Capital Gains Tax and Innovation*

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Abstract

We examine the effect of staggered changes in state-level capital gains tax on innovation. Using data on Venture Capital (VC)-backed start-ups, we find that an increase in tax rates decreases patent production. The results are consistent with a change in incentives of entrepreneurs; after a tax increase entrepreneurs reduce innovation risk to offset the reduction in returns on their investments. We also find that the effect is stronger for firms that have greater tax convexity, and those that are more likely to be affected by entrepreneurs' lock-in effect. A change in tax at the VC-level also affects the quality of patents produced, suggesting a change in VCs' incentives.

Keywords: Real innovation, Capital gains tax, Entrepreneurship, Venture capital.

JEL Classification Numbers: G24, H25, L26, O31.

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Taxation of capital gains on business assets affects a large fraction of individuals and households in the United States. Around 40% more households hold active business assets as compared to stocks and mutual funds (Gentry (2016)). Also, the magnitude of the potential effect of changes in capital gains tax is large. Unrealised capital gains on business assets in the United States is five times larger than that on stocks (2013 Survey of Consumer Finances, Federal Reserve Board).

More recently, The Tax Cuts and Jobs Act 2017 has made tax treatment of capital gains of policy interest. A key issue debated was the change in capital gains tax and its impact on entrepreneurship and innovation. By design, a study to measure impact of capital gains tax on business assets excludes public companies. To better frame the discussion on this issue, we study the effect of changes in capital gains tax policy on the level and quality of innovation by private firms.

Private firms account for around 50% of business income in the United States. 95% of US businesses, 85% of small businesses, and virtually all new businesses are organized as private entities.[2] Private firms account for a large fraction of the innovation in the United States (Acharya, Xu (2017), Hombert, Matray (2016)). Research documents that private firms carry out more exploratory innovation than public firms (Gao, Hsu, and Li (2018)). Through their exploratory research, private firms determine the direction of future research.

There are two main reasons why the actual impact of tax changes is hard to quantify. First, the information on innovation by private firms is not readily available. Second, changes in tax policy are endogenous to the firm and market environment. Our paper brings detailed innovation data on private firms to answer this question. We are one of the few to obtain data on US patents by private firms.[3]

To address, the issue of endogeneity, we use staggered changes in capital gains taxes

[2]Private entities include S corporations, partnerships, limited liability companies or LLCs, and sole proprietorships. The share of their income has increased from less than 25% of total US business income in 1980 to around 50% of total business income in 2012 (DeBacker and Prisinzano (2015)).

[3]Gao, Hsu, and Li (2018), Acharya and Xu (2017), and Hombert and Matray (2016) use patent counts of private firms in their analyses.

within the United States as a quasi-experimental setup. We conduct checks for pre-treatment trends and sub-sample analyses to further address the concern.

Existing research documents that capital gains tax rates impact entrepreneurship. Higher capital gains tax rates have been associated with a negative effect on entrepreneurship, by discouraging entry into self-employment for people of all educational backgrounds (Poterba (1989b); Gentry and Hubbard (2004); Gentry (2016)). Previous research also finds that higher rates are associated with a reduction of venture capital (VC) investments into start-up companies (Gompers and Lerner (1999); Rin, Nicodano, Sembenelli (2006); Bock and Watzinger (2017)). However, whether this translates into a negative effect on innovation of entrepreneurial firms is not clear.[4]

Arguably, an increase in taxes could keep out less innovative or less risky start-ups. As a result, we could have a decrease in entrepreneurship but these entrepreneurs could deliver more innovative, new technologies. On the other hand, if taxes affect entrepreneurs or innovators differently such that higher taxes penalize successful start-ups and do not affect less successful ones, then we could witness a decrease in innovation with changing taxes. Tax policies that affect the returns to taking risks will have consequences for innovation (Keuschnigg and Nielsen (2002), (2004); Gentry and Hubbard (2004)).

Using a panel dataset of 12,493 U.S. venture capital (VC)- backed start-up companies we find that, an increase (a reduction) in capital gains tax rate decreases (increases) the quantity of entrepreneurial firms' innovation. The main challenge in uncovering the effect of taxes on innovation lies in establishing the channel behind the relationship. There are two main channels that can drive the results: 1) entrepreneurs' willingness to take on more risk and innovate (demand channel), and 2) VCs' readiness to provide start-ups with capital (supply channel). We take advantage of geographical information in our dataset to disentangle between the two effects.

[4]Changes in corporate income tax rates have been recently shown to have a significant impact on the innovation of large, established companies (Mukherjee, Singh, and Zaldokas (2017); Atanassov and Liu (2017)).

In particular, to evaluate the demand channel, we begin by defining the tax rate changes based on the state of headquarters of the start-up company. Our treated firms are, therefore, those in states that are affected by a tax change, and the control firms are start-ups in states that are not affected by a tax change. We find that changes in capital gains tax rates affect start-up firms innovation through the demand channel. For instance, two years after a tax increase, firms located in affected states have 1% less patents than firms based in states which do not experience a tax change. We also find that firms have a symmetric response to changes in capital gains tax rates. On average, a decline in state capital gains tax rate leads to an increase in patents of 1.3%. We find similar results for the number of citations per patent, which measures the quality of innovation.

To evaluate the supply channel, we re-define the tax rate changes. For the supply channel, the tax rate changes are based on the state of headquarters of the lead VC investor. In this specification, the treated firms are start-ups that received funding from VCs whose states are affected by a tax change, and the control firms are start-ups backed by VCs whose states are not affected by a tax change. We find that treated firms generate similar number of patents as control firms but lower quality patents than control firms. These results are consistent with existing literature which argues that the majority of investors in VC firms are tax exempt and therefore the source of VC funding is unaffected by capital gains tax rates (Poterba (1989a), Gentry (2016)). VCs provide not only capital but also managerial support and expertise to young firms. Changes in capital gains tax rates alter the incentives of VCs investing in innovative firms or projects. When VCs face a change in capital gains tax, they are likely to respond by changing their effort (Keuschnigg and Nielsen (2004)). This change in VC effort can lead to lower quality of patents.

In sum, our results suggest that capital gains tax changes impact both the level and quality of firm innovation. An increase in taxes has a negative effect on the number of patents as well as the number of citations per patent. A decrease in capital gains taxes positively impacts the level of patent production and its quality.

We carry out a series of robustness tests to validate our main results. We include additional control variables such as proxies for industry concentration, a political economy variables which can predict firm-level innovation. We test across a number of sub-samples (excluding years before 1992, using innovative firms only; excluding firms within California and Massachusetts); use different clustering methods (clustering at the firm-level, state-level, year-level, and industry-level in separate specifications); and include industry fixed effects.

Finally, we examine the cross-sectional differences of the effect of capital gains tax rates on real innovation. In the first test, we consider whether the impact of capital gains tax works through the channel of entrepreneurs' risk aversion. Next, we consider the lock-in effect, i.e., entrepreneurs remaining invested in their companies due to increases in capital gains. The last test is related to the cost of capital effect - changes in funding to start-up firms due to capital gains tax changes. We find some support for all three arguments.

A change in capital gains tax can impact the profitability of investments and, thereby, the portfolio decisions of both entrepreneurs and VCs. Within the purview of the demand channel, we evaluate whether entrepreneurs change the riskiness of their innovation portfolio in response to changes in capital gains tax. An increase in capital gains tax is likely to have a negative effect on the returns to entrepreneurs and, thereby, a negative effect on the riskiness of innovation undertaken by entrepreneurs (Keuschnigg and Nielsen (2002), (2004)). We use standard deviation of citations as a proxy for riskiness of the innovation portfolio of firms (Mukherjee et al. (2017)). We find that the standard deviation of citations decreases (increases) with an increase (decrease) in capital gains tax. We also count the number of zero-cite patents and highly-cited patents as another proxy of innovation risk. We document similar, strong results for zero-cite patents. These results provide evidence in favor of the entrepreneur risk-aversion argument.

Entrepreneurs may be willing to take on more risky activities, such as innovative projects, if they can offset some of their losses and pay less taxes (Lester and Lagenmayr (2017)). Firms in industries with more convex tax schedules are likely to be more affected by changes in capital gains tax. The presence of net operating losses (NOLs) and investment tax credits (ITCs) makes a tax schedule more convex. We categorize start-up firms based on the average level of pre-shock NOLs of public firms in the same industry. We also divide start-ups based on the the average level of pre-shock ITCs of public firms in the same industry. We find that firms in industries with larger, historical NOLs and larger ITCs have a stronger tax-innovation relationship.

Entrepreneurs can be less inclined to sell their stake in startup firms to avoid payment of increased capital gains tax. Such a "lock-in" effect can distort incentives of the entrepreneur and lead him / her to make inefficient innovation choices, fewer patents or lower quality patents (Atanassov (2013), Constantinides (1983), Balcer and Judd (1987), Dammon, Spatt and Zhang (2001), Chari, Golosov and Tsyvinski (2004)). We hypothesise that privately-held firms will be especially affected by the lock-in effect associated with taxing capital gains since the owners are typically also the managers of these firms. We divide start-up firms based on whether they are private or public at the time of the tax change . We find that private firms have a stronger tax-innovation relationship. We also categorize firms, in the year of the tax change, based on how many years before the tax change they completed an IPO. Firms which completed an IPO many years before the tax change will have a high value for the proxy. Consistent with the lock-in theory, we find that firms that have completed an IPO before the year of tax change are less affected by the change.

Change in taxes can also change firms' cost of capital. A change in capital gains taxes can lead to a change in expected gains to start-up founders/managers, which can then affect the level of current investment in projects (Hall and Jorgenson (1967), Poterba (1989a), Becker et al. (2013)). We use two proxies of financial constraints or availability of financing. First, we use the Kaplan-Zingales (1997) index as a measure of financial constraints. We categorize start-ups based on the average pre-shock level of the index for public firms in the same industry. Second, we use a measure of external finance dependence at the industry level. We calculate the median pre-shock level of external finance dependence (Duchin, Ozbas, and Sensoy (2010)) of public firms in the same industry. We find some evidence that financial constraints impact the tax-innovation relationship.

Our paper is similar to two recent papers which have examined the effect of corporate tax on firm innovation using staggered changes in state-level corporate income tax rates in the U.S. (Mukherjee et al. (2017), Atanassov and Liu (2017)). Both papers find that corporate income tax hurts innovative activities. Our study looks at another aspect of tax policy, i.e., capital gains tax. We focus on private firms where the impact of capital gains tax will be of first-order importance and are able to identify both supply and demand channels. Focusing on the demand side, we are also able to identify a new channel: entrepreneur's risk aversion. In contrast to our study, the channels which are important in the case of corporate income taxes are related to cash flows and governance.

This paper makes three contributions. First, by studying young VC-backed firms, our paper contributes to the literature on entrepreneurial finance. Capital gains taxes are found to be important driver of both entrepreneurship and VC investment (Poterba (1989a), (1989b)). Start-up firms typically have limited internal funds, have not yet accumulated sufficient collateral, and find it difficult to raise external risk capital. Previous theoretical research has found that even a small capital gains tax involves a first-order welfare loss, because it exacerbates a preexisting distortion and further diminishes incentives to provide entrepreneurial effort and managerial support (Keuschnigg and Nielsen (2002), (2004)). Higher capital gains tax rates are associated with fewer start-ups financed, less venture capital raised, and less business entry and exit.[5] We show that capital gains tax rates are important for entrepreneurial firms' innovation.

Second, by focusing on one aspect of growth, innovation, the paper adds to the literature on the real effects of state and federal fiscal policies. A body of empirical literature studies

[5]For a reference, see Gompers and Lerner (1999), Bock and Watzinger (2017), Bruce (2000), Bruce (2002), and Cullen and Gordon (2007). Similarly, Rin, Nicodano, Sembenelli (2006) find that a reduction in capital gains taxation increases both, early stage and high-tech VC investments, albeit the economic effect is not very large.

the effects of corporate taxes on investment, productivity and economic growth.[6] Further, a number of papers provide evidence on the effects of corporate tax changes on corporate policies.[7] Our paper looks at whether tax policies affect firms' innovative activity.

Third, our paper contributes to the literature on finance and innovation. This strand of literature studies the effect of market characteristics including banking deregulation, bankruptcy laws, labor laws, competition, credit markets, banking relationships, liquid options markets, and derivatives on innovation.[8]

1. Venture Capital Investment and Capital Gains Tax

Venture capital firms raise money from individuals and institutional investors for investment in a fund (VC fund) with a view to make early-stage equity investments in businesses that offer high potential but at a high risk. Investments are, typically, held for the medium to long term, and include management rights. The partners in charge of managerial decision making, related to the VC fund, are called the general partners (GPs) and the outside investors are limited partners (LPs).[9]

A VC fund is typically organized as a limited partnership. This organizational form has tax advantages for investors. Partnership income is not subject to corporate taxation; instead income is taxable to the individual partners. Also, partnerships can distribute securities without triggering immediate recognition of taxable income: the gain or loss on the underlying asset is recognized when the asset is sold. Partners, who are individuals will be

[6]Examples include Jorgenson (1963); Hall and Jorgenson (1967); Levine (1991); Auerbach and Hassett (1992); Cummins, Hassett, and Hubbard (1996); Cullen and Gordon (2007); Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010); Romer and Romer (2010); Mertens and Ravn (2012).

[7]See Graham (2006); Blouin, Core, and Guay (2010); Asker, Farre-Mensa, and Ljungqvist (2015); Heider and Ljungqvist (2015); Faulkender and Smith (2016).

[8]Cornaggia et al. (2015), Amore et al. (2013), Chava et al. (2013), Acharya and Subramanian (2009), Acharya et al. (2013), and (2014), Aghion et al. (2005), Hsu et al. (2014), Hombert and Matray (2016), Blanco and Wehrheim (2017), and Brogaard et al. (2017).

[9]Limited partners provide the financial capital and have limited liability. They are predominantly institutional investors, such as: pension funds, insurance companies, family offices, endowments and foundations, but they can also be corporates, wealthy individuals or governments looking to stimulate the start-up ecosystem. While the liability of the general partners is unlimited, their exposure is minor as they typically do not borrow and are rarely exposed to the risk of having liabilities in excess of assets (Sahlmnn (1990)).

subject to their share of such fund gains at favorable long-term capital gains tax rates.[10]

A typical business arrangement for the GPs would include (1) a flat management fee (2% of invested capital) and a share of profits or carried interest (20% of returns on the investment). The general partners (and limited partners) do not incur taxable income when they receive their carried interest in the partnership: they can defer recognizing the gain (or loss) until the security is sold and pay capital gains tax rates at exit.

INSERT FIGURE 1 ABOUT HERE

Figure 1 shows the ownership structure of an average VC fund in the U.S.. The majority of U.S.-based venture capital funds are incorporated in Delaware. The state of Delaware has a well-established body of law relating to limited partnerships, and, so the certainty of the legal environment is a benefit. Given the partnership structure of the VC fund, capital gains taxes are determined by the state of tax residence of the GPs and not by the state of incorporation of the VC fund. This is because the carried interest received by the GP (and the LP) is taxed as a part of the total income of the partner, if the partner is an individual. Increases in capital gains tax rates decreases the return to GPs, hence reducing their incentives to invest, advise, and monitor the ventures (Keuschnigg and Nielsen (2002)). We call this channel the supply channel behind the capital gains tax - innovation relationship.

Poterba (1989a) documents that only 12% of venture capital funding to new funds in 1987 came from individual investors. Corporations accounted for 11%. Corporate investors face corporate tax rates, so these investors can be less sensitive to changes in capital gains tax rates than individuals. Nevertheless, changes in the capital gains tax rate can affect the cost of capital of corporations, leading to a change in the funding to venture subsidiaries

[10]To qualify for this form of tax treatment, partnerships must meet several conditions: 1) A fund's life must have an agreed-upon date of termination, established before the partnership agreement is signed; 2) The transfer of LP units is restricted; unlike most registered securities, they cannot be easily bought and sold; 3) Withdrawal from the partnership before the termination date is prohibited; 4) LPs cannot participate in the active management of a fund if their liability is to be limited to the amount of their commitment.

(Poterba (1989a)).[11] The largest share of funding to VC funds comes from untaxed pension funds and foundations. These funds accounted for more than 60% of the total funding to VCs in 2004 (National Venture Capital Association (NVCA) 2004 Yearbook). Poterba (1989a) argues that the supply effect is not observed in markets because most limited partners of VC funds are tax exempt.

The effect of capital gains tax can also be demand-driven. An increase in the capital gains tax rate induces some entrepreneurs to take up regular employment, reducing their incentives to grow and innovate, as well as their demand for venture capital. Since entrepreneurs are relatively less diversified compared to shareholders in publicly-traded companies, the capital gains tax may create a form of asymmetric "success tax" where entrepreneurs are discouraged from risk-taking as the government taxes their upside returns but does not share symmetrically in projects that fail (Poterba (1989a); Gentry (2016)). This potential reduction in risk-taking may lead to lower level of innovation generated by entrepreneurs. We call this channel the demand channel.

In this study, we take advantage of the richness of our data and of the heterogeneity in the tax treatment across different types of investors to tease out the effect of capital gains tax on innovation.

2. Data

This section describes our data and important summary statistics. First, we outline the data sources used for the analysis. Next, we provide summary statistics from the data. Finally, we perform a simple ordinary least squares (OLS) regression to examine whether there is a relationship between capital gains tax rates and firm innovation.

[11] Corporate investors, must pay an added 35% tax on their capital gain from the sale of the shares of a successful venture. They might avoid the second level of tax on subsidiaries if they own more than 80% of the stock, but in VC funds, no one investor institution owns such a large percent of any venture (Johnson (2009)).

2.1. Construction of Variables

Our data set is constructed from several data sources combining information on patents, state taxes and tax loss rules, and other firm characteristics. Our initial sample contains 12,493 U.S. entrepreneurial firms that have received VC financing between January 1, 1987 and December 31, 2014 collected from Thomson Financial VentureXpert database. The patents data comes from Thomson Reuters' Derwent World Patents Index (DWPI) database. DWPI is a value-added worldwide patents database containing patent applications and grants from 48 patent issuing authorities worldwide, on more than 23 million unique inventions covering over 50 million patent documents.[12] Each patent document has the name of an assignee, which can be a company, or an individual. We match patent assignees in the DWPI database to U.S. start-up firms' names from the Thomson Financial's VentureXpert database. We exclude financial firms (Standard Industrial Classification (SIC) codes between 6000 and 6799), utility firms (SIC codes between 4900 and 4949), and firms in the public sector (SIC codes between 9100 and 9729) in constructing the final dataset, as patents might not be good measures of the output of innovative activities in these sectors.

We use patent count to proxy for a firm's innovative activity. Specifically, our measure of innovative output is a count of patents for each firm in each year scaled by the average number of patents in the year, Pat. We count the number of patents a firm receives and divide by the average number of patents granted in the same year. However, patent counts cannot distinguish between breakthrough innovation and incremental discoveries (e.g., Griliches, 1990). To test for patent quality we use a popular measure of the value of innovative output, the number of citations per patent, $\frac{Cit}{Pat}$. We count the number of citations a patent receives divided by the average number of citations received by all patents granted in the same year.

[12]The US patents data obtained from DWPI is similar to the data obtained from the USPTO, as made available publicly by Google Patents and documented by Kogan et al. (2017), hereinafter KPSS. We compare the US patents from DWPI and patents from KPSS. To ensure the completeness of the DWPI dataset, we compare the patents available in DWPI matched to US public firms, with KPSS patents. We find that the DWPI contains all patents as available in KPSS. We identify patents based on patent number, grant date and name of assignee.

Patent citations are not only a good measure of innovation quality but also of economic importance (Hall, Jaffe, and Trajtenberg (2005)).

We combine this dataset with information on state long-term capital gains tax rate obtained from the NBER TAXSIM Data. The data contains marginal income tax rates by year and state for a representative household with $1,500,000 of wage income (split evenly between husband and wife).[13] Given that the actual tax rate on a taxpayer is endogenous, the maximum state tax rate is a better independent variable to use in a cross-state regression analysis because this variable is exogenous to individual labor supply, and investment decisions. Therefore, changes in maximum tax rates within states has the potential to be a valid instrument as these changes depend more on the state and less on the individual (Feenberg and Coutts (1993)).

To ensure consistency and relevance, we examine the impact of taxes on innovation using significant changes of at least 1% in the maximum state capital gains tax rate from 1987 to 2014 (Atanassov and Liu (2017)). The key explanatory variables in our analysis are two indicators, *Tax increase* and *Tax decrease* that take values of one if at time t in state s there has been a major increase or decrease in the state's capital gains tax rate, respectively, and zero otherwise. The tax variable equals one in the year of the change and all subsequent years unless the tax rate is reverted back to the level before the change. We also create a combined categorical tax variable, *Tax change*, which is equal to 1 if at time t in state s there has been a major increase in the state's capital gains tax rate, equal to -1 if there has been a major decrease in the state's capital gains tax rate, and 0 otherwise.

We define an increase or decrease in tax rates as a significant change if it is greater than or equal to 1%, and the change is not reverted within the next three years. If it is reverted in less than three years, it is not considered a change and the tax variable retains the value of 0. If the change is reverted three or more years later, the tax variable takes a value of 1

[13] Please refer to the description of the TAXSIM program in Feenberg and Coutts (1993). The simulation and the resulting data are available online: http://www.nber.org/ taxsim/state-rates.

(or -1) in the year of the change and any year after when the change is present, and switches back to zero after the change is reverted. We also make sure that the difference between the average tax rate during the treatment period and the average tax rate during the control period is at least 1%. The major tax increases and decreases are identified in Table 2.

INSERT TABLE 2 ABOUT HERE

From 1987 to 2014, twenty eight states experienced a major tax increase and fifteen states experienced a major tax decrease. Table 2 identifies that a large fraction of states increased capital gains taxes in 1987. This change was a part of the 1986 tax reform.[14] If we exclude this nationwide tax change event, there are a total of eleven tax increases and fifteen tax decreases across states and across years in our sample. To determine the relevant tax rate for a given firm we follow previous literature and use the state of a company's headquarters (Heider and Ljungqvist (2015)). The assumption is that most of the company's profits are generated in that state. While this assumption might not be correct for large companies, since they can conduct their business across different states; we believe that for our sample of small, young companies, this assumption is reasonable.

We also determine the relevant tax rate for VC firms (or the General Partner, as in Figure 1) in our sample. We assume that the headquarters location of the VC firm is the state in which the general partner (GP) pays capital gains taxes. We believe, that this assumption is not far from reality. Anecdotal evidence shows that most VC funds are incorporated as limited partnerships. A partnership is also called a pass-through entity, which implies that the partnership income is not taxed at the firm, rather the GP pays taxes on the capital gains of the firm as a part of his personal tax filing. We assume that the GP lives and files his/her taxes in the state of headquarters of the VC firm. Therefore, our assumption

[14] The Tax Reform Act of 1986, signed into law by President Ronald Reagan was the most-extensive review and overhaul of the Internal Revenue Code by the U.S. Congress since the inception of the income tax in 1913 (the Sixteenth Amendment). Its purpose was to simplify the tax code, broaden the tax base, and eliminate many tax shelters and preferences.

amounts to the GP and some non-institutional limited partners paying capital gains taxes, in the state of headquarters of the VC firm. Existing literature provides evidence in favour of this assumption. VCs' headquarters are likely to reflect the need to be proximate to their sources of capital and not their portfolio firms (Gompers and Lerner (1999)). This is particularly true for groups specializing in the later-stage investments, which typically occur after other groups (who may be geographically more proximate to the portfolio firm) have already joined the board (Lerner (1995)).

In our tests we control for alternative tax policies by including additional variables, such as the state level tax loss rules, R&D tax credit, and the state corporate income tax. Data on state tax loss rules is hand collected from the websites of local state tax authorities and contains information on loss carryback and loss carryover periods in a given state and year. When businesses suffer losses in a given year, well-structured state's tax codes allow them to deduct those losses against previous or future tax returns.[15] These provisions are called net operating loss (NOL) carrybacks and carryovers. States vary widely on their net operating loss policies. While some states do not have such policies, many others allow firms to recoup a portion of losses incurred, by reducing prior or future taxable income. Generally, the loss carryback and loss carryover periods are limited. Moreover, states' authorities can and do change these policies over time.

The loss carrybacks generate real and immediate cash flow for companies in the loss year. Carryovers, however, offer a more uncertain tax benefit, because the economic benefit of a loss carryover is a function of expected future profits, the expected year of profitability, the expected future tax rate, and the firm's discount rate. Previous research shows that these tax loss rules create ex-ante incentives for corporate risk-taking because the loss rules shift some risk to the government (Lester and Langenmayr (2017)). Others, like Hodge (2017),

[15]Losses in pass-through businesses can be used to offset other sources of income, provided the owner is a "material participant" in the business (section 172 of the Tax Reform Act of 1986). Passive investors, however, face limitations on the ability to use losses (section 469). In other words, passive activity losses may only be deducted from passive activity income. For tax purposes, a business you merely invest in but do not materially participate in is considered a passive activity.

have argued that the tax loss rules feature of the tax code is likely to be disadvantageous for many entrepreneurs, because businesses that take longer to turn a profit, suffer a greater tax penalty. We test the effect of tax loss rules by creating two indicator variables, *Carryover NOL change* and *Carryback NOL change*. *Carryover NOL change* (*Carryback NOL change*), is equal to 1 if at time t in state s there has been an increase in the state's tax loss carryover (carryback) period years, equal to -1 if there has been a decrease, and 0 otherwise.

The historical state-level R&D tax credit rates have been gathered from Wilson (2009), while the data on state corporate income tax changes comes from Heider and Ljungqvist (2015), and Atanassov and Liu (2017). Some states allow companies to take a tax credit against their state taxable income, which is equal to a percentage of their qualified R&D expenditures over some base amount. Wilson (2009) shows that these tax incentives are effective in increasing R&D investment within the state.[16] Thus, if the timing of R&D tax credit changes coincides with the timing of state capital gains tax changes, then our results may be attributable to R&D tax credits.

Changes in corporate income taxes may also contaminate our results, therefore we control for such tax changes. For instance, a reduction in the corporate income tax rate would achieve more equal tax treatment across the various forms of business investment, but may also have a negative effect on partnerships, LLCs, and other pass-through entities, since they would not gain from the lower corporate tax rate in contrast to corporations (Rosenberg and Marron (2015)). Moreover, previous papers have shown that corporate income taxes affect innovation (Mukherjee et al. (2017); Atanassov and Liu (2017)). Therefore, if the change in state capital gains tax rates coincides with a change in state corporate income taxes our results may be biased.[17] Similar to the construction of our main tax measures, we create two indicator variables based on state R&D tax credit changes and state corporate income

[16] He documents that 32 states provide such tax credits as of 2006.

[17] While we control for these alternative tax policies, it is worth mentioning that for their sample period 1990-2006, Mukherjee et al. (2017) find that there is little tendency for states to change R&D tax credits, top tax rates on wage income, and capital gains tax rates on long gains at the same time as the corporate income tax rates.

tax changes. The indicator variable is equal to 1 if at time t in state s there has been a major increase in tax credit or corporate income tax rate, equal to -1 if there has been a major decrease, and 0 otherwise. A major change is defined as greater than or equal to 1%, as long as that change is not reverted within the next three years.

Finally, we create control variables for state level real GDP, Per capita income, and unemployment rate. GDP and Per capita income data come from the Bureau of Economic Analysis (BEA); the historical state unemployment rate comes from the Cleveland Federal Reserve. We also control for the the political affiliation of the state legislature. We obtain data on the political affiliation of the state legislature from Klarner (2013). *Control of chambers* is a categorical variable, equal to 1 if at time t in state s, Democrats control both chambers (the Senate and the House of Representatives), equal to -1 if Republicans control both chambers, and 0 otherwise.

Given that the firms in our sample are young, private start-up companies, for which limited data is available, the firm level control variables in our analysis have been obtained from the VentureXpert database. We collect the firm's industry SIC code. Following Aghion, et al. (2005), we control for industry concentration using the Herfindahl-Hirschman index (HHI) constructed at the 3-digit SIC level. We calculate the index for all public firms within the Compustat database for each 3-digit industry-year. We attribute this value for the private firms in the same industry-year category. Finally, we include a variable that captures the number of years since the firm's founding year (as reported in VentureXpert) to control for a firm's age.

From VentureXpert, we also retrieve detailed round investment information, including round date, estimated amount of investment, the number, and types of investing VC investors. Further, we retrieve the address of the entrepreneurial firm as well as the location of the VC investor, which we use in determining the relevant state tax rate for both, start-up firms and VC firms. All control variables are lagged by one-year to reduce simultaneity concerns. All continuous variables are winsorized at the 1st and the 99th percentiles to remove the influence of extreme outliers. Variable definitions are summarized in Table 1.

2.2. Descriptive Statistics

Table 3, reports the summary statistics of the variables used in the analysis.

INSERT TABLE 3 ABOUT HERE

Table 3, Panel A provides details on firm-level variables. The main proxy for innovative activity is the number of scaled patents. The average patent count for a firm in the sample is 1.86 patents, while the average number of citations per patent is 2.91.

The average (median) natural logarithm of GDP in the state of the company is 3.81 (3.89). The mean (median) per capita state income in the state is \$37.55 (\$37.81). The average age of a firm in the sample is 13.5 years, while the median firm in the sample is 10 years old. In an average year, there is a 2.5% likelihood of a significant decrease in state corporate income taxes. In an average year, there is a 5.2% likelihood of a significant increase in state R&D tax credit. The average (median) unemployment rate is 6.52% (6.07%).

Panel B provides details on state-level tax variables. In an average year, there is 17.5% likelihood of a significant change in capital gains tax rates, an 11.4% likelihood of a increase in allowance for carryover losses, and a 90.5% likelihood of a decrease in carryback loss allowances.

3. Identification Strategy and Main Results

3.1. Capital Gains Taxes and Innovation

We extend the analysis to a multivariate setting. We are interested in finding whether changes in capital gains tax rates result in greater innovation by firms. We employ a difference-in-differences (DID) specification to estimate the change in patenting activity by firms across states. In our DID strategy, the first difference is between years before and after a significant change in state-level capital gains tax rate. The second difference exploits the fact that different states enacted the tax change laws in different years. This gives us a treated group of firms which are headquartered in states which enacted a tax change law and a control group of firms which are headquartered in states which did not enact a tax change law. In fact, most states in the U.S. either had a significant increase or decrease in capital gains tax rates or both.[18] Therefore, most firms in our sample are both in the treated and control groups at different points in time. We estimate the following OLS specification:

$$Y_{is(t+k)} = \alpha + \beta_1 \cdot Tax\ Var_{st} + \beta_X \cdot X_{ist} + \gamma \cdot Firm_i + \theta \cdot Year_t + \epsilon_{ist}, \quad (1)$$

where, subscript ist denotes observation for firm i in state s in year t. The dependent variable, $Y_{is(t+k)}$ is the measure of innovative activity for firm i in state s, k years after the current year, t. More specifically, we are measuring the number of *new* patents applied for in year $t + k$ (and eventually granted). We also use a second dependent variable, which measures the quality of innovation, using the number of citations per patent applied for in year $t + k$ (and eventually granted) to firm i in state s.

The variable, $Tax\ Var_{st}$ takes the value of $Tax\ change_{st}$, $Tax\ increase_{st}$, or $Tax\ decrease_{st}$. We use the aggregate tax change variable, $Tax\ change_{st}$, to estimate the aggregate effect of tax changes. In separate regressions, we replace the variable with $Tax\ increase_{st}$, and $Tax\ decrease_{st}$ to check if the effect is symmetric across increases and decreases in state taxes. X_{ist} is the vector of state characteristics which include *Carryover NOL change*, *Carryback NOL change*, *Ln(GDP)*, *Per capita income*, *State corporate tax change*, *State R&D tax credit change*, and *Unemployment*, and firm characteristics which include *Age*, and the *HHI*; $Firm_i$ and $Year_t$ are firm and year fixed effects. Standard errors are clustered by firm. We perform the analysis on t+1, t+2, and t+3 in separate regressions.

The literature on capital gains tax recognizes that changes in tax rates can have an impact

[18] Table 2 shows that 33 states implemented either a significant tax increase or a tax decrease or both.

on patenting either through the demand channel or the supply channel. The demand channel argument is the following: an increase in capital gains tax rates will make an entrepreneur less likely to take on risky innovation because the returns from more successful projects will be taxed more heavily and unsuccessful projects will not be taxed. The convexity in the tax function increases as a result of increases in capital gains which dampens the incentives of entrepreneurs to spend effort on more risky, and potentially, more impactful innovative projects (Keuschnigg and Nielsen (2004); Gentry and Hubbard (2004); Gentry (2016)). The supply channel argument is the following: an increase in capital gains tax rates will reduce the gains to venture capital funds which choose to invest in innovative firms or projects. Such a decrease will reduce the flow of funding to innovative firms. The increase in capital gains tax will lead to less patents through the channel of higher funding constraints (Poterba (1989a), (1989b); Gompers and Lerner (1999); Keuschnigg and Nielsen (2002), (2004)).

To disentangle the potential channels for a capital gains tax-innovation relationship, we use two different variations of the main independent variable, $Tax\ Var_{st}$, for our main analysis. To evaluate the demand channel, we define $Tax\ Var_{st}$ based on the state of headquarters of the start-up company. To evaluate the supply channel, we use the alternative variable, $Tax\ Var\ VC_{st}$, based on the state of headquarters of the lead VC firm invested in the company. We define the lead VC as the VC firm which has provided the largest fraction of the start-up company's total funding.

Our DID strategy relies on the assumption that pre-shock cross-sectional heterogeneity in headquarter state is exogenous to post-shock patent production. Because all of our models will include firm fixed effects the assumption is even more narrowly defined. The assumption is that the pre-shock cross-sectional heterogeneity in location of firm headquarters is exogenous with respect to *changes* in a firm's post-shock patent production, other than through capital gains tax changes.

Using the headquarters state of the start-up company, we estimate our main OLS specification related to the demand channel. The results are reported in Table 4.

INSERT TABLE 4 ABOUT HERE

Table 4, columns (1) to (3) report the regression estimates where the dependent variable, $LnPat_{t+k} = Ln(1 + Pat)_{t+k}$, is the number of patents obtained, one, two, and three years after year t, respectively. The coefficient on *Tax change* for k equals 1, 2, and 3 is negative and statistically significant at the 1% level for all specifications. The results are economically large as well. In the second year after the current year, or (t+2), firms which experience a tax change in their state of business have 0.7% less patents than firms in states which do not experience a tax change. Columns (4) to (6) show the regression estimates where the dependent variable, $Ln(\frac{Cit}{Pat})_{t+k} = Ln(1 + \frac{Cit}{Pat})_{t+k}$, is the number of citations per patent of a firm, one, two, and three years, respectively after the year of a significant tax change. The coefficient on *Tax change* is negative and statistically significant for all specifications. In the second year after the current year, t, the quality of innovation falls by 0.6%, for firms in states which experience a significant change in capital gains tax rates.

Importantly, each regression controls for firm and year fixed effects. Therefore, the coefficient on *Tax change* is the differential effect of a firm moving tax regimes, either from high to low capital gains tax, or the reverse. If a firm is in a state which does not enact a change in capital gains tax rates then the firm fixed effect will soak up the effect. Similarly, to address the issue that there has been an increase in patents and citations over time we include year fixed effects, which soaks up the average number of patents per year (Hall, Jaffe, and Trajtenberg (2001)). To avoid potential biases in the estimation of standard errors due to serial correlation we cluster standard errors at the firm level, which allows for an arbitrary covariance structure within firms over time.[19]

Using the headquarters state of the VC firm, we re-estimate our main OLS specification

[19]In Table 9 we consider additional standard error clustering techniques to handle any latent autocorrelation. When doing so the standard errors decline, suggesting the firm fixed effect approach we report in the main paper is capturing any potentially concerning error term structure or dependence, consistent with Petersen (2009).

for the supply channel. The results are reported in Table 5.

INSERT TABLE 5 ABOUT HERE

Table 5, columns (1) to (3) report the regression estimates where the dependent variable, $LnPat_{t+k} = Ln(1 + Pat)_{t+k}$, where Pat_{t+k} is the number of patents obtained, one, two, and three years after year t, respectively. The coefficient on *Tax change VC* for k equals 1, 2, and 3 is negative, but not statistically significant. Columns (4) to (6) show the regression estimates where the dependent variable, $Ln(\frac{Cit}{Pat})_{t+k}$, is the number of citations per patent obtained, one, two, and three years after year t, respectively. The coefficient on *Tax change VC* is statistically significant in all specifications. These results suggest that while changes in capital gains tax rates do not impact patents production through the channel of VC supply, they affect the quality of innovation, by potentially reducing the VC funding in more innovative projects.

Typically, in addition to providing finance, VCs also add value to young firms via managerial support and commercial experience. Therefore, entrepreneurs and financiers jointly contribute to the firm's success. Keuschnigg and Nielsen (2004) argue that even a small capital gains tax involves a first-order welfare loss, because it exacerbates a pre-existing distortion and further diminishes incentives to provide entrepreneurial effort as well as managerial support.[20] When VCs are affected by a tax change, the entrepreneurs' incentives remain unaffected and they should continue to put effort. While VC tax changes appear not to affect the overall level of innovation (measured by the number of patents), they do affect the quality of innovation. Consistent with Keuschnigg and Nielsen (2004), VCs' incentives to provide managerial support to start-ups are reduces after a capital gains tax increase, and this has a direct negative effect on the quality of innovation produced by stat-up companies.

[20]When returns are shared, but each party must bear the entire intangible cost of her own input, joint efforts of entrepreneurs and VCs tend to be underprovided (Keuschnigg and Nielsen (2004)).

Existing literature on the effect of taxes on innovation by public companies finds an asymmetric response of firms to changes in taxes (Mukherjee et al. (2017), Atanassov and Liu (2017)). While Mukherjee, et al. (2017) analysis shows that increases in corporate income tax reduces future innovation, Atanassov and Liu (2017) find that tax cuts boost corporate innovation. To evaluate the impact of increases and decreases in capital gains tax rates, we replace our main independent variable $Tax\ Var_{st}$, with $Tax\ increase_{st}$ and $Tax\ decrease_{st}$, respectively.

INSERT TABLE 6 ABOUT HERE

Table 6, columns (1) to (3) report the regression estimates where the dependent variable, $LnPat_{t+k} = Ln(1 + Pat)_{t+k}$, is the number of patents obtained, one, two, and three years after year t, respectively. In Panel A, the coefficient on *Tax increase* for k equals 1, 2 and 3 is negative and statistically significant at the 5% level or higher. While, in Panel B, the coefficient on *Tax decrease* for k equals 1, 2 and 3 is positive and statistically significant at least at the 5% level. The results are economically large as well. In the second year after the current year, or (t+2), firms which experience a tax increase in their state of business have 1% less patents than firms in states which do not experience a tax change. Moreover, we find that firms exhibit a symmetric response to changes in capital gains tax rates. On average, a decline in state capital gains tax rate leads to 1.3% more patents, two years after the tax change.

In columns (4) to (6), we change the dependent variable to $Ln(\frac{Cit}{Pat})_{t+k}$, the number of citations per patent obtained, one, two, and three years after year t, respectively. In Panel A, the coefficient on *Tax increase* for k equals 2 and 3 is negative and statistically significant at the 5% level, while it is insignificant in year (t+1). In terms of economic significance, in the second year after the current year, t, the quality of innovation falls by 0.7% for firms in states which experience a significant increase in capital gains tax rates. In Panel B, the coefficient for *Tax decrease* is statistically significant in all three specifications, at the 5% level or higher. This suggests that, on average, two years after a tax reduction, affected firms have 1.1% more citations per patent.

Our results provide evidence that capital gains taxes affect not only the quantity of innovation but also the quality of innovation of start-up firms. Increases in capital gains taxes lead to a decrease in the total number of patents, as well as a reduction in the quality of those patents, measured by the number of citations that they receive. On the other hand, decreases in capital gains taxes lead not only to an increase in patent production but also to higher quality patents.

3.2. Reverse Causality Concerns

Changes in capital gains tax rates are, usually, exogenous to firm-level innovative activity. Nevertheless, the concern remains that state-level tax changes are endogenous to the future patenting (and investment) opportunity set in the state. We investigate dynamics around the tax changes to ensure that there are no pre-trends in the data, which could invalidate our results.

We create four indicator variables for each of the two tax measures, *Tax increase*, and *Tax decrease* to investigate the dynamics of our results. For example, when *Tax increase* is examined in Table 7, *Tax var minus 2* is an indicator variable equal to one if there is a significant tax increase in year $t+2$ in the headquarters state s of firm i, and zero otherwise. *Tax var minus 1* is an indicator variable equal to one if there is a significant tax increase in year $t+1$ in the headquarters state s of firm i, and zero otherwise. These indicators allow us to check if there is any change in patents one or two years *before* the change in state taxes. *Tax var* is an indicator variable equal to one if there is a significant tax increase in year t or $t-1$ in the headquarters state s of firm i, and zero otherwise. *Tax var plus 2 and more* is an indicator variable equal to one if there is a significant tax increase in year $t-2$ or earlier in the headquarters state s of firm i, and zero otherwise.

INSERT TABLE 7 ABOUT HERE

In Table 7, columns (1) and (2) we evaluate tax increases and tax decreases separately. Consistent with our main results, we find a significant negative impact of *Tax increase* on patents two or more years after the year of tax increase. There is no relation between tax changes and patents in the years prior to the tax changes, which is consistent with the assumption that there are no pre-existing trends in innovation before the increase in taxes. Similarly, we find a significant positive impact of *Tax decrease* on patents two and more years after the year of tax decrease. In addition, there is no relation between tax changes and patents in the years prior to the tax decrease. Columns (3) and (4) report the same specification using $\frac{Cit}{Pat}$ as the dependent variable. We find that there is no evidence for pre-existing trends in the quality of innovation before a change in capital gains tax rates.

3.3. Other Robustness Tests

We conduct a series of additional tests to check if our results are robust to sub-sample analysis, different clustering, and additional control variables. We find that our results are robust to all these checks.

INSERT TABLE 8 ABOUT HERE

In Table 8, we re-estimate our main analysis, examining the the effect of capital gains tax increases or tax decreases on the level of firm innovation, introducing two additional variables. *Control of chambers* measures the political affiliation of the state legislature, while *HHI* controls for industry competition using the Herfindahl-Hirschman index. Consistent with previous research, we find that both of those variables have a statistically significant negative effect on innovation (Atanassov and Liu (2017)). Moreover, after controlling for the political affiliation of the state legislature and the level of industry competition, we find that our results remain robust.

INSERT TABLE 9 ABOUT HERE

In Table 9, we perform several sub-sample analysis. The 1986 tax reform resulted in a number of states changing capital gains taxes in the same year, 1987. We check if our results are robust to excluding the 1987 shock of increase in capital gains tax. We also perform our tests only on a sub-sample of innovative firms, firms that have applied for (and been granted) at least one patent in the year.

Next, we exclude firms located in the states of California and Massachusetts to address the concern that our results are driven entirely by these two clusters of innovative firms. In the main analysis, we cluster standard errors by firm. For robustness, we also cluster standard errors by year, 2-digit SIC industry, and state of location of the firm's headquarters. Finally, we include industry fixed effects to check if our results are being driven by industry specific trends or changes. While the results are slightly weaker in some specifications they are overall robust and consistent with our main findings.

4. Cross-sectional Differences of the Effect

The evidence presented so far demonstrates that firms react to increases in capital gains taxes by decreasing their patent production, and vice versa. A natural question is whether some types of firms are more influenced by tax changes than others. In this section, we present additional tests in support of the mechanism through which taxes matter. These tests of the heterogeneity of the effect include: entrepreneurs' risk aversion, entrepreneurs' lock-in effect, and firms' cost of capital.

4.1. Entrepreneurs' Risk Aversion

Capital gains taxes can affect innovation through incentives of start-up managers/founders to take on more risk (Poterba (1989a), (1989b); Keuschnigg and Nielsen (2002), (2004)). An increase in capital gains tax reduces the return to entrepreneurs. This reduction in return can act as an incentive to entrepreneurs to reduce the risk within their startup firms. We use ex-post measures of innovation risk to test whether firms change the riskiness of their innovation after a tax change. We use as dependent variables, the standard deviation of firms' citations, the number of zero cited patents, and the number of highly cited (in the top 90^{th} percentile) patents (Mukherjee et al. (2017), Amore et al. (2013)).

INSERT TABLE 10 ABOUT HERE

The results are reported in Table 10. Panel A reports results using the standard deviation of citations for each firm-year as the dependent variable. In columns (1) and (4), we report results for the standard deviation of citations in the first year after the current year. Column (1) shows that there is a decrease in standard deviation of citations with a tax increase, and column (4) shows that there is an increase in the standard deviation of citations with a tax decrease. In columns (2) and (5) we report results for the standard deviation of citations in the second year after the current year, and in columns (3) and (6) the standard deviation of citations in the third year after the current year. The results are qualitatively similar. However, the result is strongest for the first and second year after the current year. These results show that entrepreneurs change the risk profile of innovative projects in response to changes in capital gains taxes. The change is highest in the first and second year after the tax change.

Table 10 Panel B, columns (1) to (3) report the regression estimates where the dependent variable, $LnPat\ ZC_{t+k} = Ln(1 + Pat\ ZC)_{t+k}$, is the number of patents with zero citations obtained, one, two, and three years after a significant tax increase. The coefficient on *Tax change* for k equals 1, 2, and 3 is negative and statistically significant at the 1% level for all specifications. Columns (4) to (6) show the regression estimates where the dependent variable, $LnPat\ ZC_{t+k}$, is the number of zero-cite patents of a firm, one, two, and three years, respectively after the year of a significant tax decrease. The coefficient on *Tax change* is positive and statistically significant for all specifications.

Table 10 Panel C, columns (1) to (3) report the regression estimates where the dependent variable, $LnPat\ HC_{t+k} = Ln(1{+}Pat\ HC)_{t+k}$, is the number of highly cited patents obtained, one, two, and three years after a significant tax increase. We define highly cited patents as those which are in the 90^{th} percentile of citations in the year. The coefficient on *Tax change* for k equals 1, 2, and 3 is not statistically significant. Columns (4) to (6) show the regression estimates where the dependent variable, $LnPat\ HC_{t+k}$, is the number of highly cited patents of a firm, one, two, and three years, respectively after the year of a significant tax decrease. We obtain similar results.

Put together, these results confirm that there is a change in innovation risk within firms in response to changes in capital gains taxes. We find that there is a change in the number of patents with no citations and no impact on highly-cited patents.

In further tests, we use industry-level measures of tax convexity to identify firms which are more likely to be affected by changes in managerial incentives. A key feature of the U.S. tax code is the non-linear nature of taxation, or the convexity of the tax schedule. Successful firms, or those which have positive capital gains pay high taxes and unsuccessful firms, or those without capital gains, do not. The asymmetric treatment of losses can be especially detrimental for young start-up firms that are generally less diversified and have most of their wealth concentrated in their business. Higher capital gains taxes can discourage entrepreneurs from taking on more risk and as a result lead to less innovative projects. We examine whether the innovation of firms that have higher tax convexity is more sensitive to changes in capital gains taxes.

We use the tax convexity faced by U.S. public firms as a proxy for the convexity in capital gains at the time of sale by the manager/founder. Aspects of the U.S. tax code, such as the existence of net operating loss carrybacks and carryovers, and investment tax credits, result in different levels of tax convexity for firms (Graham and Smith (1999)).[21] Firms

[21] In addition to net operating loss carryovers, and nonlinear treatment assigned to corporate earnings also add to the convexity of the tax schedule of firms.

with high net operating losses are likely to face a more convex tax schedule. Managers in such firms will be more affected by changes in capital gains tax rates and the tax-innovation relationship will be stronger.

INSERT TABLE 11 ABOUT HERE

We categorize firms based on the average level of pre-shock NOLs of public firms in the same 2-digit SIC industry in the years before and including the first year with a significant tax change in the state. Table 11, columns (1) and (3) report the results. They show that for patents in the third year after the current year, firms in industries with higher NOLs have a stronger tax-innovation relationship. The effect is statistically significant only in the case of tax decreases, column (3).

We use investment tax credits (ITCs) as an alternative proxy for the convexity of the tax schedule. We aggregate firms based on 2-digit SIC to obtain the level of ITCs for each industry-year observation. We match start-up firms to public firms in the same 2-digit SIC industry to obtain the average pre-shock level of ITCs. Columns (2) and (4) show the results. Column (2) shows that for patents in the third year after the current year, firms in industries with greater ITCs have a stronger tax-innovation relationship, i.e., a tax increase leads to less patent reduction. In column (4), we examine tax decreases and find similar results, the relationship between tax and innovation is more pronounced for firms that have more convex tax schedules.

In sum, these results provide some evidence that tax changes work through the manager or founder incentives to take on more or less risk, and as a result affect firm's innovation. Managers which are more likely to be affected from convexities in the tax code are more likely to change patenting decisions with changes in capital gains tax rates. A decrease (increase) in tax rates leads to less (more) risk-aversion of these managers and, therefore, leads to more (less) patent production.

4.2. Lock-in Effect

High capital gains taxes can create an incentive for founders to manage their own enterprises and avoid paying such taxes rather than sell out to professional managers (Constantinides (1983), Balcer and Judd (1987), Dammon, Spatt and Zhang (2001), Chari, Golosov and Tsyvinski (2004)). While this lock-in effect may not have a strong impact on the managerial decisions of publicly traded companies (especially when they have dispersed ownership), for privately-held firms, the lock-in effect associated with taxing capital gains could significantly affect managerial decisions since the owners are typically also the managers of these firms. As a result, the lock-in effect can lead to less innovation because of more entrenched management.[22]

We test the lock-in effect by categorizing firms based on whether they are private or public. We expect to find that the tax-innovation relationship is more pronounced for private firms versus firms that already did an IPO. In addition, we also classify firms based on how far they are from the IPO year at the time when the tax change went into effect. We define a variable, *Distance from IPO* as the number of years between the IPO year and the year of tax change for firms which completed an IPO before the year of the tax change. Based on the lock-in effect prediction, we expect firms that are private or have just completed an IPO to be more affected by the tax change, versus firms that are public.

INSERT TABLE 12 ABOUT HERE

Table 12 reports the results. Our dependent variable is the number of patents three years after the current year. In the first two columns, (1) and (2), we show the effect of a tax increase. We find that the coefficient estimate on the interaction term between the variables, *Tax increase* and *Private*, is negative and statistically significant. Consistent with the

[22]Atanassov (2013) documents that firms that become more protected from hostile takeovers experience a significant decline in innovative output.

lock-in theory, our result indicates that the effect of tax increases on innovation is more pronounced for the sample of private firms. In our second test, reported in column (2), the interaction term between the variables, $Tax\ increase$ and $Distance\ from\ IPO$, is positive but not statistically significant. The coefficient does have the expected sign. Given that a firm is public before the tax change, the managers are less likely to have distorted incentives due to the lock-in effect. As a result, these firms are less affected by the tax change. In columns (3) and (4) we report the effect of a tax decrease. Similarly to our test for a tax increase from column (1), in column (3) we find the effect of a tax decrease on innovation to be more pronounced for the sample of private firms. Moreover, our findings are further supported by the result in column (4), where we examine the effect of a tax decrease on firms that are further from an IPO. We find that the coefficient on the interaction between the variables, $Tax\ increase$ and $Distance\ from\ IPO$, is negative and statistically significant. Consistent with the lock-in theory, we find that firms that have completed an IPO before the year of tax change are less affected by the tax change.

4.3. Firms' Cost of Capital

Finally, capital gains taxes can change patents through relaxing or tightening firm's financial constraints. The argument is that capital gains tax rates can affect the cost of capital of firms by changing the rate of return required by a firm's shareholders. As a result, higher (lower) cost of capital will lead to less (more) current investments in innovative projects (Hall and Jorgenson (1967); Poterba (1989a); Becker et al. (2013)). Moreover, the effect of capital gains tax on the cost of capital is especially relevant for private entrepreneurial firms because in contrast to their public counterparts, who can borrow debt or access tax-exempt and foreign investors, these firms heavily rely on equity financing provided by taxable investors.

To test this hypothesis we first calculate the average industry-level (based on the two-digit SIC code) measure of financial constraints, the Kaplan-Zingales Index. To calculate the index, we follow Lamont, Polk and Saa-Requejo (2001) who use the original coefficient estimates of Kaplan and Zingales (1997). We define the variable, *KZ Index*, as the average pre-shock industry-level value of the index for start-ups in the same industry. As an alternative specification, we use a measure for the level of external finance dependence at the industry level to check whether the lack of internal funds affects innovation. Duchin, Ozbas and Sensoy (2010) define external finance dependence as the extent to which investments of the average firm in the industry is not met by internal cash flows. We calculate firm-level measures of external finance dependence as a ratio of (1) the average pre-shock external finance used by the firm, and (2) the average investment by the firm over the same period. We use annual data from Compustat. To reduce the effect of outliers, we use the industry median at the two-digit SIC code level to obtain the industry-level measure of external finance dependence. We define the variable *EFD* as the average pre-shock level of external finance dependence for start-ups in the same industry.

INSERT TABLE 13 ABOUT HERE

Table 13 reports the results. We use patents in the third year after the current year as the dependent variable. In columns (1) to (2), we show the effect of a tax increase. In each of the specifications the coefficient estimate to the variable of interest, the interaction term between the variables, *Tax increase* and the proxy for financial constraints, is negative. The coefficient estimate is statistically significant in only one of the two specifications. In columns (3) to (4) we report the effect of a tax decrease. Consistent with our previous results, we find that the coefficient estimate to the interaction term between *Tax decrease* and the proxy for financial constraints is positive and statistically significant in one of the two specifications. These results provide suggestive evidence that financial constraints play a role behind the tax-innovation relationship.

Poterba (1989a) argues that VCs are unlikely to respond to changes in capital gains tax because a majority of their investors are tax-exempt. While we are unable to directly test for the funding flow after capital gains tax changes, our results are in line with expectations. Cost of capital has limited explanatory power as a channel for the tax-innovation relationship.

5. Conclusion

The U.S. recently passed a major tax legislation that "will improve innovation and entrepreneurship – key drivers of economic growth", according to Kevin McCarthy, House Majority Leader. Nevertheless, there is little empirical research that has directly linked tax policies affecting entrepreneurial firms to innovation. In this paper we use staggered changes in capital gains tax rates in the U.S. to study the importance of tax policy for future innovation using a sample of VC-backed start-up companies. We find that an increase in tax rates stifles innovation of entrepreneurial firms. We also find that both the demand channel and the supply channel contribute to this finding. Within the demand channel, we find that entrepreneurs change their risk-taking in response to tax changes, and also take inefficient investment decisions due to being "locked-into" the company. Within the supply channel, we find evidence the VCs respond to changes in taxes by impacting the quality of innovation and not the quantity of innovation from these private firms.

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Figure 1: Ownership Structure of Venture Capital Funds

This figure shows the legal ownership structure of an average venture capital fund (VC fund) in the United States. The rectangular boxes represent funds or corporations. The oval shapes represent either corporations or individuals. The text in brackets describes the legal organizational form of the corporation. Delaware L.P. implies a limited partnership firm incorporated in the state of Delaware. Delaware LLC implies a limited liability corporation incorporated in Delaware. Other state LLC implies a limited liability corporation incorporated in any state of the US excluding Delaware. The Management Co. is related to the General Partner. Usually, the Management Co. receives the management fee and the General Partner receives a share of the profits, or the carried interest.

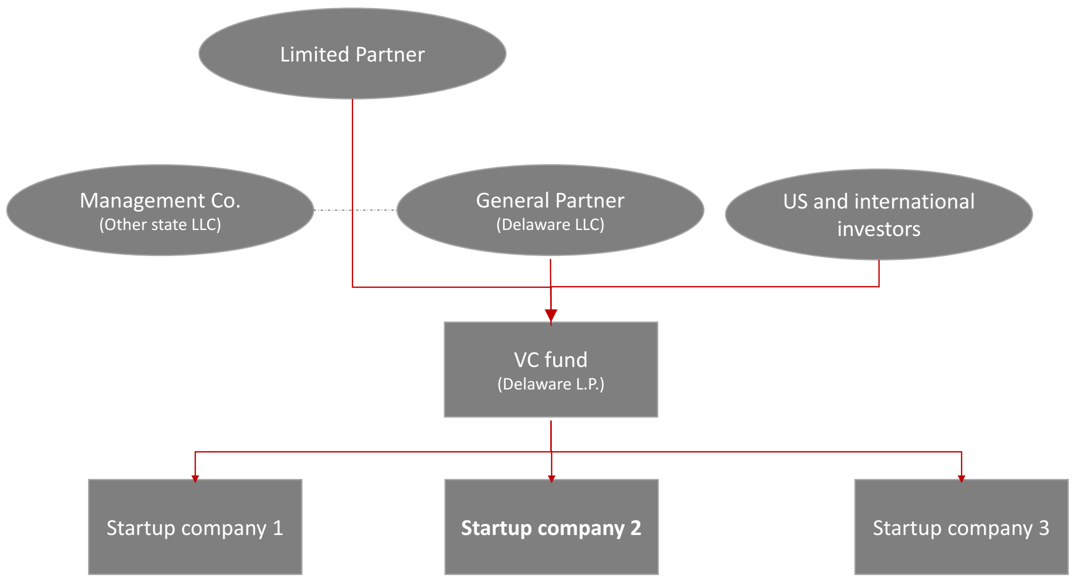

Table 1. Variable Definitions

This table shows a summary of all explanatory variables used in the analysis.

Variable name	Variable description
Firm characteristics and innovation measures:	
Pat_{it}	Count of the number of patents applied for (and eventually granted) in year t by firm i divided by the average number of patents granted to firms in the same year (Source: DWPI).
$(\frac{Cit}{Pat})_{it}$	Count of the number of citations per patent applied for (and eventually granted) in year t by firm i. Citations are the total number of citations received by all the patents of the firm divided by the average number of citations obtained by patents in the same year (Source: DWPI).
Age_{it}	Age of firm i in year t based on the years from the firm's founding year (Source: VentureXpert).
HHI_{it}	Herfindahl-Hirschman index. Equal to the sum of the squared share of firm i in total industry sales at the 4 digit SIC code in year t.
KZ index_{it}	Average level of financial constraints, as calculated by the Kaplan Zingales index, of public firms in the same 2-digit SIC industry as the firm i before the first year of significant change in capital gains tax rate.
EFD_{i}	Median level of external finance dependence of public firms within the same 2-digit SIC industry as the firm i. External financial dependence is defined as ratio of total capital expenditures net of funds from operations to total capital expenditures over five years before the first year of significant change in capital gains tax rate.
Tax policies measures:	
Tax increase_{it}	An indicator variable equal to one if there has been a significant tax increase of at least 1% in year t of state capital gains tax rate (either tax rate on wages, or tax rate on long-term capital gains) for firms headquartered in state s, and zero otherwise. State taxes on wages is the maximum state tax rate on wage income, estimated for an additional $1,000 of income on an initial $1,500,000 of wage income (split evenly between husband and wife). The taxpayer is assumed to be married and filing jointly. State capital gains tax rate is the maximum state tax rate on long-term capital gains.
Tax decrease_{it}	An indicator variable equal to one if there has been a significant tax decrease of at least 1% in year t of state capital gains tax rate (either tax rate on wages, or tax rate on long-term capital gains) for firms headquartered in state s, and zero otherwise. State taxes on wages is the maximum state tax rate on wage income, estimated for an additional $1,000 of income on an initial $1,500,000 of wage income (split evenly between husband and wife). The taxpayer is assumed to be married and filing jointly. State capital gains tax rate is the maximum state tax rate on long-term capital gains.
Tax change_{it} (Tax change $(\text{VC})_{it}$)	An indicator variable equal to one if there has been a significant tax increase of at least 1% in year t of state capital gains tax rate (either tax rate on wages, or tax rate on long-term capital gains) for firms headquartered in state s, equal to minus one if there has been a major decrease in the state's capital gains tax rate, and zero otherwise. State taxes on wages is the maximum state tax rate on wage income, estimated for an additional $1,000 of income on an initial $1,500,000 of wage income (split evenly between husband and wife). The taxpayer is assumed to be married and filing jointly. State capital gains tax rate is the maximum state tax rate on long-term capital gains. (An indicator variable equal to one if there has been a significant tax increase of at least 1% in year t of state capital gains tax rate for VC firm headquartered in state s, equal to minus one if there has been a major decrease in the VC state's capital gains tax rate, and zero otherwise.)

(Continue)

Table 1 – Continued

Variable name	Variable description
Carryover NOL change$_{it}$ (Carryover NOL change (VC)$_{it}$)	An indicator variable equal to one if there has been an increase in the length of the statutory net operating loss (NOL) carryover period in year t for firms headquartered in state s, equal to minus one if there has been a decrease in the length of the NOL carryover period, and zero otherwise. (An indicator variable equal to one if there has been an increase in the length of the statutory NOL carryover period in year t for VC firm headquartered in state s, equal to minus one if there has been a decrease in the length of the NOL carryover period in the VC's state, and zero otherwise.)
Carryback NOL change$_{it}$ (Carryback NOL change (VC)$_{it}$)	An indicator variable constructed in a similar way as Carryover NOL change$_{it}$ (Carryover NOL change (VC)$_{it}$), but using the change in length of the statutory net operating loss (NOL) carryback period, instead.
State corporate tax change$_{it}$	An indicator variable equal to one if there has been a significant tax increase of at least 1% in year t of state corporate income tax rate for firms headquartered in state s, equal to minus one if there has been a major decrease in the state's corporate income tax rate, and zero otherwise.
State R&D tax credit change$_{it}$	An indicator variable equal to one if there has been a significant increase of at least 1% in year t of state R&D tax credit rate for firms headquartered in state s, equal to minus one if there has been a major decrease in the state's R&D tax credit rate, and zero otherwise.
Tax var minus 2$_{it}$	An indicator variable equal to one if there has been a significant tax change of at least 1% in year $t+2$ of state capital gains tax for firms headquartered in state s, and zero otherwise.
Tax var minus 1$_{it}$	An indicator variable equal to one if there has been a significant tax change of at least 1% in year $t+1$ of state capital gains tax for firms headquartered in state s, and zero otherwise.
Tax var$_{it}$	An indicator variable equal to one if there has been a significant tax change of at least 1% in year t or $t-1$ of state capital gains tax for firms headquartered in state s, and zero otherwise.
Tax var plus 2 and more$_{it}$	An indicator variable equal to one if there has been a significant tax change of at least 1% in year year $t-2$ or earlier of state capital gains tax for firms headquartered in state s, and zero otherwise.
NOL$_i$	Average level of net operating losses of public firms in the same 2-digit SIC industry as the firm i before the year of significant change in capital gains tax rate.
ITC$_i$	Average level of investment tax credits of public firms in the same 2-digit SIC industry as the firm i before the year of significant change in capital gains tax rate.
Additional control variables:	
GDP$_{it}$	Level of real gross domestic product in state s and year t (Source: Bureau of Economic Analysis).
Per capita income$_{it}$	Level of real gross domestic product divided by total population in state s and year t (Source: Bureau of Economic Analysis).
Unemployment$_{it}$	Level of unemployment rate in state s and year t (Source: Cleveland Federal Reserve).
Control of chambers$_{it}$	An indicator variable equal to one if Democrats control both chambers (the Senate and the House of Representatives) in state s and year t, minus one if Republicans control both chambers, and zero otherwise.

Table 2. Significant Changes in State Capital Gains Tax Rates From 1987 to 2014

State	Years of tax increase	Years of tax decrease
Arizona		1995
Arkansas	1987	1999
California	1987, 2005	1996
Colorado	1987	
Connecticut	2009	1992
Georgia	1987	
Hawaii	1987	
Idaho	1987	
Illinois	2011	
Indiana	1987	
Kansas	1992	
Kentucky	1990	
Maine		1993
Maryland	1991	
Michigan	1987	
Minnesota	1987	
Mississippi	1987	
Missouri	1994	
Montana		2005
Nebraska	1987	
New Jersey	2004	2010
New Mexico	1987	2003
North Dakota	1987, 2001	1997
Ohio	1987	
Oklahoma	1987	2005
Oregon	1987	
Rhode Island	1987	1997, 2003
South Carolina		1995
Utah		1988, 2007
Vermont	2010	1994
Virginia	1987	
West Virginia	1987	
Wisconsin	2009	

Table 3. Summary Statistics

This table reports summary statistics for key variables used in the analysis. The sample period is from 1987 to 2014. Panel A includes the firm-level variables and Panel B includes state-level tax policy variables. Patent information is from the Derwent World Patents Index (DWPI) database. *Pat* is the number of US patents applied for (and granted) by the firm divided by the average number of patents granted to firms in the year. *Cit* is the number of citations, by US patents, received by all granted US patents in the year divided by the average number of citations received by patents in the year. All other variables are as defined in Table 1.

	N	Mean	St. Dev.	p25	Median	p75
Panel A: Firm-level Variables						
Pat	316,501	1.859	33.484	0.000	0.000	0.000
LnPat	316,501	0.093	0.523	0.000	0.000	0.000
LnCit/Pat	316,501	0.069	0.470	0.000	0.000	0.000
Ln(GDP)	316,501	3.812	0.262	3.719	3.891	3.986
Per capita income	316,501	37.551	10.304	29.802	37.813	44.554
Age	316,501	13.549	15.054	5.000	10.000	17.000
State corporate tax change	316,501	-0.022	0.247	0.000	0.000	0.000
State R&D tax credit change	316,501	0.052	0.256	0.000	0.000	0.000
Unemployment	316,501	6.524	2.180	4.942	6.067	7.692
Panel B: Tax policy variables						
Tax change	316,501	0.175	0.635	0.000	0.000	1.000
Carryover NOL change	316,501	0.114	0.990	-1.000	1.000	1.000
Carryback NOL change	316,501	-0.905	0.410	-1.000	-1.000	-1.000

Table 4. Capital Gains Tax and Innovation - Start-up Company Based Shock

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+k}$ is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t + k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. The dependent variable, $Ln(\frac{Cit}{Pat})_{t+k}$ is the natural logarithm of $(\frac{Cit}{Pat})_{t+k}$, the number of citations per patent in the year $t + k$, k = 1, 2, and 3 years after the current time period, t. *Tax change* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, minus one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax change	-0.006***	-0.007***	-0.006***	-0.004*	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryover NOL change	0.002	0.001	-0.001	0.000	0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	-0.006***	-0.001	0.006	-0.010***	0.004	0.010
	(0.002)	(0.004)	(0.004)	(0.002)	(0.007)	(0.007)
Ln(GDP)	-0.023	-0.041	-0.060	-0.070*	-0.109***	-0.161***
	(0.044)	(0.044)	(0.046)	(0.041)	(0.042)	(0.043)
Per capita income	-0.003***	-0.003***	-0.004***	-0.002**	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.002**	0.002*	0.003**	-0.001	-0.001	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.000	0.001	-0.002	0.002	0.004	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.003*	0.003	0.003*	0.005*	0.002	0.006**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.004***	-0.004***	-0.005***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	294,704	276,206	257,815	294,704	276,206	257,815
R-squared	0.809	0.820	0.830	0.541	0.559	0.586

Table 5. Capital Gains Tax and Innovation - VC Firm Based Shock

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+k}$ is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t + k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. The dependent variable, $Ln(\frac{Cit}{Pat})_{t+k}$ is the natural logarithm of $(\frac{Cit}{Pat})_{t+k}$, the number of citations per patent in the year $t + k$, k = 1, 2, and 3 years after the current time period, t. *Tax change (VC)* is an indicator variable taking the value of one if the state of the VC firm has a significant increase in the year, t, minus one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change VC, Carryback NOL change VC, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax change VC	-0.000	-0.002	-0.003	-0.005**	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryover NOL change VC	-0.001	-0.002	-0.004*	-0.002	-0.004**	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change VC	-0.001	-0.006	-0.005	-0.006***	0.005	0.006
	(0.002)	(0.004)	(0.004)	(0.002)	(0.006)	(0.005)
Ln(GDP)	-0.050	-0.076*	-0.092**	-0.082**	-0.126***	-0.178***
	(0.044)	(0.044)	(0.045)	(0.040)	(0.041)	(0.041)
Per capita income	-0.004***	-0.003***	-0.004***	-0.002**	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.003***	0.004***	0.005***	-0.001	0.000	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.001	0.001	-0.002	0.003	0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.005**	0.004**	0.004**	0.006*	0.003	0.007**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.005***	-0.006***	-0.006***	-0.006***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	292,144	273,777	255,517	292,144	273,777	255,517
R-squared	0.810	0.820	0.831	0.541	0.559	0.585

Table 6. Capital Gains Tax and Innovation - Start-up Company Based Shock

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+k}$ is the natural logarithm of $(1+Pat)_{t+k}$, where Pat is the patent count in year $t+k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. The dependent variable, $Ln(\frac{Cit}{Pat})_{t+k}$ is the natural logarithm of $(\frac{Cit}{Pat})_{t+k}$, the number of citations per patent in the year $t+k$, k = 1, 2, and 3 years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

Panel A: Tax increase

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax increase	-0.008**	-0.010***	-0.009**	-0.004	-0.007**	-0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Carryover NOL change	0.002	0.001	-0.001	0.000	0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	-0.006***	0.001	0.007*	-0.010***	0.005	0.010
	(0.002)	(0.004)	(0.004)	(0.002)	(0.007)	(0.007)
Ln(GDP)	-0.035	-0.057	-0.076*	-0.082**	-0.123***	-0.176***
	(0.044)	(0.044)	(0.045)	(0.041)	(0.042)	(0.043)
Per capita income	-0.003***	-0.003***	-0.004***	-0.002**	-0.002*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.002**	0.003**	0.004**	-0.001	-0.000	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.000	0.002	-0.002	0.002	0.004	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.004*	0.004*	0.004**	0.006*	0.003	0.006**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.004***	-0.005***	-0.005***	-0.006***	-0.006***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	294,704	276,206	257,815	294,704	276,206	257,815
R-squared	0.809	0.820	0.830	0.541	0.559	0.586

Table 6 – Continued

Panel B: Tax decrease

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax decrease	0.010**	0.013***	0.011***	0.010**	0.011***	0.010**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Carryover NOL change	0.002	0.001	-0.001	0.000	0.000	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	-0.007***	-0.002	0.005	-0.010***	0.003	0.008
	(0.002)	(0.004)	(0.004)	(0.002)	(0.007)	(0.008)
Ln(GDP)	-0.024	-0.040	-0.060	-0.062	-0.104**	-0.159***
	(0.044)	(0.044)	(0.046)	(0.041)	(0.041)	(0.043)
Per capita income	-0.004***	-0.004***	-0.004***	-0.002**	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.002**	0.002**	0.003**	-0.001	-0.000	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.000	0.001	-0.002	0.002	0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.004*	0.003*	0.003*	0.005	0.002	0.006**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.004***	-0.004***	-0.005***	-0.005***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	294,704	276,206	257,815	294,704	276,206	257,815
R-squared	0.809	0.820	0.830	0.541	0.559	0.586

Table 7. Capital Gains Tax Changes and Innovation - Dynamics

This table reports the results relating the number of patents and the number of citations per patent to the dynamics of tax changes. We estimate the OLS model of $LnPat_t$ ($Ln(\frac{Cit}{Pat})_t$) on *Tax Var Minus 2*, which is an indicator variable equal to one if there is a significant tax change in the year $t+2$ in the state of the company, and zero otherwise, on *Tax Var Minus 1*, which is an indicator variable equal to one if there is a significant tax change in the year $t+1$ in the state of the company, and zero otherwise, on *Tax Var*, which is an indicator variable equal to one if there is a significant tax change in the year t or $t-1$ in the state of the company, and zero otherwise, and on *Tax Var Plus 2 and More*, which is an indicator variable equal to one if there is a significant tax change in the year $t-2$ or earlier in the state of the company, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_t$	$LnPat_t$	$Ln(\frac{Cit}{Pat})_t$	$Ln(\frac{Cit}{Pat})_t$
	(1)	(2)	(3)	(4)
	Tax Increase	Tax Decrease	Tax Increase	Tax Decrease
Tax Var minus 2	0.001	0.001	0.003	-0.012
	(0.004)	(0.008)	(0.006)	(0.008)
Tax Var minus 1	0.001	0.009	0.008	0.007
	(0.005)	(0.008)	(0.006)	(0.008)
Tax Var	0.000	0.008	0.008	0.013*
	(0.005)	(0.007)	(0.005)	(0.007)
Tax Var plus 2 and more	-0.009**	0.010**	-0.007*	0.011**
	(0.004)	(0.004)	(0.004)	(0.005)
Ln(GDP)	-0.013	-0.007	-0.021	-0.007
	(0.043)	(0.043)	(0.042)	(0.042)
Per capita income	-0.003***	-0.003***	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.002**	0.002**	-0.001	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.005**	0.005**	0.003	0.003
	(0.002)	(0.002)	(0.003)	(0.003)
State R&D tax credit change	-0.001	-0.000	0.009***	0.008**
	(0.002)	(0.002)	(0.003)	(0.003)
Unemployment	-0.003**	-0.003***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.002)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	314,009	314,009	314,009	314,009
R-squared	0.800	0.798	0.525	0.523

Table 8. Capital Gains Tax and Innovative Firms - Additional control variables

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+k}$ is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t+k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. The dependent variable, $Ln(\frac{Cit}{Pat})_{t+k}$ is the natural logarithm of $(\frac{Cit}{Pat})_{t+k}$, the number of citations per patent in the year $t+k$, k = 1, 2, and 3 years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change, Unemployment, Control of chambers*, and *HHI*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

Panel A: Tax increase

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax increase	-0.007*	-0.010***	-0.009***	-0.003	-0.007**	-0.009***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Carryover NOL change	0.003	0.001	-0.000	0.001	0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	-0.004	0.002	0.008**	0.008	0.005	0.011
	(0.004)	(0.004)	(0.004)	(0.006)	(0.008)	(0.008)
Ln(GDP)	-0.044	-0.052	-0.057	-0.075	-0.124***	-0.163***
	(0.047)	(0.045)	(0.045)	(0.048)	(0.045)	(0.043)
Per capita income	-0.004***	-0.004***	-0.004***	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.003**	0.003**	0.003**	-0.000	-0.000	0.004***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.001	0.002	-0.001	0.003	0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.005**	0.005**	0.005***	0.006*	0.003	0.007**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.005***	-0.005***	-0.005***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Control of chambers	-0.004*	-0.004**	-0.004**	-0.003	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.091***	-0.080***	-0.072***	-0.040***	-0.023*	-0.009
	(0.022)	(0.021)	(0.020)	(0.015)	(0.013)	(0.013)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	246,633	246,615	246,595	246,633	246,615	246,595
R-squared	0.811	0.822	0.833	0.553	0.571	0.587

Table 8 – Continued

Panel B: Tax decrease

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$Ln(\frac{Cit}{Pat})_{t+1}$	$Ln(\frac{Cit}{Pat})_{t+2}$	$Ln(\frac{Cit}{Pat})_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
Tax decrease	0.008*	0.013***	0.013***	0.008	0.010**	0.011**
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)
Carryover NOL change	0.003	0.001	-0.000	0.001	0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	-0.005	-0.001	0.006	0.007	0.004	0.009
	(0.004)	(0.004)	(0.004)	(0.006)	(0.008)	(0.008)
Ln(GDP)	-0.035	-0.032	-0.036	-0.057	-0.106**	-0.148***
	(0.048)	(0.046)	(0.046)	(0.049)	(0.046)	(0.043)
Per capita income	-0.004***	-0.004***	-0.004***	-0.002**	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.003**	0.003*	0.003*	-0.001	-0.001	0.004***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	0.000	0.002	-0.001	0.003	0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
State R&D tax credit change	0.004**	0.004**	0.005**	0.005*	0.003	0.006**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Unemployment	-0.005***	-0.004***	-0.004***	-0.005***	-0.005***	-0.006***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Control of chambers	-0.004**	-0.005***	-0.005***	-0.004**	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.091***	-0.080***	-0.072***	-0.040***	-0.023*	-0.009
	(0.022)	(0.021)	(0.020)	(0.015)	(0.013)	(0.013)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	246,633	246,615	246,595	246,633	246,615	246,595
R-squared	0.811	0.822	0.833	0.553	0.571	0.587

Table 9. Capital Gains Tax and Patent Production - Robustness Tests

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+k}$ is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t + k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$	$LnPat_{t+1}$	$LnPat_{t+2}$	$LnPat_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
	Tax increase			Tax decrease		
Excluding years before 1992	-0.008***	-0.011***	-0.011***	0.010***	0.016***	0.014***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Innovative firms	-0.015	-0.024**	-0.024*	0.017	0.030**	0.027*
	(0.012)	(0.012)	(0.012)	(0.014)	(0.014)	(0.014)
Excluding CA and MA	-0.008*	-0.008*	-0.005	0.012**	0.012**	0.008
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Clustering by year	-0.008***	-0.010***	-0.009***	0.010***	0.013***	0.011**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Clustering by 2-digit SIC	-0.008**	-0.010**	-0.009	0.010*	0.013**	0.011
	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.008)
Clustering by state	-0.008**	-0.010***	-0.009**	0.010***	0.013***	0.011***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
With industry fixed effects	-0.008**	-0.010***	-0.009**	0.010**	0.013***	0.011***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)

Table 10. Capital Gains Tax and Patent Production - Innovation Riskiness

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $SD\ Cit_{t+k}$, $LnPat\ ZC_{t+k}$ and $LnPat\ HC_{t+k}$ in Panel A, B, and C, respectively. $SD\ Cit_{t+k}$ is the standard deviation of the citation count. $LnPat\ ZC_{t+k}$ and $LnPat\ HC_{t+k}$ is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count of the zero cited patents and of the highest (90%) cited patents, respectively, in year $t + k$, k=1, 2, and 3 denoting one, two, and three years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment.* The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

Panel A:						
	$SD\ Cit_{t+1}$	$SD\ Cit_{t+2}$	$SD\ Cit_{t+3}$	$SD\ Cit_{t+1}$	$SD\ Cit_{t+2}$	$SD\ Cit_{t+3}$
	(1)	(2)	(3)	(4)	(5)	(6)
		Tax increase			Tax decrease	
Tax change	-0.234***	-0.236***	-0.113*	0.355***	0.321***	0.123
	(0.059)	(0.063)	(0.062)	(0.089)	(0.093)	(0.089)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297,098	278,565	260,127	297,098	278,565	260,127
Panel B:						
	$LnPat\ ZC_{t+1}$	$LnPat\ ZC_{t+2}$	$LnPat\ ZC_{t+3}$	$LnPat\ ZC_{t+1}$	$LnPat\ ZC_{t+2}$	$LnPat\ ZC_{t+3}$
Tax change	-0.013***	-0.018***	-0.021***	0.021***	0.026***	0.027***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297,098	278,565	260,127	297,098	278,565	260,127
Panel C:						
	$LnPat\ HC_{t+1}$	$LnPat\ HC_{t+2}$	$LnPat\ HC_{t+3}$	$LnPat\ HC_{t+1}$	$LnPat\ HC_{t+2}$	$LnPat\ HC_{t+3}$
Tax change	0.001	-0.002	-0.003	0.001	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297,098	278,565	260,127	297,098	278,565	260,127

Table 11. Capital Gains Tax, and Patent Production - Entrepreneurs' Risk Aversion

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+3}$ is the natural logarithm of $(1 + Pat)_{t+3}$, where Pat is the patent count three years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+3}$			
	(1)	(2)	(3)	(4)
Tax increase	0.005	-0.001		
	(0.005)	(0.012)		
Tax increase * NOL	-0.015			
	(0.030)			
Tax increase * ITC		-0.136**		
		(0.065)		
Tax decrease			-0.020*	-0.020*
			(0.010)	(0.010)
Tax decrease * NOL			0.069***	
			(0.025)	
Tax decrease * ITC				0.281***
				(0.054)
Carryover NOL change	-0.000	-0.000	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Carryback NOL change	0.007	0.007	0.005	0.005
	(0.004)	(0.004)	(0.004)	(0.004)
Ln(GDP)	-0.114**	-0.107**	-0.107**	-0.106**
	(0.045)	(0.046)	(0.046)	(0.045)
Per capita income	-0.003***	-0.003***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Age	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	-0.002	-0.002	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
State R&D tax credit change	0.003*	0.003*	0.003*	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	-0.005***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	257,752	257,752	257,760	257,760
R-squared	0.837	0.837	0.837	0.837

Table 12. Capital Gains Tax, and Patent Production - Lock-in Effect

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+3}$ is the natural logarithm of $(1 + Pat)_{t+3}$, where Pat is the patent count three years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment.* The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+3}$			
	(1)	(2)	(3)	(4)
Tax increase	0.039	-0.015***		
	(0.025)	(0.005)		
Tax increase * Private	-0.052**			
	(0.025)			
Tax increase * Distance from IPO		0.002		
		(0.001)		
Tax decrease			-0.057	0.025***
			(0.052)	(0.007)
Tax decrease * Private			0.078***	
			(0.026)	
Tax decrease * Distance from IPO				-0.003*
				(0.002)
Carryover NOL change	0.000	-0.000	0.000	-0.000
	(0.002)	(0.003)	(0.002)	(0.003)
Carryback NOL change	0.007	0.010**	0.005	0.009
	(0.004)	(0.005)	(0.004)	(0.006)
Ln(GDP)	-0.110**	-0.104	-0.097**	-0.087
	(0.045)	(0.064)	(0.046)	(0.065)
Per capita income	-0.003***	-0.006***	-0.004***	-0.006***
	(0.001)	(0.002)	(0.001)	(0.002)
Age	0.004***	0.007***	0.004***	0.006***
	(0.001)	(0.002)	(0.001)	(0.002)
State corporate tax change	-0.001	-0.002	-0.001	-0.002
	(0.002)	(0.003)	(0.002)	(0.003)
State R&D tax credit change	0.003	0.002	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	-0.004***	-0.005***	-0.004***	-0.005***
	(0.001)	(0.002)	(0.001)	(0.002)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	257,815	257,815	257,815	257,815
R-squared	0.828	0.828	0.828	0.828

Table 13. Capital Gains Tax, and Patent Production - Firms' Cost of Capital

This table reports the impact of capital gains tax on patent production from an OLS regression. The dependent variable, $LnPat_{t+3}$ is the natural logarithm of $(1 + Pat)_{t+3}$, where Pat is the patent count three years after the current time period, t. *Tax increase* is an indicator variable taking the value of one if the state of the company has a significant increase in the year, t, and zero otherwise. *Tax decrease* is an indicator variable that takes the value one if the state has a significant decrease, and zero otherwise. All specifications include firm and year fixed effects, and controls for *Carryover NOL change, Carryback NOL change, Ln(GDP), Per capita income, Age, State corporate tax change, State R&D tax credit change*, and *Unemployment*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$LnPat_{t+3}$			
	(1)	(2)	(3)	(4)
Tax increase	-0.009**	-0.010***		
	(0.004)	(0.003)		
Tax increase * KZ index	-0.000			
	(0.000)			
Tax increase * EFD		-0.007***		
		(0.001)		
Tax decrease			0.008*	0.011**
			(0.005)	(0.004)
Tax decrease * KZ index			0.000**	
			(0.000)	
Tax decrease * EFD				-0.001
				(0.001)
Carryover NOL change	-0.000	-0.000	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Carryback change	0.007	0.007	0.004	0.005
	(0.004)	(0.004)	(0.004)	(0.004)
Ln(GDP)	-0.076*	-0.086*	-0.060	-0.060
	(0.045)	(0.045)	(0.046)	(0.046)
Per capita income	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.004**	0.004***	0.003**	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
State corporate tax change	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
State RD tax credit change	0.004**	0.004**	0.003*	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	-0.005***	-0.006***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	256,915	256,792	256,915	256,792
R-squared	0.830	0.830	0.830	0.830