment observations are mean sample values over the period Q42007 - Q42008. Standard errors are heteroscedasticity robust. Variable definitions are provided in the Appendix.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	-0.024	-3.535	0.000
Change in non-cash assets	-0.016	-4.665	0.000
Capital expenditures	-0.004	-2.827	0.005
Acquisitions	-0.001	-0.317	0.751
Research and development expenses	-0.028	-1.006	0.314

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	0.006	2.038	0.042
Cash dividends	-0.000	-0.125	0.901
Share repurchases	0.005	1.977	0.048
Net equity issues	-0.127	-2.646	0.008

Panel (c): Financial Policy

Book leverage	0.069	2.774	0.006
Market leverage	0.049	3.031	0.002
Net LT debt issues	-0.027	-3.810	0.000
ST debt issues	-0.000	-0.033	0.974

Table 9:
Corporate Policy Responses to the Diamond Cases

The table presents difference-in-difference estimation results of the effect of changes in growth opportunities on changes in cash holdings, investments, payout policy variables, and financial policy variables for the Diamond cases. The diff-in-diff coefficient is equivalent to the treatment effect, where pre-treatment observations are mean sample values over the period 1978 - 1979. Post-treatment observations are mean sample values over the period 1982 - 1983. Standard errors are heteroscedasticity robust. Variable definitions are provided in the Appendix.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	0.117	2.379	0.017
Change in non-cash assets	0.030	0.566	0.571
Capital expenditures	-0.005	-0.272	0.786
Acquisitions	-0.001	-0.159	0.873
Research and development expenses	0.143	2.918	0.004

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	-0.003	-0.847	0.397
Cash dividends	0.000	0.278	0.781
Share repurchases	-0.004	-1.893	0.058
Net equity issues	0.122	2.036	0.042

Panel (c): Financial Policy

Book leverage	-0.019	-1.279	0.201
Market leverage	-0.017	-0.981	0.327
Net LT debt issues	-0.019	-2.331	0.020
ST debt issues	0.000	0.038	0.970

Table 10:
Difference of Abnormal Announcement Returns

The table presents differences in abnormal announcement returns between treatment group and control group for the KSR case and the Diamond cases. Each day on which a court ruling is announced is chosen as event day. Event windows vary between 3 days (1-:1) and 7 days (-3:3). Both a market model and a Fama-French 3 factor model is used to compute normal (unobservable) returns. Significance of the differences is tested using a difference in means test (Wilcoxon Rank-Sum Test). Significance levels of 1%,5%, and 10% are denoted by ***, **, and ** respectively.

	Event Window	KSR v. Teleflex (2007/04/30)	Diamond v. Chakrabarty (1980/06/16)	Diamond v. Diehr (1981/03/03)
Market Model	-3:3	-0.018^{***}	0.048	-0.024
	-1:1	-0.014^{***}	0.034	-0.023
3 Factor Model	-3:3	-0.017^{***}	0.034^{**}	0.087
	-1:1	-0.014^{***}	0.016^{**}	0.039

Table 11:
Treatment Period Q32007 - Q32008

The table presents estimation results that are comparable to those in Table 8 for the KSR case. To circumvent the potential direct impact of the Lehman Brothers bankruptcy on the results, this robustness check uses only pre-Lehman data from Q32007 - Q32008 to compute After-treatment observations.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	-0.040	-3.781	0.000
Change in non-cash assets	-0.004	-0.309	0.757
Capital expenditures	-0.003	-2.593	0.010
Acquisitions	-0.000	-0.059	0.950
Research and development expenses	-0.025	-0.901	0.368

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	0.004	2.349	0.019
Cash dividends	-0.000	-0.687	0.492
Share repurchases	0.003	2.219	0.026
Net equity issues	-0.179	-2.753	0.006

Panel (c): Financial Policy

Book leverage	0.062	2.517	0.012
Market leverage	0.045	2.967	0.003
Net LT debt issues	-0.023	-3.695	0.000
ST debt issues	0.001	0.123	0.902

Table 12:
Robustness incl Controls Sizea and Profit - Diamond Cases

The table presents estimation results that are comparable to those in Table 9 for the Diamond cases. To correct for potential heterogeneity between treatment and control group which has not been accounted for by the matching procedure, the natural logarithm of total assets and operating profits scaled by total assets haven been included in the estimation as additional control variables.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	0.082	2.124	0.034
Change in non-cash assets	0.010	0.205	0.837
Capital expenditures	0.010	1.237	0.216
Acquisitions	0.001	0.573	0.566
Research and development expenses	0.036	3.190	0.001

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	-0.005	-1.309	0.190
Cash dividends	-0.001	-0.679	0.497
Share repurchases	-0.005	-1.984	0.047
Net equity issues	0.088	1.771	0.076

Panel (c): Financial Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Net LT debt issues	-0.015	-1.736	0.083
ST debt issues	0.007	0.717	0.473
Book leverage	-0.041	-2.236	0.025
Market leverage	-0.023	-1.275	0.202

Table 13:
Firm Fixed Effects Regression - KSR Case

The table presents estimation results that are comparable to those in Table 8 for the KSR case. To control for unobservable firm specific effects, firm dummies have been included in the estimation as additional control variables.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	-0.059	-2.757	0.006
Change in non-cash assets	-0.038	-3.824	0.000
Capital expenditures	-0.006	-2.662	0.008
Acquisitions	-0.000	-0.253	0.801
Research and development expenses	-0.035	-2.533	0.011

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	0.007	4.079	0.000
Cash dividends	0.000	1.069	0.285
Share repurchases	0.004	3.024	0.002
Net equity issues	-0.034	-1.833	0.067

Panel (c): Financial Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Book leverage	0.010	1.111	0.267
Market leverage	0.008	1.084	0.278
Net LT debt issues	-0.019	-2.461	0.014
ST debt issues	0.001	1.229	0.219

Table 14:
Firm Fixed Effects Regression - Diamond Cases

The table presents estimation results that are comparable to those in Table 9 for the Diamond cases. To control for unobservable firm specific effects, firm dummies have been included in the estimation as additional control variables.

Panel (a): Real Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Change in cash and equivalents	0.088	2.588	0.010
Change in non-cash assets	0.037	1.571	0.116
Capital expenditures	0.012	3.111	0.002
Acquisitions	0.002	1.156	0.248
Research and development expenses	0.012	2.290	0.022

Panel (b): Payout Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Total Distributions	-0.005	-2.537	0.011
Cash dividends	-0.002	-2.399	0.016
Share repurchases	-0.002	-1.149	0.251
Net equity issues	0.075	3.158	0.002

Panel (c): Financial Policy

Variable	Diff-in-Diff Coefficient	t-statistic	p-value
Book leverage	-0.017	-1.931	0.054
Market leverage	-0.027	-2.985	0.003
Net LT debt issues	0.002	0.358	0.720
ST debt issues	-0.004	-0.558	0.577