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The Effect of Tax Avoidance Crackdown on Corporate Innovation

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Abstract: To constrain the use of intangible assets in tax-motivated state income shifting, many U.S. state governments adopted addback statutes. Addback statutes reduce the tax benefits that firms can gain from creating intangible assets such as patents. Using a sample of U.S. public firms, we examine the effect of addback statutes on corporate innovation behavior. First, the adoption of addback statutes leads to a 4.77 percentage point decrease in the number of patents and a 5.12 percentage point decrease in the number of patent citations. Second, the "disappearing patents" resulting from addback statutes have significant economic value. Third, after a state adopts an addback statute, a firm with material subsidiaries in that state assigns fewer patents to subsidiaries in zero-tax states, whereas the number of patents assigned to the other states does not change. Overall, our findings suggest that addback statutes impede corporate innovation.

Keywords: Addback Statutes, Innovation, Tax Avoidance Crackdown, Tax-Motivated Income Shifting.

JEL Classification: G30; H71; O30.

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The Effect of Tax Avoidance Crackdown on Corporate Innovation

1. Introduction

The past three decades have witnessed significant increases in corporate tax avoidance at both the state and federal levels (e.g., Dyreng et al., 2017; Institute on Taxation and Economic Policy, 2017).[1] As one of the most important tax avoidance strategies, U.S. firms extensively use intangible assets to shift taxable income from high-tax areas to low-tax areas to reduce income taxes (Bartelsman and Beetsma, 2003; Grubert and Slemrod, 1998).[2] To combat such income-shifting behavior and crack down on tax avoidance, more than 20 U.S. state governments have adopted addback statutes that specifically target tax-motivated income-shifting transactions using intangibles (e.g., Borens and Kerner, 2013). These statutes require firms within the adopting state to add back to their state taxable income intangible-related expenses paid to related parties in other states. For example, Connecticut adopted an addback statute in 1999. Thus, if a firm's subsidiary in Connecticut pays royalty fees for using patents held by a subsidiary in another state that does not tax intangible income, the firm needs to add the royalty fees to the taxable income reported in Connecticut. Thus, these provisions are expected to effectively limit firms' ability to avoid paying state income taxes by using intangible assets to shift income across states. Different state governments adopted the addback statutes at different time points, providing a powerful setting for examining the economic consequence of this tax policy.

In this study, we analyze a possible negative consequence of addback statutes. Specifically, we examine whether the adoption of addback statutes by U.S. state governments impedes corporate innovation and, if so, whether the magnitude of this effect is economically important. As discussed

[1] Tax avoidance refers to all the planning activities that reduce a firm's explicit taxes (Hanlon and Heitzman, 2010).
[2] This type of tax avoidance strategy is referred to as tax-motivated income shifting in the literature. For example, a firm's subsidiary in a high-tax state may pay royalty fees for using patents owned by another subsidiary of the same firm in a low-tax state. Thus, the firm's taxable income decreases in the high-tax state and increases in the low-tax state, reducing the firm's overall state income taxes.

above, intangible assets play an essential role in corporate tax avoidance. The crackdown on tax-motivated income-shifting transactions using intangibles reduces the projected after-tax net present value (NPV) of innovation projects. Thus, at the margin, firms may be discouraged from engaging in innovation activities. However, on the other hand, the magnitude of this potential negative effect on innovation may be mitigated for several reasons. For example, most states' addback statutes have exceptions discussed below, and it is also not clear whether the rules are strictly enforced (e.g., Borens and Kerner, 2013). Taking these arguments together, on net, we believe and predict that addback statutes will have a negative effect on innovation.

Our empirical analyses employ a sample of U.S. firms from 1997 to 2005.[3] To measure a firm's innovation, we rely on the count of utility patents (e.g., Griliches, Hall, and Pakes, 1987).[4] This output measure comprehensively captures both observable and unobservable inputs into innovation (He and Tian, 2013). A more innovative firm is expected to create and file more patents. After controlling for other determinants of corporate innovation as well as state, firm, and year fixed effects, we find that the adoption of an addback statute in a state leads to a 4.77 percentage point decrease in the number of patents filed by a firm with material subsidiaries in that state. The decline in patent count is consistent with the predicted negative effect of the addback statutes on innovation.

Prior studies (e.g., Hall, Jaffe, and Trajtenberg, 2005) suggest that the number of patent citations reflects the quality of a patent. If total citation count does not change, the decrease in the

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[3] We obtain patent data from Kogan et al. (2017), which cover patents granted up to 2010. Our sample ends in 2005 because we focus on patents filed in year t+3 in the tests, and the process from patent filing to grant takes on average about two years (Hall, Jaffe, and Trajtenberg, 2001).

[4] There are three types of patents: utility patents, design patents, and plant patents. Utility patents, known as "patents for invention," are "patents issued for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement" (see https://www.law.cornell.edu/wex/patent). In 2015, the United States Patent and Trademark Office (USPTO) reported that about 90 percent of all patents granted are utility patents (see https://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm).

number of patents does not necessarily mean a drop in a firm's innovation. Therefore, we also measure innovation based on the total number of citations that a firm receives on its patents. We find that after a state adopts an addback statute, the total number of citations received on patents filed by affected firms also significantly decreases by 5.12 percentage points. Together with the patent count test, the negative effect on patent citations lends further support to the idea that the addback statutes have a negative effect on corporate innovation. Further, the magnitude of the decline in innovation is comparable to those documented in recent studies on other important state tax policies (Mukherjee, Singh, and Žaldokas, 2017; Atanassov and Liu, 2019). For example, Mukherjee et al. (2017) examine a sample of 32 state income tax rate increases from 1990 to 2006 and find that a 1-percentage-point increase in state income tax rate on average reduces patenting activities by approximately 5 percentage points. Therefore, the effect of addback statutes on innovation is both statistically and economically significant.

The economic implications of the declines in patents and citations rest on the value of the "disappearing patents." To shed light on this issue, we test the effect of the addback statutes on the aggregate value of patents filed by affected firms after the adoption. The change in the aggregate value reflects the economic value of the "disappearing patents." We find that the adoption of the addback statutes significantly decreases the patents' aggregate value. Moreover, when we classify patents into two groups based on whether a patent has any citations, we find that the addback statutes reduce not only zero-citation patents but also patents with citations. Furthermore, we do not find a significant change in the average number of citations per patent after the adoption of addback statutes. Thus, the "disappearing patents" resulting from the addback statutes have economic value and do not seem to be of lower quality than other patents.

We further consider the location of patents. Prior to the adoption of addback statutes, a firm could lower taxes by assigning patents to a state that does not tax intangible income (i.e., Delaware, Nevada, Wyoming, and Michigan).[5] Subsidiaries in high-tax states then pay royalties for using the patents shifting income to the zero-tax state. Addback statutes require the payee to add back the royalty expense to its state taxable income. Thus, the firm can no longer avoid paying taxes in the high-tax state with addback statutes by assigning a patent to a zero-tax state. Further, to avoid double taxation, most states provide a subject-to-tax exception to addback statutes when the royalty payment is subject to tax (i.e., taxed) in another state. Due to this exception, the amount of income tax that the firm pays is the same no matter whether the patent is located in states with addback statutes, no-tax states, or another state with a similar tax rate. We, therefore, expect addback states to reduce firms' incentives to locate their patents in zero-tax states. We identify the location of patent assignees from the United States Patent and Trademark Office (USPTO)'s patent assignment data. Indeed, we find that the adoption of an addback statute reduces the number of patents that the firm assigns to subsidiaries in states with no taxes on intangible income. In contrast, we do not observe a significant change in the number of patents that the firm assigns to other non-zero-tax states. These findings lend further support to the argument that the addback statutes limit firms' use of patents in zero-tax states for tax-motivated income shifting.

We provide a number of additional tests. First, we do not find more pronounced effects of the addback statutes on corporate innovation for firms that are more financially constrained. Second, in a subsample of non–financially constrained firms, we still find that the addback statutes significantly reduce innovation. These two sets of findings rule out the alternative explanation that the effect on innovation is simply due to the crackdown on tax avoidance increasing firms'

[5] Intangible income is income that a firm earns from allowing other firms to use its intangible assets.

financial constraints and thus reducing investments in innovation activities. Third, we also conduct tests to mitigate concerns about possible confounding effects of other tax policy changes and state-level economic conditions. In particular, we do not find that state economic conditions predict the adoption of addback statutes. Also, the adoption of addback statutes rarely coincides with other changes in state tax policies. Fourth, we do not find significant changes in cross-country income shifting and the number of patents assigned to foreign subsidiaries after the adoption of addback statutes. These findings mitigate concerns about the alternative consequence that firms shifted patents to foreign countries for federal or foreign tax avoidance instead of using them to avoid state taxes. Fifth, we find that state corporate income tax revenue significantly increases after the adoption of addback statutes. This result is consistent with the addback statutes' being effectively enforced and increasing firms' tax burdens. Finally, our results remain unchanged when alternative samples and variable definitions are used. In particular, we find similar results after excluding Information Technology (IT) industries from our sample, mitigating concerns about the dot-com bubble.

Overall, our findings suggest that the adoption of addback statutes impedes corporate innovation. This study makes several significant contributions to the accounting, tax, and economics literature. First, our study contributes to the growing literature on the consequences of tax avoidance. Prior studies focus on the effects of tax avoidance on the cost of external financing and the valuation of merger and acquisition deals (e.g., Chow, Klassen, and Liu, 2016; Goh, Lim, and Shevlin, 2016; Hasan et al., 2014). Our findings suggest that the crackdown on tax avoidance via addback statutes significantly reduces a firm's innovation behavior. Thus, our findings help understand the effect of tax avoidance on firms' real activities.

Second, our study is related to the broad literature on the economic consequences of tax policies (e.g., Asker, Farre-Mensa, and Ljungqvist, 2015; Bloom, Griffith, and Van Reenen, 2002; Blouin, Core, and Guay, 2010; Faulkender and Smith, 2016; Graham and Tucker, 2006; Hall, 1993; Heider and Ljungqvist, 2015; Hines, 1994; Hines and Jaffe, 2000; Shevlin, Thornock, and Williams, 2017), and more specifically the literature on the effect of state tax policies on corporate innovation. Prior studies in this line of literature focus on the impacts of state R&D tax credits and changes in state statutory tax rates, which explicitly aim to affect firms' risk-taking behaviors and investment in R&D projects. Differently, we examine state governments' adoptions of addback statutes, a type of tax policy that aims to crack down on intangible-based income shifting but does not directly target corporate innovation. Addback statutes are different from tax policies studied in prior literature. For example, Wilson (2009) finds that the R&D tax credit in a state encourages a firm to shift its R&D projects from other states to that state but does not affect the firm's overall innovation. This is because the application of R&D credits depends on the location of the R&D activities. However, addback provisions require firms to add back intangible-related expenses paid to related parties in other states to the taxable income reported in the *addback* states rather than that in the states where the patents are located.[6] Thus, a firm cannot avoid the application of the addback provision by shifting patents across other states.

We contribute to the literature by providing evidence that such a state tax policy has an economically significant effect on corporate innovation. As discussed above, both the number of patents and the number of patent citations decrease by more than 4 percentage points after the adoption of addback statutes. The economic magnitude of these effects is comparable to the effect

[6] For example, if a firm shifts income using patents located in Delaware from California to Delaware, California's addback provision will require the firm to add back the intangible expense to the Californian taxable income. If the firm moves the patents from Delaware to Wyoming, the intangible expense still needs to be added back to the Californian taxable income.

of state tax rate changes as documented in the prior literature. In addition, the negative effect of addback statutes on innovation is borne by states where the patents are located rather than the state that adopts the addback statutes. Thus, our findings suggest an externality of a state's tax policy on the welfare of other states. Third, our study also contributes to the literature on the determinants of corporate innovation (e.g., Cornaggia et al., 2015; Hsu and Lim, 2013; Seru, 2014). Our findings support the argument that the location of subsidiaries inside the United States affects corporate innovation.

Finally, we believe that our study informs policy makers who are interested in the consequences of policies that constrain tax-motivated income shifting (i.e., base erosion) using intangibles.[7] The Tax Cuts and Jobs Act (TCJA) of 2017 also includes an anti-base-erosion provision somewhat similar to addback statutes, which aims to constrain tax-motivated income shifting by U.S. multinational firms to foreign countries with low taxes.[8] This provision calculates an alternative taxable income by adding back to U.S. taxable income–specified outbound payments to foreign related parties (i.e., foreign subsidiaries). Our study may help policy makers understand the net benefit of this tax provision. We encourage future research to directly examine the effect of the TCJA provisions on corporate innovation.

We organize the remainder of the paper as follows. Section 2 provides relevant literature and develops our hypothesis. Section 3 describes the sample, data, and variables. We present the

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[7] Income base erosion refers to the reduction of the tax base and total tax revenue of a higher-tax jurisdiction due to firms shifting taxable income to low-tax jurisdictions.

[8] This specific provision is labeled the base erosion anti-abuse tax (BEAT) provision. The TCJA also added two other provisions that likely interact with the BEAT provision. After TCJA, a U.S. multinational firm's foreign profits exceeding 10 percent of qualified business assets is subject to immediate taxation in the United States—the global intangible low-taxed income (GILTI) provision. In addition, the TCJA provides a tax deduction to firms that export products or services to a foreign country—the foreign-derived intangible income (FDII) deduction. This provision is intended to incentivize U.S. firms to keep their intangible assets in the United States, thus further discouraging firms from shifting intangible assets to foreign countries with low tax rates. This provision is similar to "IP boxes" adopted by some countries which subject income arising from patents developed within that country to reduced tax rates.

regression models and main results in Section 4 and the additional tests in Section 5. Section 6 concludes.

2. Literature Review

2.1 Intangible Assets and Tax Avoidance

The rapid increase in corporate tax avoidance by U.S. firms over the last three decades has attracted significant attention from researchers, politicians, and the public. For example, Dyreng et al. (2017) report that U.S. firms reduced their cash effective tax rates by approximately 10 percent from 1988 to 2012. Several studies provide similar findings that U.S. firms' average effective tax rate is approximately 10 percent lower than the U.S. statutory federal tax rate (e.g., U.S. GAO, 2016). Though state income tax rates are lower than federal income tax rates, state income tax avoidance accounts for a large part of U.S. firms' overall tax avoidance behavior. The Institute on Taxation and Economic Policy (2017) shows that the average state effective tax rate was only 2.9 percent for 258 profitable Fortune 500 corporations in 2015, which is considerably lower than the average statutory state corporate tax rate of about 6.25 percent. Also, 92 out of the 258 profitable Fortune 500 corporations paid no state income tax in at least one year from 2008 to 2015. Gupta and Mills (2002) and Ma and Thomas (2020) both find that U.S. firms' state tax avoidance behavior reduces their state effective tax rates by approximately 3 percent (relative to the state statutory tax rate). Similarly, in our sample, the average state effective tax rate (*ETR*) is 4.48 percent lower than the average top state statutory tax rate of 7.45 percent.[9] In comparison, the average federal ETR is 8.5 percent lower than the top federal statutory tax rate (35%). These statistics suggest that state tax avoidance is economically important and accounts for a large

[9] In our sample, the mean state ETR is 2.97 percent, and the mean federal ETR is 26.5 percent. In addition, the mean total ETR and mean foreign ETR are 28 percent and 10.5 percent, respectively.

portion of a firm's overall tax avoidance strategy. Therefore, state tax policies could have an economically significant effect on firm behavior.

An important tax avoidance strategy uses intangible assets to shift income across subsidiaries in different countries and different states (Devereux and Maffini, 2007; Hanlon and Heitzman, 2010). The U.S. tax code (e.g., IRS code section 482) requires firms to use "arm's length price" for intrafirm transactions related to intellectual property (e.g., patents, trademarks, and copyrights). The "arm's length price" is the price that two unrelated firms would use in a similar transaction. However, such an arm's length principle is hard to enforce, because intangible assets are usually unique and hard to value.

Empirical studies find that firms use discretion when pricing intrafirm transactions to shift income to low-tax areas. Clausing (2003) finds that U.S. multinational firms use lower prices in intrafirm international transactions compared with their transactions with unrelated parties. Harris (1993) and Rego (2003) also find that U.S. multinational firms use foreign subsidiaries to avoid paying domestic taxes. Grubert (2003) estimates that the use of intangible assets accounts for half of the income shifted from high-tax to low-tax countries by U.S. multinational firms. Klassen and Laplante (2012) further show that such income shifting became even more aggressive in recent years.

In other countries, similar tax avoidance strategies have been used. For example, Huizinga and Laeven (2008) find that European firms shift income out of Germany, which is a high-tax country, to reduce their overall tax liabilities. Using data from the European Patent Office, Böhm et al. (2015) find that European firms strategically locate their patents in countries with low patent taxes to facilitate tax-motivated income shifting. Beuselinck, Deloof, and Vanstraelen (2015) further find that tax-motivated income shifting by European multinational firms is more pronounced in countries with weak tax enforcement.

Inside the United States, different states levy different tax rates on intangible-related income. Firms exploit these differences to avoid paying state income taxes (Citizens for Tax Justice, 2011; Dyreng, Lindsey, and Thornock, 2013; Gupta and Mills, 2002). As a domestic tax haven, Delaware does not tax intangible-related income. A firm can transfer its intangible assets (such as trademarks and patents) to a subsidiary established in Delaware. The firm's other subsidiaries pay royalties and other expenses to the subsidiary for the right to use the company's patents, brands, logos, or other intangible assets in other states. Because these payments are tax deductible in other states, the firm's overall state income tax is significantly reduced.

2.2 Addback Statutes

To protect against the erosion of the state corporate income tax base (e.g., Borens and Kerner, 2013), more than 20 U.S. state governments have adopted addback provisions at different points in time. While there are subtle differences in the details of the provisions in different states, addback statutes directly target intrafirm transactions related to intangible assets. Specifically, multistate firms are required to add back interest and intangible expenses paid to an out-of-state related party to the taxable income reported in the state income tax return.[10] The definition of intangible expenses is similar in all the states. For example, according to the Georgia Code Title 48. Revenue and Taxation § 48-7-28.3, intangible expenses include "expenses, losses, and costs for, related to, or in connection directly or indirectly with the direct or indirect acquisition, use, maintenance, management, ownership, sale, exchange, or any other disposition of intangible

[10] A related party is generally defined as a related entity, a component member as defined in IRC section 1563(b), or a person to or from whom there is attribution of stock ownership under section 1563(e). Related parties include members in parent-subsidiary controlled groups and brother-sister controlled groups. See https://www.irs.gov/pub/irs-tege/epchd704.pdf.

property" and also "royalty, patent, technical, and copyright fees." In addition, intangible property includes patents, patent applications, trade names, trademarks, service marks, copyrights, mask works, trade secrets, and similar types of intangible assets.[11] Before the adoption of an addback statute, a firm could avoid paying taxes in Georgia and lower its overall taxes if its subsidiary in Georgia pays royalty fees for using a patent held by another subsidiary in Delaware where intangible income is tax free. However, after the adoption of an addback statute, the Georgia subsidiary has to add back the royalty fees to the taxable income in Georgia. The amount of income taxes that the firm pays in Georgia becomes the same no matter whether the patent is located in Delaware or Georgia. Thus, the tax benefit of creating patents is lowered. Additionally, if the cost of planning intrafirm transactions (i.e., royalty payments) is significant, the firm may further prefer to hold the patent in Georgia instead of Delaware. Thus, compared with before the adoption of addback statutes, not only are the after-tax payoffs to innovation decreased, but the firm's incentives to assign the patent to Delaware decrease.

There are three common exceptions to the addback statutes (Borens and Kerner, 2013). First, most states have a subject-to-tax exception in their statutes. According to this exception, a firm does not need to add back intangible expenses paid to a related party if the related party is subject to income tax in the state or another state. Thus, the corresponding item of income will not be double taxed.[12] For example, if a subsidiary in Georgia pays royalty for using a patent created and held in another state that taxes intangible income, the firm would pay taxes for the intangible income in both states without this exception. Then, the firm would have incentives to

[11] The addback statutes also cover the expenses generated by trade secrets. Thus, our findings of decreased patent count are not likely because firms keep the technologies as trade secrets instead of filing them as patents. For details, see http://www.mtc.gov/uploadedFiles/Multistate_Tax_Commission/Uniformity/Uniformity_Projects/A_-_Z/Add-Back%20-%20FINAL%20version.pdf.
[12] Nonetheless, Guariglia, Shipley, and Banks (2005) suggest that there are certain cases where double taxation may occur.

assign the patent to either Georgia or another state without taxes on intangible income (e.g., Delaware) to avoid the double taxation. But such incentives to relocate the patent are mitigated by the subject-to-tax exception. With this exception, the firm pays the same amount of taxes no matter whether the patent is located in Georgia, a zero-tax state, or other states with the same tax rate as Georgia.[13] Consequently, the subject-to-tax exception would further disincentivize patent relocations to zero-tax states.

Second, another common exception is known as the conduit exception, which applies when the related party further pays the intangible royalty fees to an unrelated party. The transaction with the unrelated party must have a valid business purpose and/or use the arm's length price. For example, if firm A pays intangible fees to a related firm B and firm B further pays the intangible fees to an unrelated firm C, then the intangible fees (i.e., expenses) do not need to be added back to firm A's taxable income. It is possible that all the three firms do not pay taxes for the intangible fees if firms B and C are located in states with no taxes on intangible income. But for this exception to apply, firm C must be unrelated to firms A and B. Thus, the intangible fees paid by the group of A and B to C are for business purposes rather than avoidance or reduction of taxation. State tax authorities can limit the application of the conduit exception, if it believes the purpose of the payment to the unrelated party is to avoid taxes (e.g., Guariglia et al., 2005).

Lastly, the third most common exception will apply if the taxpayer can prove that the application of addback statutes is unreasonable. To qualify for this reasonableness exception, a taxpayer may provide evidence that the related-party transaction has economic substance, follows the arm's length principle, and is not used to avoid paying taxes.

[13] The state of Georgia would collect more tax revenue if the patent is located in Georgia or a zero-tax state rather than being located in states with taxes on intangible income. But addback statutes do not explicitly provide incentives to encourage firms to locate patents in the addback state. The purpose of addback statutes is to reduce tax avoidance rather than affecting the location of patents.

However, the application of these exceptions usually has several requirements, and it is difficult for firms to meet these requirements. There is some ambiguity in the interpretations of the exceptions. For example, many firms argue that the subject-to-tax exception should apply as long as the related party is subject to any tax (e.g., sales tax) in another state. If so, firms could still avoid taxes through intangible-based income shifting by paying taxes for other income items. However, in recent lawsuits, both the Alabama Supreme Court and New Jersey Tax Court denied such an interpretation.[14] The courts held that the subject-to-tax exception only applies when the income from intangible-related transactions should be subject to the same income taxes in another state. Thus, many experts expect the adoption of addback statutes to effectively limit corporations from avoiding taxes by income shifting using intangibles (e.g., Carey and Huston, 2003).

Addback statutes are different from other tax policies related to intangible income. For example, a number of countries have adopted intellectual property (IP) boxes (also known as patent boxes) to encourage firms to innovate and hold their patents in those countries by levying a lower tax rate on intangible income.[15] Similar to IP boxes, a state's addback statutes may encourage firms to hold patents in the state. However, the purpose of addback statutes is to crack down on patent-based income-shifting tax avoidance rather than encouraging corporate innovation within the state (e.g., Guariglia et al., 2005; Borens and Kerner, 2013).[16]

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[14] Please see *Surtees v. VFJ Ventures, Inc.*, 8 So.3d 950 (Ala. Ct. Civ. App. 2008), *aff'd* by *Ex parte VFJ Ventures Inc.*, 8 So.3d 983 (Ala. 2008).

[15] For example, the UK government suggests that the IP box "is designed to encourage companies to keep and commercialise intellectual property in the UK." See details at https://www.gov.uk/guidance/corporation-tax-the-patent-box. See also Guenther (2017) for more details on IP boxes. While the United States has not adopted an IP box to date, as previously noted, the foreign-derived intangible income (FDII) deduction in the TCJA 2017 is intended to incentivize firms to keep their U.S. innovation in the United States by reducing taxes on intangible income.

[16] Also, while IP boxes discourage intangible-based income shifting from a country with the policy to other countries, it could also incentivize the firm to shift intangible-based income from high-tax countries to the adopting country (e.g., Haufler and Schindler, 2020). To discourage income shifting into the IP box country, the OECD (2015) recommends that the IP income be generated from R&D conducted within the country. Additionally, IP boxes differ as to how they allow IP acquired through M&A to qualify for the lower tax rate on IP income (known as the nexus requirement).

2.3 Hypothesis

Innovation plays an important role in determining a firm's growth and value (e.g., Hirshleifer, Hsu, and Li, 2013). Understanding the consequences of tax policies on innovation is important for policy makers. Prior literature on the effect of tax policies on innovation can be summarized into two streams. The first stream of studies examines the effect of R&D tax credits and allowances on R&D investments (e.g., Bloom et al., 2002; Hall, 1993; Hines, 1994; Hines and Jaffe, 2000; Rao, 2016). While most prior studies focus on country-level R&D tax credits, Wilson (2009) examines how state-level R&D tax credits affect firms' innovation behavior. He finds that the R&D tax credit in a state increases a firm's R&D investment in that state mainly by drawing the firm's R&D projects from other states. Thus, state R&D tax credits do not have a substantial effect on a firm's nationwide innovation.

Another stream examines the effect of statutory tax rates on innovation. Theoretical models (e.g., Hall and Jorgenson, 1969; Jorgenson, 1963) predict that if R&D investment is tax deductible, statutory tax rates are not expected to have a major impact on R&D projects—because the tax benefits from R&D investment deductions are canceled out by the taxes on taxable income. However, recent empirical studies (e.g., Atanassov and Liu, 2019; Mukherjee et al., 2017) find that higher state tax rates negatively affect patenting and R&D investment because of lower after-tax income available for future investment.

We are interested in the impact of addback statutes on corporate innovation. As discussed earlier, addback statutes are designed to crack down on tax-motivated income-shifting transactions using intangibles. However, such tax policies imposed by state governments may have a negative impact on innovation. Because the role of patents in tax avoidance is limited by the addback

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Bradley, Robinson, and Ruf (2020) examine the effect of IP boxes on M&A activities as a function of these nexus requirements and find stricter nexus reduces the volume of M&A.

statutes, the projected net present value (NPV) of innovation projects decreases, resulting in a disincentive for corporate innovation. Therefore, these arguments lead to the prediction that addback statutes impede corporate innovation. We state this prediction in the alternative form as follows:

Hypothesis: The adoption of addback statutes negatively affects corporate innovation.

Given the significant amount of state taxes that firms avoid by using intangible-based income shifting, we expect the innovation effect of addback statutes to be economically important. However, there are also reasons why the magnitude of the predicted effect may be mitigated and become insignificant. For example, managers may not take tax savings into consideration when they make investment decisions about innovation projects.[17] Also, as discussed above, most states' addback statutes have exceptions in these rules. Thus, it is not clear whether the rules are strictly enforced. Further, if effective, addback statutes help the adopting state's government raise more tax revenue. As a result, the state government may spend more on public goods, such as local research institutions and labs, higher education, and public infrastructure. These public goods may help a firm better innovate. For example, the firm may be able to recruit more talented researchers for innovation activities from local research institutions. Therefore, it is also possible that we may not observe significant evidence consistent with our hypothesis.

[17] If R&D decisions are made by subsidiary-level managers rather than the top management team, the usefulness of patents in shifting taxable income across subsidiaries/states may not be incorporated into the R&D investment decisions. However, prior literature suggests that the headquarters of a firm coordinates its R&D investment decisions (Larsson, 2004). Therefore, the headquarters would consider the tax policies of different states.

3. Sample, Variable Measurement, and Descriptive Statistics

3.1 Data and Sample

We obtain company financial data from *Compustat* and patent data from Kogan et al. (2017).[18] Data on material subsidiaries disclosed in Exhibit 21 of Form 10-K are from Dyreng and Lindsey (2009) and Dyreng et al. (2013).[19] Data on state statutory tax rates and state R&D tax credits are from the Federation of Tax Administrators and Wilson (2009).

We begin with the sample of U.S. firms between 1997 and 2005 in *Compustat*. Our sample period starts from 1997, which is two years before the first state adopted an addback statute in 1999. Kogan et al. (2017) provide patent data matched with *CRSP* firms up to 2010. Patents filed before and in 2008 would have most likely been granted by 2010.[20] Therefore, the sample for our primary tests ends in 2005, because we examine the number of patents filed three years ahead.

We have several sample selection requirements. First, we remove firms that are not taxed as corporations as well as firms with missing Central Index Keys (CIKs).[21] Second, we exclude single-state firms that have material subsidiaries in only one state, because addback statutes are supposed to affect the tax avoidance behavior of multistate firms. Third, we delete firm-year observations that have both negative state income tax and negative domestic pretax income, as these firms pay no state income taxes and thus are unlikely to be affected by state tax policies.[22]

[18] We do not have access to data on patents granted in other countries. But due to the territorial nature of patent rights, U.S. firms usually file patents for the same inventions in the United States and in other major economies (e.g., European Union) at around the same time to protect their patents from infringements inside or outside of the United States.

[19] Data are available at Scott Dyreng's website: https://sites.google.com/site/scottdyreng/Home/data-and-code/EX21-Dataset.

[20] A patent is included in their dataset only after it is granted by the USPTO. Because the patent review process at the USPTO takes on average about two years, the number of patents filed in 2009 and 2010 are relatively smaller in the database. To avoid possible truncation bias that there may not be enough time for patents filed in 2009 and 2010 to get granted by the end date of the available data (Hall et al., 2001), our primary tests do not use patent data beyond 2008.

[21] A nonmissing CIK is required, as we use domestic material subsidiaries disclosed in Exhibit 21 of Form 10-K to map out the economic nexus of a firm.

[22] Our results are robust if we do not exclude these observations.

Next, we exclude firms with missing industry code and firms in nonpatent industries.[23] Further, to ensure enough within-firm variation for our analyses, we require each firm to have at least three observations in our sample period.[24] Lastly, we restrict the sample to observations with nonmissing data to compute the variables used in the main tests. Our final sample includes 11,228 firm-year observations, which belong to 1,946 unique firms.

3.2 Variable Measurement

3.2.1 Identifying Affected Firms and Observations

Appendix B shows the years in which different states adopted addback statutes. Following Dyreng et al. (2013), we identify locations where a firm has economic nexus based on domestic material subsidiaries disclosed in Exhibit 21 of Form 10-K.[25] We identify a firm as an affected firm if it has at least one subsidiary in a state during the year in which the state adopts the addback statutes. To mitigate the concern that low-innovation firms "self-select" into states with the addback statutes, we remove a firm if all its subsidiaries in states with the addback statutes are established after the adoption of the addback statutes in those states.[26] Also, we require each affected firm to have observations both before and after being affected by the addback statutes.[27]

Further, to identify firm-year observations impacted by the adoption of addback statutes, we construct an indicator variable, *Addback*. Specifically, for an affected firm, we set *Addback* to 1 for the adoption year and all the subsequent years, unless the firm no longer has any subsidiary in

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[23] We define a nonpatent industry as a four-digit SIC group with no patent in Kogan et al. (2017)'s patent dataset.
[24] As explained below, our regression model controls for firm fixed effects. Firms with fewer than three observations may not have enough within-firm variations, reducing the power of our analyses.
[25] According to Regulation S-X, firms are required to disclose material subsidiaries with at least 5 percent of total sales. Firms may voluntarily disclose other subsidiaries if these are considered economically important by the firms. Therefore, firms should have significant economic activities and economic nexus in all the states where the firms have disclosed subsidiaries. Firms may have immaterial subsidiaries in other states. Omitting these immaterial subsidiaries may misclassify affected firms as unaffected ones and thus bias against finding our results.
[26] Our results remain robust without this restriction.
[27] Our results remain robust without imposing this requirement.

states with the addback statutes. If a firm has no subsidiaries in states with the addback statutes in a given year, *Addback* equals 0. To alleviate the concern that high-innovation firms choose to leave states with the addback statutes, we remove observations of an affected firm that no longer has subsidiaries in states with the addback statutes after being affected by the addback statutes.[28]

3.2.2 Measuring Innovation

Following prior literature on innovation (e.g., Griliches et al., 1987), we use patent-based innovation measures for two reasons. First, patent is an output measure that captures both observable and unobservable inputs into innovation (He and Tian, 2013), whereas R&D expense only reflects observable inputs. Second, reported R&D expenditures contain significant measurement errors. Koh and Reeb (2015) show that almost one half of firms in *Compustat* report missing R&D expenditures, and about 10 percent of firms with missing R&D expenditures actually file patents. We also find that R&D expense is missing for 58.4 percent of the *Compustat* population during our sample period. Therefore, we use patent count and citation count to capture the amount and quality of innovation. Our innovation variables are constructed using patent data provided by Kogan et al. (2017).

Following He and Tian (2013), our first innovation variable is *Ln_NPat3*, which is measured as the natural logarithm of one plus the number of patents filed three years after the year in which the key independent variable *Addback* is measured.[29] The use of three-year-ahead patent count is because of the long-term nature of the innovation process and consistent with prior studies that assume the innovation process lasts three years (e.g., Atanassov and Liu, 2019; Manso, 2011;

[28] Excluding these 213 observations could mitigate concerns about self-selection bias. We predict that affected firms will have lower innovation than nonaffected firms. If we include these observations in our sample, high-innovation firms would be classified into the nonaffected group. Thus, the magnitude of our effect will be overestimated. Our results are robust to the inclusion of these observations.

[29] We use patent filing date rather than grant date because filing date is closer to the time of the actual innovation (Hall et al., 2001; Tian and Wang, 2014).

Moshirian et al., 2019).[30] Our second innovation variable is *Ln_NCite3*, which is measured as the natural logarithm of one plus the number of non-self-citations received on patents that are filed three years ahead. Hall et al. (2005) posit that a patent would keep receiving citations over a long period after its grant date, but only citations received by the end date of the available data can be observed, which may impose truncation bias. To correct for this truncation bias in citation count, we do the following: (1) consistent with Lerner, Sorensen, and Strömberg (2011), only citations received on a patent within the three-year window starting from the patent's grant year are included in the citation count, and (2) following Kogan et al. (2017), we deflate a patent's citation count by the average number of citations received by all patents filed in the same year as the patent.[31]

3.3 Descriptive Statistics

The descriptive statistics of the variables used in our regression analyses are presented in Table 1. All variables (except *TobinQ*) are winsorized at the top and bottom 1 percent. As we can see in Panel A, 26 percent of firm-year observations in the sample have *Addback*=1. Consistent with prior studies on innovation (e.g., Atanassov and Liu, 2019; He and Tian, 2013), the distributions of patent count and citation count are highly skewed, as there are many firm-year observations with zero patents. The mean of *NPat3* (the number of patents filed by a firm in year t+3) is 13.40, and the mean of *NCite3* (the truncation-adjusted number of citations received on patents filed by a firm in year t+3) is 4.43.

Figure 1 further shows the percentage of firms affected by addback statutes by year. As expected, we find that more firms are affected by the addback statutes in later years. In the year of the first state's adoption of an addback statute (1999), 19 percent of the observations are affected. In the last year of our sample (2005), the percentage is almost tripled and reaches 57 percent. This

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[30] Atanassov and Liu (2019) find that there is a three-year delay in the effect of tax rate changes on innovation.
[31] Year fixed effects included in the regression models also mitigate the impact of truncation bias.

sharp increase in the percentage provides a powerful setting to examine the consequences of the addback statutes. Also, these are consistent with our expectation because more states adopted the addback statutes in the later part of our sample period.

4. Primary Tests

We test our hypothesis of the effect of addback statutes on future innovation using the following OLS models (1) and (2). All the subscripts are suppressed, as all independent variables are measured in the same time period—year t.

$$
\begin{aligned}
Ln\_NPat3 = {} & \beta_0 + \beta_1 Addback + \beta_2 Ln\_AT + \beta_3 ROA + \beta_4 CFO + \beta_5 Leverage \\
& + \beta_6 TobinQ + \beta_7 RD + \beta_8 CAPEX + \beta_9 NOL + \beta_{10} Ln\_NPat + \beta_{11} \Delta Ln\_NPat \\
& + \beta_{12} State\_RD\_Credit + \beta_{13} \Delta State\_RD\_Credit + \beta_{14} State\_Tax\_Rate \\
& + \beta_{15} PIC\_Separate + \beta_{16} PIC\_NoNexus + \beta_{17} \#States + Firm\ FE \\
& + State\ FE + Year\ FE
\end{aligned} \tag{1}
$$

$$
\begin{aligned}
Ln\_NCite3 = {} & \beta_0 + \beta_1 Addback + \beta_2 Ln\_AT + \beta_3 ROA + \beta_4 CFO + \beta_5 Leverage \\
& + \beta_6 TobinQ + \beta_7 RD + \beta_8 CAPEX + \beta_9 NOL + \beta_{10} Ln\_NCite + \beta_{11} \Delta Ln\_NCite \\
& + \beta_{12} State\_RD\_Credit + \beta_{13} \Delta State\_RD\_Credit + \beta_{14} State\_Tax\_Rate \\
& + \beta_{15} PIC\_Separate + \beta_{16} PIC\_NoNexus + \beta_{17} \#States + Firm\ FE \\
& + State\ FE + Year\ FE
\end{aligned} \tag{2}
$$

The dependent variables in Models (1) and (2) are patent count (*Ln_NPat3*) and citation count (*Ln_NCite3*), respectively. Patent count is the natural logarithm of one plus the number of patents filed by a firm in year t+3, while citation count is the natural logarithm of one plus the truncation-adjusted number of non-self-citations received by patents that are filed in year t+3. We use the logged form of patent count and citation count as the dependent variables to address skewness. In both models, the key independent variable is *Addback*, which equals 1 if a firm is affected by addback statutes in year t. The coefficient on *Addback* indicates how the innovation of affected firms changes after being affected by the addback statutes compared with that of the other firms. Our hypothesis predicts that the addback statutes negatively affect innovation. Therefore, we expect a significant and negative coefficient on the key variable of interest, *Addback*.

To estimate generalized difference-in-differences (DiD) regressions, our models need to include a set of group- and time-fixed effects (Wing, Simon, and Bello-Gomez, 2018). Therefore, we include firm and year fixed effects in both models. State fixed effects are also included in the models. To mitigate the confounding effects of firm characteristics and other tax policies across states, we include a number of control variables, which potentially correlate with both innovation and state tax policies. The definitions of all the variables are included in Appendix A.

Table 2 reports the regression results of Model (1) when *Ln_NPat3* is the dependent variable. Standard errors are clustered by firm to mitigate serial correlation concerns. In the first column, we only control for firm, state, and year fixed effects.[32] In the second column, we further include all the other variables in Model (1). The coefficient on *Addback* is −0.0501 in Column 1 and −0.0477 in Column 2, both significant at the 5 percent level, indicating that operating in a state that has adopted an addback statute is negatively associated with the number of patents filed three years later. Therefore, after the adoption of an addback statute in a state, the number of patents filed by affected firms in year t+3 decreases by 4.77 percentage points, which is equivalent to 0.639 patents (=13.4×4.77 percent) and 0.536 percent of its standard deviation (=0.639÷119.30).[33]

We compare the magnitude with two recent studies on the effects of state corporate income tax rates on corporate innovation. Mukherjee et al. (2017) examine a sample of 32 state income tax rate increases, the average magnitude of which is 1 percentage point. They find that a state income tax rate increase on average leads to a 5.3 to 5.5 percentage point decrease in patenting activities. Similarly, Atanassov and Liu (2019) find a 5.1 percentage point decrease in patent count

[32] We also estimate the regression without the firm and state fixed effects. Instead, we include an indicator for treated firms. Results remain similar.

[33] When a coefficient in a log-linear regression is small, it approximately corresponds to the percentage change in the dependent variable if the independent variable increases by 1 (Benoit, 2011). The coefficient on *Addback* is -0.0477. Thus, when *Addback* increases from 0 to 1, the number of patents decreases by approximately 4.77 percentage points.

following state income tax increases, which is approximately 0.5 percent of its standard deviation. Therefore, the magnitude of the effect of addback statutes on innovation is comparable to that of other important state tax policies.

Regarding the control variables, we find that the number of patents filed three years later is positively associated with operating cash flows, Tobin's Q ratio, capital expenditures, and change in the number of patents filed in the current year but negatively related to financial leverage. These results are consistent with our expectations. Also, the adjusted R-squared is greater than 87 percent, suggesting that the model fits well overall.

Table 3 reports the regression results of Model (2) where *Ln_NCite3* is the dependent variable. Similar to Table 2, the first column only controls for firm, state, and year fixed effects. The second column estimates the full regression Model (2). The results are consistent with those in Table 2 in that *Addback* is negatively correlated with *Ln_NCite3*, with the coefficient being −0.0509 in Column 1 and −0.0512 in Column 2. Therefore, after the adoption of an addback statute in a state, a firm with material subsidiaries in that state has an approximately 0.227 (=4.43×5.12 percent) reduction in the truncation-adjusted number of citations on patents filed three years later. This change in citation count is equivalent to 0.438 percent of its standard deviation (=0.227/51.77) and similar to the magnitude of the effect on patent count documented in Table 2. Coefficients on control variables are also generally in line with our expectations. For example, the number of citations received on patents filed three years later is positively associated with Tobin's Q ratio, capital expenditures, and change in citation count in the current year.

Overall, these findings are consistent with our hypothesis that the adoption of addback statutes significantly reduces the level of corporate innovation of affected firms, reflected in the

4.77 percentage point decrease in patent count and the 5.12 percentage point decrease in citation count.

5. Additional Tests

5.1 Economic Importance of "Disappearing Patents"

Our primary tests find that addback statutes have a negative effect on a firm's overall innovation level measured by the total number of patents or citations. However, the economic implications of the decline in patent and citation counts may be different, depending on whether the patents that disappear after the adoption of the addback statutes are of lower or higher quality than other patents. The decline in the total number of patents may not necessarily indicate a negative consequence, if a firm mainly uses low-quality patents for tax-motivated income shifting. However, firms may not use only low-quality patents in tax avoidance transactions, because high-quality patents have a higher economic value and could be used to shift a larger amount of pretax income. For example, one subsidiary needs to pay more royalty fees to another subsidiary for using a high-quality patent which has a higher economic value. Therefore, it is unclear whether the quality and economic value of the "disappearing patents" would be different than other patents.

We provide several tests to infer the quality of the "disappearing patents." First, we examine the effect of addback statutes on the economic value of patents filed by a firm in year t+3. Our patent value data are obtained from Kogan et al. (2017), which measure patent value as the firm's abnormal stock return on the patent grant date. This measure relies on the assumption of stock market efficiency. We exclude observations from 1997, 1998, and 2005 from our sample, which are affected by three-year-ahead stock market crashes due to the dot-com bubble and the 2008 financial crisis. The crashes significantly reduced stock market efficiency and the reliability of the patent value measure. In Column 1 of Table 4, we rerun Model (1) with *Ln_Value3* as the dependent variable. Specifically, *Ln_Value3* is the natural logarithm of one plus the value of patents filed in year t+3. *Ln_Value3* equals 0 if a firm has no patents filed in year t+3. If the "disappearing patents" do not have economic value, the adoption of the addback statutes should have no impact on the aggregate values of the patents filed by the firm in year t+3. Thus, the effect of the addback statutes on patent value shows the economic value of the "disappearing patents." In this test, we replaced *Ln_NPat* and Δ*Ln_NPat* in Model (1) with *Ln_Value* and Δ*Ln_Value*, which are the level and change of the aggregate values of the patents filed by the firm in year t. We find a significantly negative coefficient on *Addback* in Column 1. This finding is consistent with the addback statutes negatively impacting the value of future patents filed by the affected firms.

To further analyze the quality of the "disappearing patents," we split the patents filed in year t+3 into two groups based on whether a patent has any non-self-citations in the first three years starting from its grant year. Then, we create two variables: the natural logarithm of one plus the number of patents without any citation (*Ln_NPat_NoCite3*) and the natural logarithm of one plus the number of patents with at least one citation (*Ln_NPat_Cite3*). We re-estimate Model (1) after replacing the dependent variable with these two variables. In Column 2 of Table 4, we use *Ln_NPat_NoCite3* as the dependent variable. We find that addback statutes significantly reduce the number of zero-citation patents filed three years later. In Column 3 of Table 4, the dependent variable is *Ln_NPat_Cite3*. We find that *Addback* is associated with a significantly lower number of patents with citations. These findings further support the argument that the addback statutes do not just reduce low-quality patents.

In Column 4, we further examine the effect of addback statutes on citations per patent. The dependent variable is *Ln_Ave_Cite3*, the natural logarithm of one plus the average number of citations received by a patent filed by the firm in year t+3.[34] If the "disappearing patents" have lower (higher) citations than other patents, we would expect an increase (a decrease) in the average number of citations per patent. However, the coefficient on *Addback* is insignificant and close to 0. Thus, the average number of citations received by the "disappearing patents" is not different from that received by other patents.

In sum, these findings suggest that the "disappearing patents" resulting from the adoption of the addback statutes have significant economic value and do not seem to have lower quality than other patents.

5.2 The Location of Patents

The addback statutes reduce firms' ability to shift income using intangibles across states to reduce taxes and thus limit the benefits that firms can gain from patents. As discussed earlier, this disincentive should not only lower firms' innovation but also discourage them from holding patents in states that have low corporate income tax rates or do not tax intangible income. While the main finding is consistent with a negative effect on innovation, we conduct further analyses to document evidence that the adoption of the addback statutes reduces firms' incentives to strategically locate patents for the purpose of transfer pricing. To perform such tests, we identify four states that do not tax corporate intangible income: Delaware, Nevada, Wyoming, and Michigan. Thus, firms can avoid paying state-level income taxes by using patents to shift income from other states to these four states.

[34] In Column 2 of Table 4, we replace the control variables *Ln_NPat* and Δ*Ln_NPat* with *Ln_NPat_NoCite* and Δ*Ln_NPat_NoCite*, which are the natural logarithm of one plus the number of zero-citation patents filed in the current year t and its change. In Column 3, we replace these two control variables with *Ln_NPat_Cite* and Δ*Ln_NPat_Cite*, which are the natural logarithm of one plus the number of patents that are filed in the current year and cited in the first three years after being granted and its change. Similarly, in Column 4, we replace these two control variables with *Ln_Ave_Cite* and Δ*Ln_Ave_Cite*.

We rely on the USPTO patent assignment data to identify the states where patent assignees are located. Thus, we construct the variable *Assign_NoTax3*, as the log of one plus the number of patents filed in t+3 and later assigned to subsidiaries in the four no-tax states. *Assign_NoTax3* is used as the dependent variable in Column 1. In Column 2, the dependent variable is *Assign_Tax3*, the log of one plus the number of patents filed in t+3 and later assigned to subsidiaries in the other 46 states. We include all fixed effects and control variables from Model (1) after replacing *Ln_NPat* and Δ*Ln_NPat* with *Assign_Tax* and Δ*Assign_Tax* in Column 1 and *Assign_Tax* and Δ*Assign_Tax* in Column 2. Further, because a firm would naturally have fewer patents to assign if it has filed fewer patents, we control for the number of patents filed by a firm in year t+3 (*Ln_NPat3*).

Table 5 presents the regression results. Consistent with our prediction, the coefficient on *Addback* is negative and significant in Column 1. These results show that the adoption of the addback statutes is negatively associated with the number of patents that firms assign to the four no-tax states. However, the coefficient on *Addback* is insignificant in Column 2. Thus, the addback statutes do not affect the number of patents that firms assign to the other 46 states that tax corporate intangible income. These findings lend direct support to the argument that the addback statutes reduce firms' use of patents in states with zero taxes on intangible income for tax-motivated income shifting.

5.3 The Effect of Financial Constraints

An alternative explanation for our findings is that crackdown on tax avoidance increases a firm's financial constraints and thus reduces the level of investment in innovation activities (e.g., Edwards, Schwab and Shevlin, 2016). Although this alternative explanation is still consistent with a negative effect of addback statutes on innovation, the mechanism is different. Therefore, we provide two sets of tests to address the concern that the effect on innovation is simply attributed to financial constraints. First, we test the interaction effect of the addback statutes and financial constraints on innovation. The alternative explanation predicts the effect of the addback statutes on innovation to be more pronounced for more financially constrained firms. However, most patents are created by financially healthy firms. The effect of the addback statutes on these firms' financial constraints may not be large enough to affect their innovation behavior. If so, we will not observe significant interaction effects of the addback statutes and financial constraints. Second, we rerun our primary analyses using a subsample of firms that are not financially constrained. If our findings remain in this subsample, this alternative explanation is ruled out.

The regression results are reported in Table 6. We use three measures of financial constraints: the KZ index of financial constraints (Farre-Mensa and Ljungqvist, 2016; Lamont, Polk, and Saa-Requejo, 2001), credit rating, and operating cash flows. Firms with lower values of the KZ index, credit ratings, and higher operating cash flows are less financially constrained. In Columns 1 to 3, we interact *Addback* with KZ index (*KZ Index*), an indicator for firms with credit ratings (*Rated_Firm*), and operating cash flows (*CFO*), respectively. The alternative explanation predicts a negative (positive) coefficient on the interaction term in Column 1 (Columns 2 and 3). In Columns 4 to 6, we re-estimate Model (1) using the subsample of observations with KZ index below the top decile, the subsample of observations with credit ratings, and the sub-subsample of observations with positive operating cash flows, respectively. The reported regressions use patent count (*Ln_NPat3*) as the dependent variable. We find insignificant interaction effects in Columns 1 and 3. Further, the interaction effect is negative and significant in Column 2.[35] Thus, inconsistent with the alternative explanation, the effect of addback statutes on innovation is not more

[35] The negative interaction effect of credit rating and addback statutes is possibly because firms with credit ratings have more patents prior to being affected by addback statutes.

pronounced for firms that are more financially constrained. Further, we find significantly negative coefficients on *Addback* in Columns 4 to 6. These findings suggest that the addback statutes have a negative effect on innovation among firms that are not financially constrained. Therefore, the effect on innovation cannot be simply attributed to crackdown on tax avoidance increasing financial constraints and thus reducing investment in innovation.

5.4 State Economic Conditions and Confounding Events

We provide several tests to alleviate concerns about confounding effects of other tax policy changes and state economic conditions. In Panel A of Table 7, we check whether other corporate tax policy changes might coincide with the adoption of addback statutes. We consider changes in statutory tax rates, R&D tax credits, loss carryback/forward periods, and policies related to combined reporting and economic nexus. During our sample period, three states adopted the addback statutes and decreased statutory tax rates at the same time. Lower statutory tax rates are supposed to encourage investment in innovation (Mukherjee et al., 2017), and hence are not likely to explain our findings. Also, only two states (Alabama and New Jersey) adopted addback statutes at the same time as increasing statutory tax rates. In untabulated tests, our results are robust to excluding firms with subsidiaries in these two states. Furthermore, lower R&D tax credits and shorter loss carryback/forward periods may discourage firms from investing more in R&D. We do not find any state's adoption decision coincides with the adoptions of combined reporting or economic nexus rules, R&D tax credit changes, or loss carryback/forward period changes. Overall, these findings significantly mitigate concerns about confounding events.

Next, we examine whether state governments' decisions to adopt addback statutes are related to state economic conditions. If states adopt the addback statutes in economic downturns and firms also invest less when the economy is performing poorly, the validity of our inferences may be questionable. To test this possibility, we estimate a state-level linear probability model with addback adoption as the dependent variable.[36] *Addback_Adopt* is an indicator for states with addback statutes, which equals 1 if a state has adopted the addback statutes in year t, and 0 otherwise. We include several measures of state-level economic conditions from year t-1 in the model, including the state's labor force (*Labor_Force*), unemployment rate (*Unemployment_Rate*), real annual growth rate in Gross State Product (*GSP*), and state budget balance (*Budget_Balance*). The model also includes year and state fixed effects. As shown in Panel B of Table 7, none of the economic conditions significantly explains the adoption decisions.

In Panel C, we re-estimate the primary regression model (Model 1) after controlling for these state-level economic conditions. Specifically, we calculate the weighted-average labor force (*Labor_Force_S*), unemployment rate (*Unemployment_Rate_S*), real annual growth rate in Gross State Product (*GSP_S*), and budget balance (*Budget_Balance_S*) of states where a firm has material subsidiaries. Results remain qualitatively similar. Together with results in Panel B, our findings suggest that the decline in corporate innovation is not due to differences in state-level economic conditions.

5.5 Are Patents Shifted to Foreign Countries?

An alternative response by firms to the adoption of addback statutes is that since firms' ability to use patents to avoid state taxes is limited, firms shift their patents to foreign countries for federal or foreign tax avoidance instead. Unfortunately, we do not have full access to data on patents granted by all non-U.S. patent offices. However, patents are territorial rights and the exclusive rights extend only throughout the territory of the country or region where the patent is filed and granted. If a firm files patents only in other major economies such as in the European

[36] We use the linear probability model instead of Probit model because state fixed effects could perfectly predict the dependent variable in the Probit regression.

Union, its patents are vulnerable to infringements in the United States, as those patents filed in foreign countries are not protected in the United States. Therefore, due to concerns about patent infringement, a firm is unlikely to file important patents in other countries but not in the United States.

To further mitigate any related concerns, we provide tests in Table 8. If this alternative consequence exists, we would expect firms to shift more taxable income to foreign countries after the adoption of addback statutes. Following Hope, Ma, and Thomas (2013), we use the percentage of foreign pretax income to worldwide pretax income (*%F_Income*) as our measure of cross-border income shifting. More income shifting from the United States to foreign countries would result in a higher value of *%F_Income*. As shown in Column 1, the coefficient on *Addback* is insignificant, which suggests no significant change in income shifting to foreign countries after the adoption of addback statutes. Further, we use the number of patents that are initially filed in the United States but later assigned to foreign subsidiaries as the dependent variable in Column 2. If this alternative consequence is material, we would expect to observe that affected firms assign more patents to foreign subsidiaries after the adoption of addback statutes. However, in Column 2, the coefficient on *Addback* is insignificant, inconsistent with firms shifting more intangibles overseas after the adoption of addback statutes. These findings also mitigate concerns about other possibly confounding events that increased firms' ability to shift income overseas (such as the Check-the-Box regulation).[37]

[37] The Check-the-Box regulation became effective on January 1, 1997. Our sample period starts from fiscal year 1997. Thus, the vast majority of our sample observations are from the period after the adoption of the regulation. This also mitigates concerns about the Check-the-Box regulation. Also, our sample period does not overlap much with the American Jobs Creation Act of 2004.

5.6 State Corporate Income Tax Revenue

In Table 9, we shed light on the enforcement of addback statutes by testing whether a state's adoption of addback statutes increases the state's corporate income tax revenue. We manually collect data on state corporate income tax revenue for each state from the U.S. Census Bureau's State & Local Finances Database. Such data are not available for 2001 and 2003. We also exclude state-year observations without state corporate income taxes. Thus, the sample includes 322 state-year observations. The dependent variable is *TaxRevenue*, which is the natural logarithm of state corporate income tax revenue collected by a state in year t. The key independent variable is *Addback_State*, an indicator variable which equals 1 for a state after the year in which the state adopts addback statutes, and 0 otherwise. If addback statutes are effectively enforced, we expect an increase in state corporate tax revenue and a positive coefficient on *Addback_State*. We also control for several other state-level variables as well as state and year fixed effects.

Consistent with expectations, the coefficient on *Addback_State* is 0.1968 (t-statistic=3.27). Thus, the adoption of addback statutes increases state corporate tax revenue by approximately 21.75 percentage points (=$e^{0.1968}$ -1). In comparison, the coefficient on *State Statutory Tax Rate* is 15.3976. That means a 1-percentage-point increase in state statutory tax rate increases state corporate tax revenue by approximately 16.65 percentage points (==$e^{0.153976}$ -1). As a result, the effect of addback statutes on state corporate income tax revenue is equivalent to approximately an increase of 1.31 (=21.75 /16.65) percentage points in state statutory tax rates. Overall, these findings support the idea that addback statutes are effectively enforced and significantly increase affected firms' tax burdens.

5.7 R&D Tests

As discussed above, we do not use R&D expenditures as the measure of innovation in our primary tests because of significant measurement errors in reported R&D (Koh and Reeb, 2015). Similar to Koh and Reeb (2015), 44.3 percent of our sample firms have missing R&D expenses in every year of our sample period. However, 9.1 percent of these firms with missing R&D expenses have filed patents during our sample period.

As robustness checks, we provide tests using R&D expenditures as the dependent variable in Table 10. Specifically, the dependent variable in Column 1 is *RD3-zero,* the natural logarithm of one plus R&D expenditures (scaled by sales) three years later. *RD3-zero* is set to 0 if its value is missing. We find an insignificant negative effect of addback statutes on R&D expenses in this regression specification. However, as suggested above, replacing missing values of R&D expenses with 0 could significantly bias the estimated coefficient (e.g., He and Tian, 2013; Koh and Reeb, 2015).

To mitigate concerns about measurement errors in the dependent variable, we remove observations with missing R&D expenses from our sample rather than set them to 0. We report the regression results in the second column of Table 10. The dependent variable is *RD3,* the natural logarithm of one plus R&D expenditures (scaled by sales) three years later. We find a significant and negative coefficient on *Addback*. This finding is consistent with the addback statutes negatively impacting firms' R&D investment and innovation activities.

5.8 Robustness Tests

Table 11 provides five robustness tests. In the first column, we reestimate Model (1) after replacing the dependent variable with *Ln_NPat5*, which is the log of one plus the number of patents filed in year t+5. Results remain similar to those in Table 2. In the second and third columns, we provide a falsification test by using the natural logarithm of one plus the number of patents filed in year t-1 (*Ln_NPat_Past*) and the natural logarithm of one plus the number of patents filed in year t-3 (*Ln_NPat_Past3*) as the dependent variables. The coefficient on *Addback* is insignificant in both columns. In the fourth column, we exclude firms that never file patents in our sample period. In the fifth column, we use the location of headquarters instead of subsidiaries for the definition of *Addback*.[38] In both Column 4 and Column 5, the coefficients on *Addback* are negative and significant. Finally, in the last column, we exclude IT industries (Fama-French industry groups 34, 35, and 36) from our sample and find similar results. Thus, our findings are not due to the dot-com bubble.

6. Conclusion

To crack down on corporate state tax avoidance via intangibles-based income shifting, many state governments adopted addback statutes. In this study, we examine whether the adoption of such addback statutes by U.S. state governments impedes corporate innovation. Specifically, the addback statutes require firms within the adopting state to add back to their state taxable income intangible-related expenses paid to related parties in other states. These provisions prevent firms from using intangible assets to avoid taxes and consequently reduce the benefits that firms and managers can gain from creating intangible assets such as patents. In other words, the projected net present value (NPV) of patents and innovation projects will decrease.

Our study examines whether the adoption of the addback statutes has a negative effect on corporate innovation. We find that the adoption of addback statutes significantly reduces a firm's innovation. Specifically, the number of patents decreases by 4.77 percentage points and the

[38] We do not use headquarters location in the primary tests, because most firms earn a significant portion of their pretax income from states other than the headquarters state. As long as a state where a firm has taxable income adopts addback statutes, the firm's income-shifting behavior can be affected.

number of patent citations decreases by 5.12 percentage points. Thus, the decline in innovation is economically significant. The magnitude is comparable to the effects of other state tax policies on innovation. For example, both Mukherjee et al. (2017) and Atanassov and Liu (2019) find that a 1-percentage-point increase in state income tax rate on average decreases patenting activities by approximately 5 percentage points. Moreover, the patents that disappear because of addback statutes have economic value and do not seem to be of lower quality than other patents. Furthermore, we find that after a state adopts the addback statutes, a firm with material subsidiaries in that state assigns fewer patents to subsidiaries in states that have zero statutory tax rates or that do not tax intangible income. We do not find a decline in the number of patents that the firm assigns to the other states.

We also provide several additional tests. First, we do not find more pronounced effects of the addback statutes on corporate innovation for financially constrained firms. Second, in a subsample of non–financially constrained firms, the addback statutes still negatively affect innovation. Therefore, the effect on innovation is not simply due to crackdown on tax avoidance increasing firms' financial constraints and thus reducing investments in innovation. Third, our results are not likely due to the confounding effects of other tax policy changes and state-level economic conditions. Fourth, we do not find significant changes in cross-border income shifting and the number of patents transferred to foreign subsidiaries after the adoption of addback statutes. Fifth, we document a substantial increase in the amount of corporate income tax revenue collected by a state after the state adopts addback statutes, consistent with effective enforcement of the addback statutes. Finally, our findings are robust to using alternative measures of corporate innovation and in a number of robustness tests.

Overall, we find that the adoption of addback statutes has a significant negative effect on corporate innovation. Our findings have important implications for policy makers who are interested in understanding the consequences of policies that constrain tax-motivated income shifting using intangibles and prevent income base erosion. For example, the recent Tax Cut and Jobs Act of 2017 also includes anti-base-erosion provisions similar to the addback statutes, which aim to crack down on tax-motivated income shifting by U.S. multinational firms to foreign countries with low taxes.

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Appendix A: Variable Definition

Variable Name	Definition
Addback	Indicator variable, which equals 1 if a firm is affected by addback statutes in year t, and 0 otherwise. Specifically, we identify a firm as an affected firm if it has at least one subsidiary in a state during the year when the state adopts the addback statutes. For an affected firm, we set *Addback* to 1 for the adoption year and all the subsequent years unless the firm no longer has any subsidiary in a state with addback statutes. If a firm has no subsidiaries in states with addback statutes, *Addback* equals 0. Source: Manual Collection and Dyreng et al. (2013)
Addback_Adopt	Indicator variable, which equals 1 if a state has adopted addback statutes in year t, and 0 otherwise. Source: Manual Collection
Addback_State	Indicator variable, which equals 1 for a state with addback statutes after the year in which the state adopts addback statutes, and 0 otherwise. Source: Manual Collection
Assign_Foreign	The natural logarithm of one plus the number of patents filed in year t and later assigned to foreign countries. Source: USPTO
Assign_Foreign3	The natural logarithm of one plus the number of patents filed in year t+3 and later assigned to foreign countries. Source: USPTO
Δ*Assign_Foreign*	The change in *Assign_Foreign*. Source: Kogan et al. (2017)
Assign_Tax	The natural logarithm of one plus the number of patents filed in t and later assigned to entities in the 46 states that tax corporate intangible income. Source: USPTO
Assign_Tax3	The natural logarithm of one plus the number of patents filed in t+3 and later assigned to entities in the 46 states that tax corporate intangible income. Source: USPTO
Δ*Assign_Tax*	The change in *Assign_Tax*. Source: Kogan et al. (2017)
Assign_NoTax	The natural logarithm of one plus the number of patents filed in t and later assigned to entities in the 4 states that do not tax corporate intangible income. Source: USPTO
Assign_NoTax3	The natural logarithm of one plus the number of patents filed in t+3 and later assigned to entities in the 4 states that do not tax corporate intangible income. states. Source: USPTO
Δ*Assign_NoTax*	The change in *Assign_NoTax*. Source: Kogan et al. (2017)
Budget_Balance	The difference between a state's general revenues and its general expenditures deflated by its general expenditures. Source: U.S. Census Bureau's State & Local Finances Database

Budget_S	Weighted average state budget balance (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). Source: U.S. Census Bureau's State & Local Finances Database
CAPEX	Capital expenditures (CAPX) deflated by total assets (AT) at the beginning of year t. Source: *Compustat*
CFO	Operating cash flows, computed as operating cash flow (OANCF) deflated by total assets (AT) at the beginning of year t. Source: *Compustat*
%F_Income	The ratio of foreign pretax income (PIFO) to total pretax income (PI). If the ratio is greater than one, it is set to 1. When foreign income is positive and total income is negative, the ratio is set equal to one. When foreign income is negative and total income is positive, the ratio is set equal to zero. When both foreign income and total income are negative, the ratio is set to missing. Source: *Compustat*
Federal Tax Deductibility	Tax deductibility of federal taxes from state taxable income, calculated as the difference between state effective statutory corporate income tax rate and state nominal statutory corporate income tax rate. Source: Wilson (2009)
GSP	The real annual growth rate in gross state product. Source: U.S. Bureau of Economic Analysis.
GSP_S	Weighted average real annual growth rate in gross state product (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). Source: U.S. Bureau of Economic Analysis.
KZ Index	Following Lamont, Polk, and Saa-Requejo (2001), we compute KZ index as −1.001909*[(IB + DP)/lagged PPENT] + 0.2826389*[(AT + abs(PRCC_F)*CSHO - CEQ - TXDB)/AT] + 3.139193*[(DLTT + DLC)/(DLTT+ DLC + SEQ)] − 39.3678*[(DVC + DVP)/lagged PPENT] − 1.314759*[CHE/lagged PPENT]. Source: *Compustat*
Labor_Force	The natural logarithm of state labor force including employed and unemployed persons (in millions). Source: U.S. Bureau of Labor Statistics.
Labor_S	Weighted average state labor force (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). Source: U.S. Bureau of Labor Statistics.
Leverage	Leverage, computed as total liabilities (LT) deflated by total assets (AT) at the beginning of year t. Source: *Compustat*
Ln_AT	The natural logarithm of total assets (AT). Source: *Compustat*

Ln_Ave_Cite	The natural logarithm of one plus the average number of citations (truncation-adjusted, non-self-citations) received by patents filed in year t in the three years starting from the grant year. Source: Kogan et al. (2017)
Ln_ Ave _Cite3	The natural logarithm of one plus the average number of citations (truncation-adjusted, non-self-citations) received by patents filed in year t+3 in the three years starting from the grant year. Source: Kogan et al. (2017)
Δ*Ln_Ave_Cite*	The change in *Ln_Ave_Cite*. Source: Kogan et al. (2017)
Ln_NCite	The natural logarithm of one plus the truncation-adjusted number of non-self-citations received on patents filed in year t. Source: Kogan et al. (2017)
Ln_NCite3	The natural logarithm of one plus *NCite3*. Source: Kogan et al. (2017)
Δ*Ln_NCite*	The change in *Ln_NCite*. Source: Kogan et al. (2017)
Ln_NPat	The natural logarithm of one plus the number of patents filed in year t. Source: Kogan et al. (2017)
Ln_NPat3	The natural logarithm of one plus the number of patents filed in year t+3. Source: Kogan et al. (2017)
Ln_NPat5	The natural logarithm of one plus the number of patents filed in year t+5. Source: Kogan et al. (2017)
Δ*Ln_NPat*	The change in *Ln_NPat*. Source: Kogan et al. (2017)
Ln_NPat_Cite	The natural logarithm of one plus the number of patents filed in year t that receive citations in the three years starting from the grant year. Source: Kogan et al. (2017)
Ln_NPat_NoCite	The natural logarithm of one plus the number of patents filed in year t that do not receive citations in the three years starting from the grant year. Source: Kogan et al. (2017)
Ln_NPat_Cite3	The natural logarithm of one plus the number of patents filed in year t+3 that receive citations in the three years starting from the grant year. Source: Kogan et al. (2017)
Ln_NPat_NoCite3	The natural logarithm of one plus the number of patents filed in year t+3 that do not receive citations in the three years starting from the grant year. Source: Kogan et al. (2017)
Δ*Ln_NPat_NoCite*	The change in *Ln_NPat_NoCite*. Source: Kogan et al. (2017)

Δ*Ln_NPat_Cite*	The change in *Ln_NPat_Cite*. Source: Kogan et al. (2017)
Ln_NPat_Past	The natural logarithm of one plus the number of patents filed in year t-1. Source: Kogan et al. (2017)
Ln_NPat_Past3	The natural logarithm of one plus the number of patents filed in year t-3. Source: Kogan et al. (2017)
Ln_Value3	The natural logarithm of one plus the total dollar value of patents filed in year t+3. The value of each patent is measured based on the firm's idiosyncratic stock market return on the day of patent grant. To remove the potential effect of market-wide fluctuations, we scale the value of each patent by the average value of patents that are granted in the same year. Source: Kogan et al. (2017)
NCite3	The number of citations received on patents filed in year t+3. For each patent, we count the non-self-citations that the patent receives in the first three years starting from its grant year and correct for truncation bias by scaling this count by the average number of three-year non-self-citations received by patents that are filed in the same year. Source: Kogan et al. (2017)
NPat3	The number of patents filed in year t+3. Source: Kogan et al. (2017)
NOL	Indicator variable, which equals 1 if the firm has tax loss carryforward (TLCF) at the beginning of year, and 0 otherwise. Source: *Compustat*
PIC_Separate	Indicator variable, which equals 1 when a firm-year meets three criteria: (1) in the upper tercile of the number of subsidiaries in separate filing states, (2) the upper tercile of the number of subsidiaries in Delaware, (3) in the upper half of market-to-book ratio, and 0 otherwise. Source: Dyreng et al. (2013) and *Compustat*
PIC_NoNexus	Indicator variable, which equals 1 when a firm-year meets three criteria: (1) in the upper tercile of the number of subsidiaries in NoNexus states, (2) the upper tercile of the number of subsidiaries in Delaware, (3) in the upper half of market-to-book ratio, and 0 otherwise. Source: Dyreng et al. (2013) and *Compustat*
Rated_Firm	Indicator variable, which equals 1 for firms with credit rating in the five-year period ending in year t, and 0 otherwise. Source: *Compustat*
RD	R&D expenditures (XRD) deflated by sales (SALE) in year t-1. Missing R&D expense is set to 0 for all firms. Source: *Compustat*
Δ*RD*	The change in *RD*. Source: *Compustat*
RD3-zero	The natural logarithm of one plus R&D expenditures (scaled by sales) in year t+3. *RD3-zero* is set to 0 if its value is missing. Source: *Compustat*

RD3	The natural logarithm of one plus R&D expenditures (scaled by sales) in year t+3 retaining only non-missing R&D firm-year observations. Source: *Compustat*
ROA	Return on assets, computed as operating income before depreciation (OIBDP) deflated by total assets (AT) at the beginning of year t. Source: *Compustat*
State_RD_Credit	Weighted average state R&D tax credits (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). For a state whose tax credit is a range, we use the rate for the highest tier of R&D spending. *State_RD_Credit* is set to 0 when the firm has no positive R&D spending in the current year and past year. Source: Wilson (2009)
Δ*State_RD_Credit*	The change in *State_RD_Credit*. Source: Wilson (2009)
State Statutory *Tax Rate*	State statutory corporate income tax rates. Source: Wilson (2009) and the Federation of Tax Administrators
State_Tax_Rate	Weighted average state statutory tax rates (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). Source: Wilson (2009) and the Federation of Tax Administrators
TaxRevenue	The natural logarithm of annual state corporate income tax revenue. Source: U.S. Census Bureau's State & Local Finances Database
TobinQ	Tobin's Q ratio, computed as (abs(PRCC_F)*CSHO + DLTT + max(0, DLC))/(LT+CEQ). It is set to missing if CEQ is negative. Following prior literature (e.g., Baker and Wurgler, 2002), we truncate outliers with *TobinQ* greater than 30. Source: *Compustat*
Unemployment_Rate	The natural logarithm of state unemployment rate. Source: U.S. Bureau of Labor Statistics.
Unemployment_S	Weighted average state unemployment rates (the weight is the number of subsidiaries that a firm has in a state divided by the total number of subsidiaries of the firm). Source: U.S. Bureau of Labor Statistics.

Appendix B: Years in Which States Adopted Addback Statutes

State	Addback Statutes	State	Addback Statutes
Alabama	2001	Montana	
Alaska		Nebraska	
Arizona		Nevada	
Arkansas	2004	New Hampshire	
California		New Jersey	2002
Colorado		New Mexico	
Connecticut	1999	New York	2003
Delaware		North Carolina	2001
Florida		North Dakota	
Georgia	2006	Ohio	1999
Hawaii		Oklahoma	
Idaho		Oregon	2005
Illinois	2005	Pennsylvania	2015
Indiana	2006	Rhode Island	2008 (Repealed in 2015)
Iowa		South Carolina	2005
Kansas		South Dakota	
Kentucky	2005	Tennessee	2004
Louisiana	2016	Texas	
Maine		Utah	
Maryland	2004	Vermont	
Massachusetts	2002	Virginia	2004
Michigan	2008	Washington	
Minnesota		West Virginia	2009
Mississippi	2001	Wisconsin	2009
Missouri		Wyoming	

Notes:

1. We collect the data from the following sources: Guariglia, Shipley, and Banks, 2005; Garrett and Smith, 2005; Maine and Nguyen, 2017; CCH; Checkpoint. When there are inconsistences between these sources, we further check the state tax code. If the effective date is “after December 31 of a year,” we set the effective year to the next year.
2. Michigan used to have a Single Business Tax, which is a value-added tax (VAT). Starting from 2008, Michigan switched to the Michigan Business Tax, which is an income tax. Michigan requires adding back intangible expense in the calculation of the Michigan Business Tax. In 2011, Michigan officially adopted a corporate income tax, which imposes a 6 percent tax on the income of C corporations.
3. Delaware requires firms to add back certain interest expenses. But Delaware’s policy is not related to intangible expense. We do not consider Delaware’s policy an addback statute.
4. South Carolina’s policy does not apply to a related party transaction if the payment is made in the same year of the transaction.
5. Wisconsin added intangible expense to the list of addback expenses in 2009; addback statutes exist for interest expense from 2008.

6. Ohio's addback statutes apply to all corporations for tax years 1999 and thereafter. For tax years prior to 1999 and after the enactment of the act in 1997, this section applies only to a corporation that has, or is a member of an affiliated group that has, or is a member of an affiliated group with another member that has, one or more of the following:

   (1) Gross sales, including sales to other members of the affiliated group, during the taxable year of at least fifty million dollars;
   (2) Total assets whose asset value at any time during the taxable year is at least 25 million dollars;
   (3) Taxable income before operating loss deduction and special deductions during the taxable year of at least five hundred thousand dollars.

Figure 1 The Percentage of Firms Affected by Addback Statutes

This figure shows the percentage of firms that are affected by addback statutes from the first adoption of addback statutes in 1999 until the last year of our sample (2005). The percentage increases from 19 percent in 1999 to 57 percent in 2005.

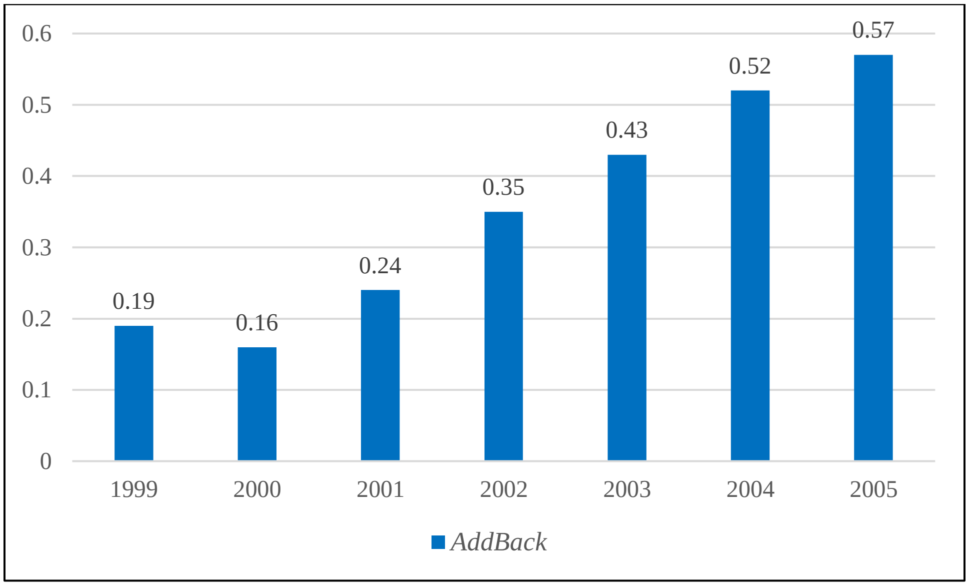

Table 1 Descriptive Statistics

This table presents the descriptive statistics of variables in our primary tests. The sample period is 1997–2005. We show the mean, standard deviation, and the 10^{th}, 50^{th}, and 90^{th} percentiles of the variables used in the empirical analyses. All variables are winsorized at the top and bottom 1%. Please refer to Appendix A for variable definitions.

Variable	**N**	**Mean**	**Std Dev**	**10^{th} Pctl**	**50^{th} Pctl**	**90^{th} Pctl**
Addback	11,228	0.26	0.44	0	0	1
NPat3	11,228	13.40	119.30	0	0	9
NCite3	11,228	4.43	51.77	0	0	1.68
Ln_AT	11,228	6.23	2.02	3.63	6.18	8.89
ROA	11,228	0.12	0.16	-0.05	0.13	0.29
CFO	11,228	0.07	0.14	-0.07	0.08	0.22
Leverage	11,228	0.61	0.36	0.22	0.58	0.98
TobinQ	11,228	1.54	1.33	0.54	1.12	3.01
RD	11,228	0.06	0.18	0	0	0.16
CAPEX	11,228	0.06	0.08	0.01	0.04	0.14
NOL	11,228	0.31	0.46	0	0	1
#States	11,228	1.23	0.79	0	1.10	2.30
NPat	11,228	14.76	119.70	0	0	13
State_RD_Credit	11,228	0.02	0.03	0	0.02	0.06
State_Tax_Rate	11,228	0.07	0.02	0.06	0.08	0.09
PIC_Separate	11,228	0.43	0.49	0	0	1
PIC_NoNexus	11,228	0.37	0.48	0	0	1

Table 2 Effects of Addback Statutes on Future Patents

This table presents the effects of addback statutes on the number of patents filed in future periods. The dependent variable is *Ln_NPat3*, the log of one plus the number of patents filed in t+3. The key independent variable is *Addback*, an indicator for firm-year observations affected by addback statutes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Dependent Variable=	*Ln_NPat3*	*Ln_NPat3*
Addback	-0.0501**	-0.0477**
	(-2.23)	(-2.15)
Ln_AT		0.0245
		(1.57)
ROA		0.0129
		(0.24)
CFO		0.1070**
		(2.00)
Leverage		-0.0653***
		(-3.03)
TobinQ		0.0276***
		(4.17)
RD		0.0862
		(1.49)
CAPEX		0.1749*
		(1.90)
NOL		-0.0220
		(-1.02)
Ln_NPat		-0.0471*
		(-1.72)
Δ*Ln_NPat*		0.0907***
		(4.87)
State_RD_Credit		0.7176
		(1.36)
Δ*State_RD_Credit*		1.3013
		(1.26)
State_Tax_Rate		-1.1526
		(-1.12)
PIC_Separate		-0.0168
		(-0.50)
PIC_NoNexus		-0.0047
		(-0.13)
#States		0.0300
		(1.02)
FE	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.877	0.879
No. of Firm-Year Observations	11,228	11,228

Table 3 Effects of Addback Statutes on Future Citations

This table presents the effects of addback statutes on the number of citations from patents filed in future periods. The dependent variable is *Ln_NCite3*, the log of one plus the number of citations received on patents filed in year t+3. For each patent, we count the non-self-citations that the patent receives in the first three years starting from its grant year, and we correct for truncation bias by scaling this count by the average number of three-year non-self-citations received by all patents that are filed in the same year. The key independent variable is *Addback*, an indicator for firm-year observations affected by addback statutes. The sample is from 1997 to 2004. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Dependent Variable=	*Ln_NCite3*	*Ln_NCite3*
Addback	-0.0509*	-0.0512**
	(-1.90)	(-1.96)
Ln_AT		-0.0335*
		(-1.91)
ROA		0.0451
		(0.73)
CFO		0.0827
		(1.42)
Leverage		-0.1076***
		(-5.03)
TobinQ		0.0263***
		(3.06)
RD		0.0347
		(0.52)
CAPEX		0.1994**
		(2.02)
NOL		-0.0076
		(-0.27)
Ln_NCite		0.0124
		(0.35)
Δ*Ln_NCite*		0.1103***
		(5.01)
State_RD_Credit		0.5811
		(0.94)
Δ*State_RD_Credit*		1.7537
		(1.61)
State_Tax_Rate		-0.7716
		(-0.62)
PIC_Separate		-0.0833**
		(-1.97)
PIC_NoNexus		0.0494
		(1.12)
#States		0.0568*
		(1.67)
FE	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.726	0.733
No. of Firm-Year Observations	10,232	10,232

Table 4 Economic Importance of "Disappearing Patents"

This table presents the effects of addback statutes on the value of patents filed in year t+3. The dependent variable in column 1 is *Ln_Value3*, the log of one plus the aggregate value of patents filed in year t+3. The value of patents is measured based on stock market reactions to patent grants. The dependent variable in Column 2 is *Ln_NPat_NoCite3*—the log of one plus the number of patents filed in year t+3 that do not receive any citations in the first three years starting from the grant year. The dependent variable in Column 3 is *Ln_NPat_Cite3*—the log of one plus the number of patents filed in year t+3 that have citations in the first three years starting from the grant year. The dependent variable in Column 4 is *Ln_Ave_Cite3*—the log of one plus the average number of citations received by patents filed in year t+3 in the three years starting from the grant year. The key independent variable is *Addback*, an indicator for firm-year observations affected by addback statutes. The sample is from 1999 to 2004 for Column 1 and 1997 to 2004 in other columns. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable=	*Ln_Value3*	*Ln_NPat_NoCite3*	*Ln_NPat_Cite3*	*Ln_Ave_Cite3*
Addback	-0.0579**	-0.0402**	-0.0519**	0.0000
	(-2.10)	(-2.13)	(-2.05)	(0.01)
Ln_AT	-0.0173	0.0273*	-0.0307*	-0.0122**
	(-1.02)	(1.81)	(-1.76)	(-2.01)
ROA	0.0321	-0.0258	0.0445	0.0136
	(0.72)	(-0.58)	(0.74)	(0.52)
CFO	0.0771*	0.0524	0.0907	0.0184
	(1.95)	(1.25)	(1.63)	(0.78)
Leverage	0.0055	-0.0078	-0.1057***	-0.0327***
	(0.26)	(-0.41)	(-5.00)	(-4.38)
TobinQ	0.0211***	0.0182***	0.0250***	0.0047
	(2.89)	(3.36)	(3.07)	(1.49)
RD	0.0306	0.0433	0.0487	0.0016
	(0.63)	(0.92)	(0.76)	(0.05)
CAPEX	0.0481	-0.1232	0.1904*	0.1347***
	(0.49)	(-1.38)	(1.91)	(3.37)
NOL	0.0162	-0.0242	-0.0038	-0.0090
	(0.78)	(-1.19)	(-0.13)	(-1.07)
Ln_Value	-0.1392***			
	(-2.91)			
Δ*Ln_Value*	0.1979***			
	(5.39)			
Ln_NPat_NoCite		0.0081		
		(0.25)		
Δ*Ln_NPat_NoCite*		0.0526**		
		(2.16)		
Ln_NPat_Cite			0.0230	
			(0.62)	
Δ*Ln_NPat_Cite*			0.1189***	
			(5.11)	
Ln_Ave_Cite				-0.0237
				(-1.18)
Δ*Ln_Ave_Cite*				0.0490***
				(2.76)
State_RD_Credit	0.1979***	0.0526**	0.1189***	0.0490***
	(5.39)	(2.16)	(5.11)	(2.76)
Δ*State_RD_Credit*	0.0040	0.1835	0.2659	0.2173

	(0.01)	(0.40)	(0.42)	(1.06)
State_Tax_Rate	0.2978	-0.5045	2.0971*	0.5194
	(0.24)	(-0.55)	(1.89)	(1.20)
PIC_Separate	-0.7595	-0.5747	-0.3954	-0.2511
	(-0.73)	(-0.67)	(-0.33)	(-0.56)
PIC_NoNexus	-0.0087	0.0073	-0.0891**	-0.0220*
	(-0.31)	(0.25)	(-2.00)	(-1.79)
#States	0.0121	-0.0133	0.0666	0.0090
	(0.40)	(-0.43)	(1.43)	(0.71)
FE	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.891	0.859	0.650	0.306
No. of Firm-Year Observations	7,610	10,232	10,232	10,232

Table 5 Effects of Addback Statutes on Patent Locations

This table presents the effects of addback statutes on the number of patents filed in year t+3 and assigned to no-tax states versus other states in future periods. No-tax states refer to Delaware, Wyoming, Nevada, and Michigan, which do not impose income taxes on intangible income. In Column 1, the dependent variable is *Assign_NoTax3*, the log of one plus the number of patents filed in t+3 and later assigned to entities located in these four states. In Column 2, the dependent variable is *Assign_Tax3*, the log of one plus the number of patents filed in t+3 and later assigned to entities in all the other 46 states. The key independent variable is *Addback*, an indicator for observations affected by addback statutes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Dependent Variable=	*Assign_NoTax3*	*Assign_Tax3*
Addback	-0.0224**	-0.0073
	(-2.36)	(-0.65)
Ln_AT	0.0009	-0.0043
	(0.14)	(-0.56)
ROA	0.0147	0.0153
	(0.75)	(0.55)
CFO	0.0040	-0.0534*
	(0.20)	(-1.90)
Leverage	-0.0119	-0.0156*
	(-1.58)	(-1.76)
TobinQ	0.0017	0.0070**
	(0.49)	(1.98)
RD	-0.0247	0.0009
	(-1.13)	(0.02)
CAPEX	-0.0102	-0.0012
	(-0.25)	(-0.03)
NOL	-0.0087	-0.0108
	(-1.00)	(-1.01)
Assign_NoTax	-0.0013	
	(-0.03)	
Δ*Assign_NoTax*	0.1013***	
	(2.79)	
Assign_Tax		-0.0514***
		(-2.72)
Δ*Assign_Tax*		0.0534***
		(3.91)
State_RD_Credit	-0.1233	-0.2133
	(-0.58)	(-0.71)
Δ*State_RD_Credit*	-0.2391	0.5774
	(-0.53)	(0.96)
State_Tax_Rate	0.4987	-0.2302
	(0.93)	(-0.37)
PIC_Separate	0.0166	-0.0255
	(1.06)	(-1.18)
PIC_NoNexus	-0.0177	0.0320
	(-1.10)	(1.44)
#States	-0.0044	-0.0173
	(-0.38)	(-1.16)
Ln_NPat3	0.1646***	0.6111***
	(7.72)	(31.25)
FE	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.790	0.915
No. of Firm-Year Observations	11,228	11,228

Table 6 Are Effects of Addback Statutes Due to Financial Constraints?

This table tests the interaction effects of addback statutes and non–financially constrained firms on innovation in Columns 1 to 3. Columns 4 to 6 present the results in the subsample of non–financially constrained firms. The dependent variable is *Ln_NPat3*—the number of patents filed in year t+3. The key independent variable is *Addback*, which equals 1 if the firm operates in a state that has adopted the addback statutes in year t, and 0 otherwise. Non–financially constrained firms are defined as (1) firms with KZ index below the top decile; (2) firms that have received credit rating in the five-year period ending in year t; (3) firms with positive operating cash flows (CFO). Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Full Sample	Low KZ Index	Rated_Firm	Positive Cash Flow
Dependent Variable=	*Ln_NPat3*	*Ln_NPat3*	*Ln_NPat3*	*Ln_NPat3*	*Ln_NPat3*	*Ln_NPat3*
Addback	-0.0513**	0.0136	-0.0372*	-0.0520**	-0.0717*	-0.0506**
	(-2.24)	(0.57)	(-1.67)	(-2.10)	(-1.78)	(-2.01)
Addback KZ Index*	0.0000					
	(0.46)					
KZ Index	-0.0000					
	(-0.76)					
*Addback*Rated_Firm*		-0.1317***				
		(-3.25)				
Rated_Firm		0.0462				
		(1.22)				
*Addback*CFO*			-0.1282			
			(-1.00)			
CFO	0.1049*	0.1020*	0.1256**	0.1218**	0.0455	0.1179
	(1.93)	(1.91)	(2.23)	(2.01)	(0.29)	(1.35)
Ln_AT	0.0245	0.0245	0.0256	0.0305	0.0879**	0.0554**
	(1.54)	(1.54)	(1.64)	(1.63)	(1.97)	(2.53)
ROA	0.0168	0.0164	0.0075	0.0039	0.0126	0.0475
	(0.31)	(0.31)	(0.14)	(0.06)	(0.07)	(0.53)
Leverage	-0.0656***	-0.0680***	-0.0646***	-0.0717***	-0.1564***	-0.0883***
	(-2.98)	(-3.16)	(-3.00)	(-2.78)	(-2.98)	(-3.19)
TobinQ	0.0267***	0.0284***	0.0279***	0.0282***	0.0602***	0.0354***
	(4.02)	(4.31)	(4.21)	(3.61)	(2.94)	(3.70)
RD	0.0846	0.0898	0.0880	0.0595	-0.0166	0.2821
	(1.47)	(1.56)	(1.52)	(0.80)	(-0.07)	(1.30)
CAPEX	0.1719*	0.1756*	0.1741*	0.2064*	0.4237**	0.1192
	(1.85)	(1.91)	(1.89)	(1.81)	(2.10)	(1.01)
NOL	-0.0223	-0.0233	-0.0224	-0.0264	-0.0054	-0.0195

	(-1.02)	(-1.08)	(-1.04)	(-1.10)	(-0.13)	(-0.78)
Ln_NPat	-0.0469*	-0.0477*	-0.0473*	-0.0444	0.0179	-0.0511
	(-1.71)	(-1.74)	(-1.73)	(-1.56)	(0.42)	(-1.50)
Δ*Ln_NPat*	0.0906***	0.0914***	0.0910***	0.0907***	0.0622**	0.0888***
	(4.87)	(4.92)	(4.89)	(4.65)	(2.07)	(3.86)
State_RD_Credit	0.7216	0.7438	0.7145	0.6339	1.7264	1.0284
	(1.35)	(1.42)	(1.36)	(1.07)	(1.48)	(1.59)
Δ*State_RD_Credit*	1.2580	1.3376	1.2931	1.0810	3.3213	0.8363
	(1.21)	(1.30)	(1.26)	(0.92)	(1.52)	(0.71)
State_Tax_Rate	-1.1636	-1.0829	-1.1302	-1.5682	-0.7399	-1.2354
	(-1.11)	(-1.05)	(-1.10)	(-1.34)	(-0.35)	(-0.95)
PIC_Separate	-0.0136	-0.0208	-0.0158	-0.0339	-0.0149	-0.0209
	(-0.40)	(-0.61)	(-0.47)	(-0.88)	(-0.20)	(-0.48)
PIC_NoNexus	-0.0064	-0.0026	-0.0052	0.0131	-0.0423	-0.0107
	(-0.18)	(-0.07)	(-0.15)	(0.32)	(-0.54)	(-0.23)
#States	0.0308	0.0260	0.0299	0.0273	0.0797	0.0278
	(0.93)	(0.80)	(0.92)	(0.76)	(1.17)	(0.74)
FE	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.879	0.880	0.879	0.879	0.908	0.887
No. of Firm-Year Observations	11,003	11,228	11,228	9,903	4,289	9,086

Table 7 Other Tax Policies and State-level Economic Conditions

Panel A: Confounding Events

In this panel, we report the number of addback statute adoptions that coincide with other changes in state tax policies during our sample period.

Other Tax Policy Changes	**No. of Coincident Addback Statute Adoptions**
Statutory Tax Rate Increase	2
Statutory Tax Rate Decrease	3
Combined Reporting Adoption	0
Economic Nexus Adoption	0
R&D Credit Change	0
Loss Carryback/Forward Period Change	0

Panel B: Do State-level Economic Conditions Predict the Adoption of Addback Statutes?

This panel presents the test on whether state-level economic conditions predict a state's adoption of addback statutes. The dependent variable is *Addback_Adopt*—an indicator variable which equals 1 if a state adopts addback statutes in year t, and 0 otherwise. The sample excludes state-years without corporate income taxes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by state. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)
Dependent Variable=	*Addback_Adopt*
Labor_Force	-1.7490
	(-1.67)
Unemployment_Rate	0.0578
	(0.30)
GSP	0.2625
	(0.49)
Budget_Balance	0.1449
	(0.77)
FE	State, Year
Adjusted R-square	0.190
No. of State-Year Observations	376

Table 7 Other Tax Policies and State-level Economic Conditions

Panel C: Controlling for State-level Economic Conditions

In this panel, we repeat the main test on future patents in Table 2 and include weighted-average state-level economic conditions as additional controls. The dependent variable is *Ln_NPat3*—the log of one plus the number of patents filed in year t+3. The key independent variable is *Addback*, which equals 1 if the firm operates in a state that has adopted the addback statutes in year t, and 0 otherwise. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)
Dependent Variable=	*Ln_NPat3*
Addback	-0.0473**
	(-2.15)
Ln_AT	0.0254
	(1.62)
ROA	0.0121
	(0.23)
CFO	0.1094**
	(2.04)
Leverage	-0.0648***
	(-3.00)
TobinQ	0.0277***
	(4.20)
RD	0.0875
	(1.53)
CAPEX	0.1770*
	(1.92)
NOL	-0.0197
	(-0.91)
Ln_NPat	-0.0463*
	(-1.70)
Δ*Ln_NPat*	0.0893***
	(4.84)
State_RD_Credit	0.4293
	(0.75)
Δ*State_RD_Credit*	0.7203
	(0.72)
State_Tax_Rate	-0.1264
	(-0.12)
PIC_Separate	-0.0155
	(-0.46)
PIC_NoNexus	-0.0079
	(-0.22)
#States	0.0313
	(1.06)
Unemployment_S	7.1547***
	(4.05)
Labor_S	-0.0154**
	(-2.49)
GSP_S	0.5600*
	(1.95)

Budget_S	0.3750***
	(3.47)
FE	Firm, State, Year
Adjusted R-square	0.8642
No. of Firm-Year Observations	11,228

Table 8 Are Patents Shifted to Foreign Countries?

This table presents the effects of addback statutes on cross-border income shifting and patent assignments to foreign countries. The dependent variable is *%F_Income*, the ratio of foreign pretax income to total pretax income in Column 1, and *Assign_Foreign3*, the log of one plus the number of patents filed in year t+3 and later assigned to foreign countries in Column 2. The key independent variable is *Addback*, an indicator for firm-year observations affected by addback statutes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Dependent Variable=	*%F_Income*	*Assign_Foreign3*
Addback	-0.0100	-0.0071
	(-1.21)	(-0.92)
Ln_AT	0.0025	0.0012
	(0.36)	(0.17)
ROA	-0.2481***	-0.0099
	(-7.75)	(-0.47)
CFO	0.0181	0.0340*
	(0.67)	(1.72)
Leverage	0.0211**	-0.0202***
	(2.40)	(-2.62)
TobinQ	-0.0111***	0.0024
	(-3.93)	(0.87)
RD	-0.0578*	-0.0037
	(-1.76)	(-0.17)
CAPEX	-0.0532	0.0555*
	(-1.32)	(1.75)
NOL	0.0240***	0.0007
	(2.67)	(0.08)
Assign_Foreign		-0.1288***
		(-3.62)
Δ*Assign_Foreign*		0.1452***
		(4.48)
State_RD_Credit	-0.1009	-0.0233
	(-0.47)	(-0.13)
Δ*State_RD_Credit*	-0.4042	0.0052
	(-0.89)	(0.01)
State_Tax_Rate	-0.0637	0.2007
	(-0.12)	(0.61)
PIC_Separate	-0.0002	-0.0130
	(-0.01)	(-0.92)
PIC_NoNexus	-0.0107	0.0168
	(-0.70)	(1.18)
#States	0.0041	0.0083
	(0.35)	(0.66)
FE	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.659	0.737
No. of Firm-Year Observations	10,818	11,228

Table 9 Effect of Addback Statutes on State Corporate Income Tax Revenue

This table presents the test on whether a state's adoption of addback statutes increases state corporate income tax revenue. The dependent variable is *TaxRevenue*—the natural logarithm of state corporate income tax revenue. Data on state income tax revenue are not available for 2001 and 2003.The key independent variable is *Addback_State*—an indicator variable which equals 1 for a state after the year in which the state adopts addback statutes, and 0 otherwise. The sample excludes state-years without state corporate income taxes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by state. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)
Dependent Variable=	*TaxRevenue*
Addback_State	0.1968***
	(3.27)
State Statutory Tax Rate	15.3976***
	(4.55)
Labor_Force	2.0500***
	(3.13)
Unemployment_Rate	-0.3170**
	(-2.32)
GSP	1.1191**
	(2.23)
Federal Tax Deductibility	-22.6539**
	(-2.62)
FE	State, Year
Adjusted R-square	0.481
No. of State-Year Observations	322

Table 10 Future R&D Investment

This table presents the association between addback statutes and R&D expenditures in future periods. The dependent variable in Column 1 is *RD3-zero*, the natural logarithm of one plus R&D expenditures (scaled by sales) three years later. *RD3-zero* is set to 0 if its value is missing. The dependent variable in Column 2 is *RD3*, the natural logarithm of one plus R&D expenditures (scaled by sales) three years later. Observations are omitted if R&D expenditures are missing. The key independent variable is *Addback*, an indicator for firm-year observations affected by addback statutes. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Dependent Variable=	*RD3-zero*	*RD3*
Addback	-0.0050	-0.0186**
	(-1.22)	(-1.96)
Ln_AT	0.0051	-0.0080
	(0.70)	(-0.47)
ROA	-0.0091	-0.0101
	(-0.49)	(-0.25)
CFO	0.0340	0.0286
	(1.19)	(0.43)
Leverage	0.0126	0.0434**
	(1.53)	(2.04)
TobinQ	0.0062**	0.0050
	(2.17)	(1.08)
RD	0.1675	0.1222
	(1.08)	(0.74)
Δ*RD*	-0.0878	-0.0842
	(-0.91)	(-0.70)
CAPEX	-0.0449	-0.0930
	(-0.74)	(-0.56)
NOL	-0.0084	-0.0132
	(-1.59)	(-1.29)
Ln_NPat	-0.0029	-0.0081
	(-0.51)	(-0.93)
State_RD_Credit	0.2266	0.5201
	(1.07)	(0.98)
Δ*State_RD_Credit*	0.3781	-0.5329
	(0.86)	(-1.48)
State_Tax_Rate	-0.1983	0.0830
	(-0.75)	(0.18)
PIC_Separate	0.0135	0.0346
	(0.78)	(1.00)
PIC_NoNexus	-0.0141	-0.0375
	(-0.92)	(-1.30)
#States	-0.0247**	-0.0459**
	(-2.34)	(-2.22)
FE	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.581	0.697
No. of Firm-Year Observations	11,228	4,648

Table 11 Robustness Tests

This table presents the robustness tests. In Column 1, the dependent variable is *Ln_NPat5*, the log of one plus the number of patents filed from year t+5. The sample period is from 1997 to 2003. In Column 2, the dependent variable is *Ln_NPat_Past*, the log of one plus the number of patents filed in year t-1. In Column 3, the dependent variable is *Ln_NPat_Past3*, the log of one plus the number of patents filed in year t-3. In Columns 4 to 6, the dependent variable is *Ln_NPat3*, the log of one plus the number of patents filed in year t+3. In Column 4, we exclude firms that never file patents in our sample period. In Column 5, we redefine *Addback* based on the location of firm headquarters. In Column 6, we exclude IT industries (i.e., Fama-French industry groups 34, 35, and 36) from our sample. Please refer to Appendix A for variable definitions. All variables in the regressions are winsorized at the top and bottom 1%. Standard errors are clustered by firm. *, **, and *** refer to significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.=	*Ln_NPat5*	*Ln_NPat_Past*	*Ln_NPat_Past3*	*Ln_NPat3*	*Ln_NPat3*	*Ln_NPat3*
Addback	-0.0538**	-0.0027	-0.0102	-0.0849**	-0.0604**	-0.0537**
	(-2.39)	(-0.53)	(-0.49)	(-2.16)	(-2.07)	(-2.10)
Ln_AT	0.0017	0.0021	-0.0339**	0.0217	0.0294*	0.0271
	(0.12)	(0.42)	(-2.41)	(0.64)	(1.85)	(1.43)
ROA	0.0607	0.0009	0.0219	-0.0294	0.0051	0.0434
	(1.19)	(0.06)	(0.40)	(-0.25)	(0.10)	(0.63)
CFO	0.1122**	-0.0117	-0.0100	0.1819	0.1030*	0.071
	(2.17)	(-0.73)	(-0.19)	(1.47)	(1.86)	(1.11)
Leverage	-0.0497***	-0.0023	-0.0099	-0.0852*	-0.0668***	-0.0572**
	(-3.03)	(-0.35)	(-0.54)	(-1.69)	(-2.96)	(-2.49)
TobinQ	0.0076	0.0011	-0.0062	0.0292***	0.0252***	0.0288***
	(1.22)	(0.62)	(-1.03)	(2.80)	(3.75)	(2.74)
RD	-0.0868	0.0163	-0.0508	0.01	0.0568	0.2210**
	(-1.41)	(0.75	(-0.99)	(0.13)	(1.10)	(2.34)
CAPEX	0.0087	-0.0549*	-0.1039	0.1351	0.1598	0.1407
	(0.11)	(-1.94)	(-1.08)	(0.57)	(1.64)	(1.41)
NOL	-0.0155	-0.0008	0.0187	-0.0259	-0.0283	-0.0155
	(-0.68)	(-0.11)	(1.00)	(-0.65)	(-1.18)	(-0.59)
Ln_NPat	-0.1814***	0.9786***	0.6960***	-0.0382	-0.0749**	-0.019
	(-6.45)	(115.5)	(41.90)	(-1.45)	(-2.56)	(-0.61)
Δ *Ln_NPat*	0.1246***	-1.0772***	-0.2104***	0.0610***	0.0972***	0.0829***
	(6.35)	(-107.88)	(-8.33)	(3.39)	(4.95)	(3.67)
State_RD_Credit	0.1009	0.17	-0.1065	1.6589*	0.9053*	0.7331
	(0.18)	(1.38)	(-0.20)	(1.75)	(1.68)	(1.14)
Δ*State_RD_Credit*	0.7041	0.2946	-0.0997	1.4025	0.8039	1.278
	(0.78)	(0.82)	(-0.09)	(0.64)	(0.74)	(1.11)
State_Tax_Rate	-0.741	0.1417	-0.4145	-3.9840**	-1.7436*	-0.2399
	(-0.85)	(0.78	(-0.39)	(-2.15)	(-1.75)	(-0.20)
PIC_Separate	-0.017	-0.0175	-0.0063	-0.0173	0.0006	-0.0431
	(-0.46)	(-1.25)	(-0.19)	(-0.30)	(0.02)	(-0.94)
PIC_NoNexus	0.0402	0.0202	0.0227	-0.0496	-0.0084	0.0149
	(1.07)	(1.53)	(0.65)	(-0.82)	(-0.23)	(0.31)
#States	0.0452	-0.0132*	0.0346	0.071	0.035	0.0305
	(1.42)	(-1.72)	(1.22)	(1.17)	(1.08)	(0.86)
FE	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year	Firm, State, Year
Adjusted R-square	0.8795	0.8702	0.720	0.8263	0.876	0.8212
No. of Observations	9,118	11,228	11,228	5,300	9,615	8,549