THE EFFECT OF MARKET-BASED SOURCING ON FIRM INNOVATION

A Dissertation

by

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ABSTRACT

Historically, states have taxed intangible income in the state where a firm's intangibles are located. However, over the past two decades, states have begun adopting market-based sourcing (MBS), which causes the intangible income to be sourced to the state where the customer is located. Using a generalized difference-in-differences design, I examine the effect of MBS laws on both state corporate tax revenue and firm innovation, as MBS directly effects both where innovation is taxed as well as the tax rate for innovation. My tests indicate that the adoption of MBS is associated with both an increase in state corporate tax revenues as well as a decrease in the quantity and quality of firm innovation. Additionally, I document that affected firms locate a greater proportion of patents in states with MBS. Together, these findings suggest that MBS laws lead to changes in state tax rates that impede corporate innovation.

DEDICATION

To my family, who allow me to talk about taxes far too much to them and without them, I never would have made it this far.

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1. INTRODUCTION

In this study, I investigate how a change in state sourcing methodology for intangible income affects firm innovation. Intangibles are mobile, and firms can strategically locate intangibles in jurisdictions for both legal and tax purposes (Karkinsky and Riedel 2012; Dyreng et al. 2013). Historically, U.S. domestic firms could strategically determine where their intangible income was taxed by changing the location of their intangibles and this is important because state tax rates on intangible income vary greatly. Specifically, state sourcing laws determine if a state will tax intangible income depending on the location of the customer or the intangible. States have recently begun changing their intangible sourcing laws following the adoption of MBS by an intergovernmental state agency, but these laws also create an opportunity for states to tax out-of-state firms and protect in-state firms. These changes affect both where a firm pays taxes on its intangible income as well as a firm's ability to strategically locate intangibles, impacting a firm's marginal tax rate on innovation and innovation itself.

Examining the economic effects of changes in intangible income sourcing laws is important for several reasons. First, intangibles are a critical element of innovation, which is an important determinant of economic growth (e.g., Romer 1986; Romer 1990). Second, intangibles' mobility facilitates tax-motivated income shifting, which has generated significant scrutiny from state and federal tax authorities and policy makers.[1] However, firms may locate intangibles in specific states for various reasons, and it is unclear to what extent firms may do so for tax avoidance purposes. Finally, state sourcing laws affect state tax collections on income from intangible assets. Consequently, a change in sourcing can affect state corporate tax revenues and have significant economic repercussions on state budgets.

States use one of two types of sourcing methodologies: cost of performance (COP) or market-based sourcing (MBS). Historically for intangible income, states have used COP, where income is sourced to the state where the intangible is located. Over the past two decades, 23 states have shifted to MBS, where income is sourced to the state where the customer is located. Prior literature demonstrates that increases in state tax rates reduce innovation (Mukherjee et al. 2017; Atanassov and Liu 2020). Ex ante, it is unclear whether a change in intangible sourcing laws would increase or decrease the marginal tax rate on intangible income and affect firm innovation. If the change in sourcing laws provide opportunities for firms to exploit the variation in state sourcing laws to generate income that is not taxed, prior literature suggests that the corresponding decrease in the marginal tax rate on innovation will lead to an increase in firm innovation. Conversely, the change in sourcing laws may constrain firm tax planning

[1] Although both the Internal Revenue Service and the Organization for Economic Cooperation and Development (OECD) have tried to curb tax avoidance techniques based on locating intangibles in low tax rate jurisdictions, states have been slow to recognize or limit this form of tax avoidance (Dyreng et al. 2013).

opportunities by diminishing firms' ability to strategically locate intangibles in favorable jurisdictions, which would lead to lower innovation.

To examine the effect of these laws on firm innovation, I exploit the staggered adoption of MBS laws across U.S. states from 1992 to 2014 with a generalized difference-in-differences regression. Over that time span, seven states separately adopted MBS laws. The treatment group consists of firms with substantial economic activity within these states, and the control group consists of firms who do not have substantial economic activity within those states. To measure a firm's innovation, I collect the number of patents filed by a firm using patent data provided by Kogan et al. (2017). Patents generate intangible income that is directly affected by MBS laws, and capture both observable and unobservable inputs of innovation (He and Tian 2013). While I use patents as my main measure, my results should generalize to other intangibles such as copyrights and trademarks.

To identify firms that are affected by the adoption of MBS laws, I use several approaches to isolate where a firm has substantial economic activity, or nexus. Nexus is a sufficient connection for a firm to be subject to a state corporate income tax, and nexus is a requirement for a firm to have intangible income sourced under COP. For my primary analysis, I use a firm's headquarter location, as a firm's headquarter state is where a firm has nexus and likely where a firm conducts most of its business (Atanassov and Liu 2020). These firms are most likely to be affected by a state adopting MBS rules. In robustness tests, I use state name counts from annual reports as well as significant customer headquarter states as alternative location measures.

I start by examining the effect of MBS on state corporate tax revenues to understand whether these laws increased or decreased state tax collections. While MBS laws allow a state to tax intangible income earned by out-of-state firms, these laws conversely shelter in-state firms intangible income from out-of-state customers. The fiscal impact for each state depends on the distribution of intangible income and assets within and outside the state. I find a positive and significant association between corporate tax revenues and MBS, suggesting that MBS leads to an increased marginal tax rate on intangible income for firms. These results imply that the adoption of MBS could negatively impact firm innovation.

Next, I examine the effects of MBS on innovation more directly, testing the effect of MBS on future firm patent quantity and quality. I show that companies headquartered in states that adopt MBS are associated with a decrease in the quantity of patents filed by 4.76 percentage points in year t+3, which is equivalent to 0.58 patents, in comparison to firms headquartered in COP states. Additionally, following the adoption of MBS, the patents filed by treated firms are associated with both a decrease in citations received by 2.8 percentage points, as well as a decrease in in economic value by 7.55 percentage points. Next, I examine firms in each treated state separately, and show that my negative effect is primarily driven by firms headquartered in California. I do find marginal evidence that firms may be able to benefit from MBS in certain states. Together, these findings suggest that MBS is associated with a decline in both future innovation quantity and quality, which is consistent with MBS increasing the tax rate on innovation by constraining firm tax planning opportunities, but the results are chiefly concentrated in California.

In cross-sectional analysis, I first examine whether patent-intensive firms are more affected by MBS laws, as firms that generate more intangible income should be more sensitive to these laws. Results indicate that firms in high-tech industries as well as industries with high royalty income decrease innovation quantity and quality compared to firms that are not in those industries, which is consistent with my expectations. Second, as MBS eliminates benefits from locating patents in low-tax jurisdictions, I expect firms with greater state tax planning are more impacted by MBS. I find that the decline in innovation is stronger for firms with below median annual state effective tax rates, suggesting firms with greater state tax planning are more impacted by MBS.

I next examine the extent to which firms have research and development (R&D) within their headquarter state, which I measure by where firms' inventors are located. If firms locate patents in their headquarter states because R&D is also located there, then the tax rate on intangibles should decline and innovation should increase due to the potential to generate income not sourced to any state. Alternatively, if firms relocate their patents away from where R&D occurs, then this relocation could lead to an increase in taxes and a decrease in innovation. I find that firms with a higher proportion of R&D within their headquarter state experience a greater decrease in the quantity and quality of patents, which is consistent with the second explanation.

Finally, I test whether firms alter where they locate their patent assignments in response to MBS laws. Specifically, I examine the portfolio of patents a firm owns and where those patents are located over time, and if the percentage of patents assigned to states that adopt MBS changes following treatment. As I find that MBS is associated with a decline in innovation quantity and quality, I expect that firms will strategically move patents to MBS states to maximize the likelihood of generating income not subject to state tax and minimize the likelihood of generating income taxed in two states. In line with my prediction, I find evidence that firms increase the proportion of patents assigned to MBS states. Dyreng et al. (2013) document that states such as Delaware have a high proportion of patents assigned to the state, and MBS regulations are way states can counteract firms' use of domestic tax havens. Additionally, I validate my primary results by examining potential alternate shocks, alternate treatment measurements, using different lead dependent variables, using R&D as a dependent variable, using a stacked difference-in-differences design, and replicating Atanassov and Liu (2020).

This study contributes to the literature on market-based sourcing by documenting two unintended consequences associated with the sourcing of intangible income. First, while states have viewed MBS as a beneficial policy that could protect local firms, my results indicate that the adoption of MBS is associated with firms decreasing innovation. The effect of market-based sourcing is important because these laws decrease the relevance of patent location, instead emphasizing customer location, thereby reducing a firm's ability to control where its intangible income is sourced to. Furthermore, extant literature on these laws is sparse, with Welsch (2022) showing that market-based sourcing provides benefits in the form of increased employment for the service industry in certain states. In contrast, I document that market-based sourcing is associated with reduced innovation at the firm level. Second, I find that MBS is associated with increased patent assignments in MBS states. My results speak to Dyreng et al. (2013), who note that state policies such as combined reporting and economic nexus can reduce state tax avoidance strategies, by showing that MBS is another tax policy that can also diminish the benefits of these strategies.

Additionally, this study contributes to the growing literature on taxes and innovation. Prior literature on taxes and innovation focuses on either general state tax policies, such as corporate tax rates, or more targeted innovation-specific tax policies, such as R&D tax credits and location-specific incentives (Akcigit and Stantcheva 2020). Market-based sourcing laws are unique in that they represent a policy specifically targeting intangible income that is not intended to affect innovation. My tests are designed to provide evidence that, regardless of intent, state sourcing policies are important determinants of firm innovation, and this effect is exacerbated for patent-intensive firms with high in-state R&D and state tax planning. These results complement prior studies (e.g., Mukherjee et al. 2017; Atanassov and Liu 2020) by showing that other state tax laws besides state tax rates are important for innovation.

Finally, this study contributes to the literature on the effect of sourcing methodologies. Sourcing is one component of a state's apportionment methodology, and prior literature has focused on other components, mainly the number of factors included in the apportionment formula as well as the weighting of these factors on firm decision making (e.g., Goolsbee and Maydew 2000; Gupta and Hofman 2003; Giroud and Raud 2019). This study instead examines the calculation of one of the factors, the sales factor, which can change where a firm incurs a tax liability. Domestic policy makers should consider the potential ramifications of MBS policies have on firms, as these laws constrain firms' ability to strategically assign their patents. This result also has implications for international policy makers, as the OECD's plan of creating new revenue sourcing rules to reallocate corporate profits to market jurisdictions could affect firm innovation activities.

2. BACKGROUND AND PRIOR LITERATURE

2.1. Nexus and Apportionment

A state can only impose an income tax on a business that has a connection to the state, and this connection is known as nexus. The U.S. Constitution primarily controls nexus determination, in which the Due Process Clause requires a definite link or minimal connection between a state and the entity it wants to tax, and the Commerce Clause requires substantial presence. Generally, nexus is established by having physical property, employees, or sales activities in a state. States have recently begun adopting more aggressive nexus standards to expand their ability to tax out-of-state companies (Schadewald 2019). For instance, some states employ economic nexus, a nexus that focuses on just a firm's sales to a state, to determine whether a state has an income tax liability, and this practice may be increasing due to the recent Supreme Court ruling, South Dakota v. Wayfair, Inc., 138 S. Ct. 2080 (2018) (Stanton 2022).

If a firm does establish nexus across multiple states, a firm's income must then be apportioned between these jurisdictions. While initially states had disparate methods of apportioning income, in 1957 the Uniform Law Commission, a nonprofit that works with U.S. states to draft model acts, promulgated The Uniform Division of Income for Tax Purposes Act (UDIPTA). UDIPTA provides a standard for apportioning taxable income across states for multistate businesses known as the three-factor formula. Under this formula, firms would calculate their apportionment to the state based on the average of three factors: property, payroll, and sales. Each individual factor is calculated as the in-state total divided by the total firm amount.

Through legislation, states have three ways that they can modify their apportionment formulas – by changing the weighting of each factor, the number of factors to include, or the calculation of the factors. First, states have historically used the three-factor formula for apportionment, with 44 of 46 taxing states using this model in 1989 (Weiner 1996). States however have been changing this model so the factors are not equally weighted. Specifically, states have increasingly weighted the sales factor more, and frequently the sales factor is weighted twice as much as the property and payroll factors. As of 2014, 16 states had a factor formula that weighted the sales factor more than the other factors. At the extreme, states can exclude all other factors and just rely on the sales factor to calculate their apportionment (Swenson 2015). As of 2014, 19 states relied on a single-sales factor apportionment model, and this number as grown to 32 as of 2023. Finally, states can change the calculation of a factor. For instance, a state can define in-state sales as sales that were produced or originated from in-state or as sales to customers within the state.

States have intended to stimulate economic development by relying more heavily on the sales factor through either increasing the weight of that factor or excluding other factors (Mazerov 2005). Increased reliance on the sales factor shifts the corporate tax burden from in-state firms with high property and payroll but low sales factors, to out-of-state firms with low property and payroll but high sales. However, a single sales factor can disproportionally favor large companies over small companies and unfairly shift the tax burden to out-of-state firms that do not benefit from state services the tax revenue goes towards (Mazerov 2005). As an example of the effect of adopting a single sales factor, suppose a firm produces widgets in State A that are primarily sold in other states. In State A, the firm might have a 10 percent sales factor but a 100 percent property and payroll factor. Under the three-factor formula, 70 percent of the firm's income would be apportioned to State A. In contrast, if State A used a single-factor formula with sales, the firm would only apportion 10 percent of its income to the state. In addition, investing additional resources to expand the firm's manufacturing in State A would not alter the amount of income apportioned to that state under a single-factor sales formula. Hence, states have an incentive to adopt a single sales factor apportionment model.

2.2. Market-Based Sourcing

Given the growing emphasis of the sales factor, the method used for calculating a state's sales factor is important to firms. The calculation of the sales factor depends on what product is sold. For tangible personal property, such as machinery, equipment, or inventory, these sales are sourced on a destination basis, or the location where the property was delivered from the seller to the buyer. Intangibles and service income, on the other hand, have historically been sourced under a different method, cost of performance (COP). Specifically for intangibles, COP sources income to where the intangible was produced or held. If the intangible was produced across multiple states, then the income would generally be sourced to the state with the greatest proportion of the costs (MTC Reg IV.18.(c)(3)).[2] Additionally, as intangibles are mobile, firms can move intangibles to different jurisdictions through intercompany transactions. Doing so separates an intangible from where it was produced, changing what jurisdiction the intangible is in and where its related income is sourced.

While some states changed from COP to market-based sourcing (MBS) for the calculation of intangibles in the late 1990s and early 2000s, efforts for large scale adoption of MBS began in the mid-2000s.[3] Instead of sourcing intangible income to states based on the intangibles' location, under MBS this income is sourced to where a customer benefits from the intangibles. In 2008, the Uniform Law Commission contemplated revising UDIPTA, which would include potentially reviewing and changing sourcing for services and intangibles. However, in 2009, the Uniform Law Commission decided to not revise UDIPTA. In response, the Multistate Tax Commission (MTC), an intergovernmental state tax agency, began crafting new regulations that would include MBS for states to adopt. The MTC's revisions to Article IV of the Multistate Tax Compact that included MBS were proposed in 2014 and finalized in 2017. As of 2023, 23 states have adopted MBS for intangibles.

To the MTC, amending the sourcing regulations was "the highest priority for review and amendment. The [COP] provision is outmoded … and states have begun to

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[2] Most states follow the preponderance approach, as it was initially outlined in the Multistate Tax Commission's model regulation. Some states instead have since adopted a pro rata approach, where the gross receipts derived from the performance of an activity across multiple states is prorated based on the costs performed in the state.

[3] The three early adopters of MBS are Minnesota (1987), Iowa (1996), and Georgia (2006). See Appendix A for a complete list of when states have adopted MBS.

unilaterally implement non-uniform alternative sourcing" (MTC 2008). The MTC identified three main issues to the COP approach. First, that the rules created by the UDIPTA in 1957 were old and no longer as applicable due to multistate businesses becoming more common and states increasing their reliance on the sales factor. Second, COP fails to reflect the contributions of the market state, which undermines the purpose of the sales factor to begin with. Finally, it can be difficult for states to determine where the cost of performance occurs and administer the rule properly.

States have different motivations for the adoption MBS laws. First, MBS laws can potentially extend the reach of a state to tax companies by having out-of-state firms now have a tax liability within the state. When the Illinois Senate discussed their market-based sourcing bill, Senator Hendon said "This is for people who live outside of Illinois. So, we're just trying to tax people who live outside Illinois and we don't have to tax the good people of this State" (Film Production Tax Credit 2007). Senator Hadley of Nebraska noted that market-based sourcing "opens up another source of revenue because those companies that are not paying taxes in Nebraska will now start paying taxes in Nebraska" (Changing Provisions 2012).

Second, states are adopting MBS laws to protect local firms from being subject to double taxation. State legislators realize that MBS laws adopted by other states cause their in-state firms to potentially pay tax twice on intangible income and are reacting accordingly by adopting their own MBS laws. Specifically, a firm that locates an intangible in an COP state and licenses it to a customer in an MBS state has its income sourced to both states, both the state where the intangible is located as well as the state where the customer is located. Stephanie Copeland, the executive director of the Colorado Office of Economic Development and International Trade, testified to the Colorado House Business Affairs and Labor that enacting MBS would protect local firms from double taxation (Market Sourcing 2018).

Finally, states believe enacting MBS laws will make their state more attractive for investment from multi-state businesses. MBS laws reduce a firm's tax burden from locating intangibles in the state by taxing intangibles based on where the benefit is derived, not where they are held. Furthermore, this advantage can even be stronger for a state where its competitors have COP laws. Senator Hadley described Nebraska's market-based sourcing bill as "I think this is a good bill. It helps Nebraska companies. It encourages them to grow and expand in Nebraska" (Changing Provisions 2012).

As of 2023, 22 states have implemented throwout laws to prevent firms from benefiting from the variation in state tax methodologies. When calculating the state sales factor, under a throwout regime, the firm must exclude untaxed sales from the denominator of the calculation. For instance, consider a firm that creates a patent in State A and only produces the following royalty income: $50 from customers in State A, an MBS state; and $50 from customers in State B, a COP state. Without a throwout law, the sales factor for State A would be 50 percent (50/100) and for State B would be 0 percent (0/100). No intangible income is sourced to State B because State B uses COP, and the intangible was produced and is located in State A, effectively generating tax free income for the firm. However, with a throwout law, the untaxed income is excluded from State A's sales factor denominator, making the sales factor 100 percent (50/[100-50]).

Throwback laws are similar to throwout laws, except they apply to tangible personal property and affect the numerator of the sales factor instead of the denominator. Following the previous example, if instead State A had a throwback law, the state sales factor would be 100 percent ([50+50]/100).

MBS differs from other laws states have enacted over the past several decades to counteract domestic income shifting. A common form of domestic tax planning a firm can use that takes advantage of the mobility of intangible property is creating a passive investment company in Delaware and transferring patents to it. The passive investment company then charges a royalty for the use of the intangible to the parent company, and this strategy creates a deduction in the parent's state, as well as tax-free income in Delaware (Dyreng et al. 2013). To combat this and other forms of domestic income shifting, states have enacted combined reporting and addback statutes. Combined reporting laws require a parent company and its subsidiary companies to file one combined tax return for the state, which nullifies intercompany transactions. Addback statutes require firms within the state to add back intercompany costs, which reverses any tax-motivated income-shifting transactions the firm may have made with intangibles. While these laws limit firms' benefit from shifting income through intercompany transactions, MBS laws focus on sales to customers outside of the firm.

2.3. Prior Sourcing and Apportionment Studies

States can modify their apportionment formulas by changing the weight of each factor, the number of factors to include, and the calculation of each factor. Doing so can change the total apportionment percentage a firm will use to calculate its state taxable income. Prior literature has generally focused on the weighting and number of the factors used to calculate the apportionment percentage. Gordon and Wilson (1986) model the effects of each of the factors in the three-factor formula model, and they find that the factors can distort the location of capital and labor. For instance, a firm with production activities concentrated in a high-tax state is incentivized to have sales in a low-tax state to reduce its overall tax burden. Goolsbee and Maydew (2000) examine specifically how the payroll apportionment factor can affect employment. They find that a reduction of the factor weighting from one-third to one-quarter leads to an increase in manufacturing employment by 1.1 percent in a state. The authors also find that a state reducing the weight of the payroll factor creates a negative externality in other states, as the jobs gained in one state is offset with jobs lost in another state. Gupta and Hofman (2003) instead look at the property apportionment factor and show that new capital expenditures increase with a decline in the tax burden on property. Giroud and Rauh (2019) find that increases in state tax rates are associated with the closing of state establishments, and that firm movement of establishment, employees, and capital is greatest when a state has higher property and payroll factor weights.

While prior literature has established that the weighting and number of apportionment factors influence firm decision making, prior studies have largely ignored the calculation of the factors. The calculation of the factors matters, especially the sales factor, as states have begun placing more weight on or solely relying on that factor. Under COP, the sales factor intrinsically embodies the property and payroll factor. COP sources income to where the intangible is produced or held, which is likely identical to where a firm has its property and payroll located. Therefore, the movement from a three-factor model to a single sales factor model may not have a large impact on firms. A recent study by Welsch (2022) examines the change in state sourcing methodologies, from COP to MBS, for service industries. Using a matched-state generalized difference-in-differences model, Welsch examines 19 states that adopted MBS for service industries from 2007 to 2019. Following a state adopting MBS, for the affected industries, Welsch finds a 3.6 percent increase in employees and wages per quarter for five years after adoption. This effect only occurs if states do not also incorporate a throwout law to prevent taxpayers from avoiding taxation from having sales to states that do not tax the income. While Welsch analyzes the effects of MBS for service income at the state level, I examine the effects of MBS at the firm level for intangible income.

2.4. Prior Innovation Studies

Innovation is an important determinant of economic growth (e.g., Romer 1986; Romer 1990), and research has shown that the states with the highest innovation have also exhibited the fastest growth between 1900 and 2000 (Akcigit et al. 2017). Given these findings, prior studies have investigated the relationship between state tax policies and corporate innovation. For example, studies show that states can effectively and directly subsidize innovation. Wilson (2009) finds that state R&D tax policies are not only successful at increasing in-state R&D, but also lead to reduced R&D spending in other states. This finding highlights the mobility of R&D activity, and furthermore, that state tax policies can impose externalities on R&D activity in other states. Direct corporate tax subsidies can also have spillover effects. Lee et al. (2021) examine state corporate tax subsidies and find that these direct subsidies can have spillover effects on other local firms. They find that firms increase patenting in the subsidized location following a corporate tax subsidy, which suggests a knowledge or learning spillover benefit from tax subsidies bringing in new practices, techniques, or processes to a location. Furthermore, the authors find that firms do not seem to shift investment out of other counties; rather, the overall level of innovation within the affected firms increase.

Besides subsidies, two prior studies find that states can also affect firm innovation through tax rates. Mukherjee et al. (2017) study changes in state tax rates from 1990 to 2006 and find that an increase in tax rates is associated with a five percent decline in patenting activity. When investigating a decrease in tax rates, this study shows generally a positive insignificant association with an increase in patenting activity. The results are similar for firm R&D as well as for the introduction of new products into the market, suggesting that the effect of corporate tax rates impacts various stages of innovation. When testing the channels driving their results, the authors find that tax increases are associated with inventors moving across firms. The authors suggest that this could be due to either inventors voluntary departing companies and seeking higher post-tax compensation elsewhere or a firm firing existing workers. The authors also find that firms undertake less risky innovation projects after a tax increase, supporting a risk channel, where an increase in tax progressivity reduces firms' incentives to undertake innovation. Overall, Mukherjee et al. (2017) document a negative relation between changes in tax rates and innovation, attributed to inventors leaving their employers and a decline in risky innovation projects.

Atanassov and Liu (2020) similarly show a relationship between state tax rates and innovation. In their sample period from 1988 to 2006, they show that tax increases are associated with decreases in firm patent filings, while tax decreases are associated with increases in firm patent filings. Similar to Mukerjee et al. (2017), their result is robust to looking at changes in firm R&D. A notable difference between the two studies is Atanassov and Liu's finding of a significant relation between tax decreases and patent filings while Mukherjee et al. find an insignificant relation. The differences between these findings may be due to Atanassov and Liu using 10-K filings to identify the treatment of firms instead of headquarter states as well as Atanassov and Liu using only major tax changes that are not reversed within three years instead of all tax changes, which would include small and transitory changes. Additionally, Atanassov and Liu employ different theory from Mukerjee et al. The authors develop a model where higher taxes make it more lucrative for managers to shirk by enjoying the quiet life instead of innovating. To support this hypothesis, the study shows that there is a larger impact on the association between tax cuts and innovation for firms with weaker governance, where it is easier for managers to shirk. Furthermore, the relationship between tax rates and innovation is stronger for financially constrained firms, which reduces the resources available for firms to engage in innovation. Finally, the study shows that the relationship between tax rates and innovation is also moderated by a firm's assets-at-hand, where tax rates more strongly affect firms with lower assets to collateralize and fund innovation. In summary, Atanassov and Liu triangulate the main findings of Mukherjee et al. and show that the effect of tax changes on innovation is moderated by a firm's financial resources and governance.

Finally, state tax laws that do not specifically target innovation or a explicitly change a state tax rate my still have unintended consequences for firm innovation. Li et al. (2021) examine addback statutes, laws that states implement to constrain firms' abilities to use assets to shift income across state lines. As intangibles are often used to aid firms in tax avoidance, the prevention of firms from engaging in tax-motivated income-shifting transactions could reduce the projected after-tax net present value of innovation projects and, at the margin, discourage innovative activities. In a sample from 1997 to 2005, the study finds that firms with material subsidies in states with addback statutes decrease the number of patents they file by 4.77 percent. The results are also similar for examining the effect of addback statutes on future patent citations, future patent value, and R&D. Furthermore, the study shows that in response to these laws, firms also increase the assignment of patents to states with no corporate income tax. Addback statutes are different from MBS as addback statutes target intercompany transactions, while MBS targets transactions between separate companies. As addback statutes primarily inhibit tax-motivated income-shifting, to the extent that MBS also diminishes tax-motivated income-shifting, I would expect MBS to then also decrease firm innovation.

3. HYPOTHESIS DEVELOPMENT

Sourcing laws can shift the location where a firm's intangible income is sourced and taxed. When COP sources a firm's intangible income to the location of the intangible, MBS instead sources intangible income to the location of the customer. The following three examples illustrate the shifting of intangible income through sourcing rules, ignoring the role of apportionment for the moment. To begin, assume a firm is headquartered in State A (the nexus state). Assume further that the firm locates intangibles in State B and collects royalty income from customers in both states. In example 1, both states use COP sourcing. In this case, all the royalty income is taxed in State B (the location of the intangible) and none in State A.

In example 2, State A adopts MBS and State B remains COP. In this case, State A will tax the royalty income from customers in State A (the location of the sales), but State B would still tax all the royalty income under COP sourcing (the location of the intangibles). Hence, a shift to MBS subjects the royalty income from customers in State A to double tax. In example 3, State A remains COP and State B adopts MBS. In this case, State A will not tax any royalty income (the intangibles are in State B), and State B would only tax the royalty income from the customers in State B (the location of the customers). Hence, a shift to MBS in State B fails to tax the royalty income from customers in State A. Technically, the changes in the marginal tax rate do not occur directly. Instead, sourcing intangible income affects the sales factor and thereby alters how taxable income is allocated between states through state apportionment process.[4]

Ex ante, it is first unclear whether the adoption of MBS will lead to net increase or decrease in corporate tax revenue for states. The impact MBS will have on state revenues will depend on the composition of firms in the enacting state. States with corporations that have high in-state customers and low in-state intangibles will generate increased corporate tax revenue from adopting MBS. These states may be incentivized to adopt MBS for the increase in corporate tax revenue as well as preventing firms from engaging in tax planning opportunities by moving intangibles to different states. Conversely, states with corporations that have high in-state intangibles and low in-state customers will generate less corporate tax revenue from adopting MBS. These states may adopt MBS to shelter in-state firms from being double taxed and give those firms a competitive advantage. State budget estimates are also ambiguous as to the expected effect of these laws. For example, Colorado's fiscal note for their bill shows a range from -$2.9 million to $8.6 million impact in the first year and Nebraska estimated a $2.5 million loss in the first year. As MBS has the potential to raise or lower state corporate tax revenue from intangible income, I state my first hypothesis in the null:

H1: The adoption of market-based sourcing laws does not affect state corporate tax revenues.

[4] See Appendix B for more detailed examples on MBS.

Examining the effect of MBS on state corporate tax revenues provides initial evidence as to the potential effect of MBS on firms. Prior studies have found that higher tax rates lead to both lower after-tax income for firms to invest in innovation as well as diminished net present value of future innovative projects. Together, these outcomes disincentivize corporate innovation (Atanassov and Liu 2020; Mukherjee et al. 2017). However, whether the adoption of MBS lead to an increase or an decrease in the MTR of innovation is ambiguous. Firms may be able to take advantage of the conflicting sourcing rules across states to generate nowhere income. Doing so would reduce a firm's MTR, increasing the projected after-tax net present value of projects and encouraging innovation. Alternatively, MBS may constrain the firms' tax planning opportunities by sourcing income to where the customer is instead of where the patent is. To the extent that firms have strategically located patents in a low-tax jurisdiction, MBS would diminish the benefits from this strategy. Furthermore, firms that have strategically located their patents in low tax COP states could have their intangible income double taxed by MBS states. Here, MBS would reduce the after-tax net present value of projects by increasing the MTR for intangible income, discouraging firms from engaging in innovation. As MBS has the potential to raise or lower taxes on intangible income, I state my first second hypotheses in the null:

H2: The adoption of market-based sourcing laws does not affect corporate innovation.

As MBS taxes intangible income based on where the benefit is received, not where the intangible is located, firms may respond by moving where their patent assignments are located. Prior research shows that firms strategically locate their patents both internationally (e.g., Griffith et al. 2014; De Simone et al. 2023) as well as domestically (e.g., Dyreng et al. 2013) in response to corporate income taxes. Firms may first move their patents to MBS states to capitalize on the potential to generate nowhere income by licensing or selling intangibles to customers in COP states. Second, firms may also move their patents to MBS states to minimize the likelihood of their intangible income becoming double taxed. My third hypothesis, stated in the null, is:

H3: The adoption of market-based sourcing laws does not affect the location of patent assignments.

4. DESIGN

For my first hypothesis, I use the following generalized difference-in-differences design to analyze the effect of MBS laws on state corporate income taxes:

$$\Delta CorpTaxRevenue_{s,t} = \alpha + \beta_1 Post * Treatment_{s,t} + \Delta State\ Controls_{s,t} + StateFE + YearFE + \varepsilon$$

I follow Gupta and Lynch (2016) and use a changes model to test the effect of a change in sourcing laws on state tax collections. I measure state corporate tax revenues as the percentage change in corporate income tax collections scaled by state gross domestic product as well as the change in the natural log of state corporate income tax collections. For state control variables, I control for changes in macro-economic variables, such as population, state gross domestic product, and unemployment, which Gupta et al. (2009) show to impact state corporate income tax collections. I also control for changes to the state tax rate and sales factor weighting, as those also can directly impact state corporate income tax collections. As part of a generalized difference-in-differences model, I include both state and year-quarter fixed effects to control for time-invariant state characteristics and time trends in tax collections that affect all states (Gupta and Lynch 2016). Finally, I cluster standard errors by state.

For my following two hypotheses, where I more directly test the effect of MBS laws on corporate innovation, I use the following generalized difference-in-differences design:

$$
\begin{aligned}
&Innovation_{i,t+3} \\
&\qquad = \alpha + \beta_1 Post * Treatment_{i,t} + Firm\ Controls_{i,t} \\
&\qquad + State\ Controls_{i,t} + FirmFE + StateFE + YearFE + \varepsilon
\end{aligned}
$$

To test my second hypothesis, I follow prior literature on innovation and use patent-based measures for my dependent variable (e.g., Griliches et al. 1986; Mukherjee et al. 2017; Atanssov and Liu 2020; Li et al. 2021). I first measure the quantity of innovation as the natural logarithm of one plus the number of patents filed by a firm in the year t+3. I use a three-year lead variable because of the long-term nature of the innovation process and to be consistent with prior literature (e.g., Li et al. 2021; Atanassov and Liu 2020). This measure captures a quantitative change in the innovation output of a firm. My second measure is the natural logarithm of one plus the number of citations received on patents that are filed three years ahead. I deflate a patent's citation count by the average number of citations received by patents filed in the same class and year to account for the truncation of patent citations (Hall et al. 2001; Kogan et al. 2017). While the number of patents captures the quantity of innovation, patent citations capture the quality of innovation, with higher quality innovations receiving more citations. Finally, as another measure of innovation quality, I use the economic value of patents filed by a firm three years ahead from Kogan et al. (2017), who measure patent values as the firm's abnormal stock return on the patent grant date.

I choose to use a patent-based measure for innovation instead of R&D for three reasons. First, where R&D captures only the observable inputs into innovation, patents can capture both the observable and unobservable inputs and measures as well as innovation success (He and Tian 2013). Second, R&D tax incentives can lead to firms potentially reclassifying investments as R&D for tax purposes (Mukherjee et al. 2017). Finally, MBS laws are specifically targeting income resulting from the license or sale of intangible assets to a third party, so using patents more accurately captures the target of these laws. In a robustness test, I use R&D to measure innovation.

To test my third hypothesis, I use the ratio of firm patent assignments located in states that have adopted MBS. I use the United States Patent Assignment dataset to supplement the data provided by Kogan et al. (2017) with patent assignment locations over time (Marco et al. 2015). For each firm-year, I create a ratio of the number of patent assignments with addresses in treated states over the total historical number of patents a firm has.

My main variable of interest is the Post*Treatment variable, which equals one if a firm is affected by an MBS law in year t. This coefficient indicates how the innovation of affected firms change after a state adopts MBS. There are two ways that a firm can be affected by MBS laws. First, a firm can be affected if they have intangibles located in a state that adopts MBS and these intangibles are then licensed or sold out-of-state, which could decrease a firm’s MTR on innovation. Second, a firm can be affected if they license or sell intangibles to customers in MBS states, which could increase a firm’s MTR on innovation. To measure treatment, I would need to know where a firm’s intangibles are located and where they are being licensed or sold. While where a firm’s patents are assigned is observable, which patents are licensed and sold and where they are being licensed and sold to is not observable. Instead, I measure treatment using a firm's headquarter state in my primary analysis. A firm's headquarter state is assumed to be where a firm has nexus, as it is likely where a firm conducts the majority of its business operations (Atanassov and Liu 2020). To the extent that a firm's headquarter state does not capture a firm's activity, this would bias me against rejecting the null.

In robustness tests, I use two other methods to identify treatment. I first use the state that a firm mentions the most in its annual report (García and Norli 2012). The more a firm discusses a state in financial reports, the more likely that state is integral to the operations of that firm. I next use a firm's major customer locations to identify treatment. Firms are required to disclose external customers that encompass ten percent of more of their revenues and I combine these disclosures with firm headquarter data to locate what states a firm's major customers are in. I then set treatment equal to one if a firm has a major customer headquartered in a state that adopts MBS. Firms with a customer located in an MBS state have an increased chance of having income taxed twice if the intangible asset is also sourced to a COP state.

I include a bevy of firm and state level control variables to mitigate potential confounding effects of firm characteristics and other state tax policies, and the construction of these variables is described in Appendix C. For firm controls, I first control for firm size, as larger firms may have economies of scale, resources, and information advantages to use for innovative activities (Hall and Ziedonis 2001; Díaz-Díaz et al. 2022). I control for net operating losses (NOL), as firm risk taking is sensitive to tax loss-offset rules (Ljungqvist et al. 2017; Langenmayr and Lester 2018). I control for leverage, as higher debt can increase managerial risk aversion at the expense of risky long-term projects (Brown et al. 2009). I control for return on assets (ROA) and operating cash flows because more profitable and cash-rich firms can invest more in innovation. I control for capital expenditures, as capital intensive firms are more able to invest in innovation (Hall and Ziedonis 2001). I include R&D as well as the change of R&D to control for the visible inputs to innovation. Finally, I include an indicator set equal to one for firm-year observations that have no patent filings.

For state controls, I first control for state laws that attempt to counteract companies from engaging in domestic income shifting, as these have been documented to affect overall firm innovation. I control for whether a state includes addback statutes (Li et al. 2021) and consolidated reporting (Dyreng et al. 2013). I next control for the state tax rate as well as apportionment methodology, as these could affect both the decision to locate and the intensity of research and development within a state. Finally, I control for the state economic climate with the unemployment rate, state gross domestic product, and the state budget balance.

To estimate a generalized difference-in-differences (DiD) regression, I include a set of group- and time- fixed effects in my model (Wing et al. 2018). Additionally, I also include state fixed effects. Finally, I cluster standard errors by firm. While I use a generalized difference-in-differences design to examine the average effect of MBS across states, I do in subsequent tests examine each treatment state individually.

5. DATA AND SAMPLE

I examine each state to determine whether a state has adopted a law or changed state tax regulations to implement MBS. While some states adopt MBS laws for both services and intangibles, other times states only adopted MBS laws for services.

For my state-quarterly revenue tests, I obtain state revenue data from the U.S. Census Bureau. I collect state corporate tax rates from the Tax Foundation as well as the World Tax Bank. For the sales apportionment factor, I use data provided by Giroud and Raud (2019) and the CCH Handbooks. State unemployment, GDP, and budget information comes from the U.S. Bureau of Labor Statistics, Bureau of Economic Analysis, and the U.S. Census, respectively. My state-quarterly sample begins in Q2 2005 and ends in Q4 2020 due to data limitations for when quarterly state tax revenue from the U.S. Census Bureau begins.

For my firm innovation tests, I primarily use financial data from Compustat for firm variables. I use patent data matched to CRSP up to 2020, which is provided by Kogan et al. (2017). I supplement this patent dataset with patent assignment location data from the US Patent Office. For when states adopt addback laws, I use data provided by Li et al. (2021).

To identify when firms have economic nexus in a state that adopts MBS, I examine where a firm is headquartered using data provided by Jennings et al. (2017).[5] In

[5] The headquarter data from Jennings et al. (2017) spans from 1990 to 2017. The authors hand collect headquarter locations from the 10-K each year but use the Compustat address when missing. For 2018 to

robustness tests, I leverage two other methods of identifying when states are affected by MBS. First, I use state mentions in firm annual reports with data provided by García and Norli (2012) and supplemented with additional years hand collected from Direct Edgar. Second, for major customer disclosures, I use the historical customer segment data from Compustat that has been fuzzy matched and verified by Cen et al. (2017) and Cohen and Frazzini (2008).

I start my firm-year sample in 1992 to have four years prior to Iowa adopting MBS in 1996. While my sample ends in 2020 for my state revenues test, my sample ends in 2014 for my firm innovation test due to limitations on the patent data.[6] First, patent data suffers from a truncation bias, so while the Kogan et al. (2017) patent data extends to 2020, I drop the last three years of the patent data to adjust for this bias (Hall et al. 2001). Next, I use a three-year lead for my patent variables. Together, this causes my patent dataset to end in 2014. In robustness tests using R&D as my dependent variable, I extend my sample to 2019 to include additional treatment states. I also exclude observations from firms in non-patenting industries, which I measure as a four-digit SIC group with no patents in the dataset, as well as firms in utility and financial industries. Finally, I exclude firms that are headquartered in Minnesota, which adopted MBS before my sample period in 1987, as well as any singleton firm observations.

2020, I supplement the Jennings et al. (2017) data with headquarter location data provided by Loughran and McDonald (2016). Loughran and McDonald (2016)'s data comes from the header section of the 10-K/Qs. I do not use Loughran and McDonald (2016)'s data for my main tests because it only substantially covers firms starting in 1994 and my sample begins in 1992.

[6] Seven states adopt MBS between 1992 to 2014: Iowa (1996), Georgia (2006), Illinois (2009), Alabama (2011), California (2011), Massachusetts (2014) and Nebraska (2014). Between 2015 to 2020, fourteen more states adopted MBS, which can be found in Appendix A.

6. RESULTS

6.1. Summary Statistics – State Corporate Tax Revenues

Table 6.1 reports the descriptive statistics for the state-quarter sample from 2005 to 2020. While 44 percent of the state-quarter observations are treated states, only around 30 percent of those observations are in the post period, which is due to few states adopting MBS in the early years of the sample. The average state corporate tax rate during this period is six percent. In untabulated analysis, treated states have a higher average state tax rate during this period (7.2 percent) than the control states (5.5 percent). The average quarterly corporate state tax revenue is 243 million, which greatly varies across states with an interquartile range of 200.5 million.

Table 6.1 State-Quarterly Sample Statistics

Variable	N	Mean	Std. Dev.	P25	Median	P75
Corporate Revenue	3,024	243.29	489.50	38.00	102.00	238.50
Treat	3,024	0.44	0.50	0.00	0.00	1.00
Post*Treat	3,024	0.13	0.34	0.00	0.00	0.00
Corporate Tax Rate	3,024	0.06	0.03	0.06	0.07	0.08
Sales Factor	3,024	0.59	0.32	0.33	0.50	1.00
Unemployment Rate	3,024	5.84	2.22	4.16	5.38	7.25
Ln(Population)	3,024	15.16	1.03	14.39	15.31	15.85
Ln(GDP)	3,024	12.18	1.06	11.25	12.23	12.94

6.2. Main Results – State Corporate Tax Revenues

I first estimate the effects of MBS laws on state corporate tax revenues to understand whether MBS leads to increased or decreased state tax collections. This is important because, ex ante, it is unclear whether these laws lead to an increase in taxes on firms. In Table 6.2, in the first and third column, I include year and state fixed effects, but no controls, and find a positive and significant association between MBS and state corporate tax revenues for Δ(Corp Rev/GDP), but not ΔLn(Corp Rev). In the second and fourth column, I include state control variables, and find a positive and significant association across both specifications. Overall, this provides initial evidence that MBS laws increased the corporate tax collection for states, which should then affect firm innovation.

Table 6.2 Market-Based Sourcing and Corporate Tax Revenue

Dependent Variable:	Δ(Corp Rev / GDP)	Δ(Corp Rev / GDP)	ΔLn(Corp Rev)	ΔLn(Corp Rev)
Post*Treat	0.0025**	0.0026**	0.0405	0.0578**
	(2.64)	(2.58)	(1.56)	(2.14)
ΔTax Rate		-0.6373**		-39.612**
		(-2.18)		(-2.06)
ΔSales Factor		-0.0017		-1.6039*
		(-0.08)		(-1.88)
ΔUnemployment Rate		0.0024		-0.1399
		(0.57)		(-1.66)
ΔPopulation		-0.7721		-14.746
		(-1.51)		(-1.26)
ΔGDP		0.2533		0.0941
		(0.93)		(0.05)
Constant	-0.0001	-0.0011	0.0055	0.0318
	(-0.95)	(-0.48)	(1.58)	(1.26)
Fixed Effects	State, Year	State, Year	State, Year	State, Year
Observations	3,024	3,024	3,024	3,024
Adj. R^2	0.2794	0.2819	0.2216	0.2324

Next, I disaggregate the Post*Treat variable into the 21 states that adopt MBS between 2005 and 2020 and present the coefficient estimates for each state. For Δ(Corp

Rev/GDP) in Table 6.3, eleven (two) states have significantly higher (lower) corporate tax revenue following the adoption of MBS relative to control states. Results are similar in Table 6.4 with ΔLn(Corp Rev), where eleven (three) states have a significantly higher (lower) corporate tax revenue. Most states are significant across the two panels, with California, North Carolina, and Indiana being significant in only one of the two panels. Overall, these disaggregated results suggest the relationship between the adoption of MBS and state quarterly corporate tax revenue is not driven by a single treatment state. Still, states may exhibit an increase in corporate tax revenues due to other adopted legislation during this period. Therefore, while the results from Table 6.3 and Table 6.4 suggest that states collecting more corporate tax revenue may lead to a higher tax burden on firms and lower innovation, examining the direct effect of MBS on firm innovation is still important.

Table 6.3 Heterogeneous Treatment Effects – Scaled Revenue

	DV: Δ(Corp Rev / GDP)		Year Treated	Observations		Average	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	N/A	N/A	1996	N/A	N/A	N/A	N/A
Georgia	0.0068**	(2.45)	2006	3	60	0.0025	0.0001
Illinois	0.0023***	(4.02)	2009	15	48	(0.0019)	0.0007
Alabama	0.0003	(0.36)	2011	23	40	(0.0001)	0.0003
California	0.0023***	(3.15)	2011	23	40	(0.0016)	0.0006
Massachusetts	0.0033***	(4.20)	2014	35	28	(0.0023)	0.0013
Nebraska	0.0009**	(2.22)	2014	35	28	(0.0004)	0.0005
Rhode Island	0.0063***	(6.25)	2015	39	24	(0.0020)	0.0042
Connecticut	0.0071***	(8.17)	2016	43	20	(0.0002)	0.0078
Louisiana	0.0040***	(4.45)	2016	43	20	(0.0003)	0.0039
Tennessee	-0.0006	(-0.92)	2016	43	20	(0.0002)	0.0003
Kentucky	-0.0008	(-0.69)	2018	51	12	0.0012	0.0012
Montana	-0.0039***	(-4.42)	2018	51	12	0.0012	(0.0008)
Oregon	-0.0016*	(-2.00)	2018	51	12	0.0006	0.0021
Indiana	-0.0005	(-0.40)	2019	55	8	0.0011	0.0008
New Jersey	0.0203***	(12.56)	2019	55	8	0.0011	0.0208
Colorado	-0.0001	(-0.05)	2019	55	8	0.0004	0.0031
Hawaii	0.02120***	(4.34)	2020	59	4	(0.0009)	0.0148
Missouri	0.0023	(0.49)	2020	59	4	0.0003	0.0024
North Carolina	0.0006	(0.31)	2020	59	4	(0.0013)	0.0026
New Mexico	0.0117***	(3.91)	2020	59	4	(0.0012)	0.0082
Vermont	0.0007	(0.27)	2020	59	4	(0.0003)	(0.0002)

Table 6.4 Heterogeneous Treatment Effects – Log Revenue

	DV: Ln(Corp Rev)		Year Treated	Observations		Average	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	N/A	N/A	1996	N/A	N/A	N/A	N/A
Georgia	0.1286**	(2.09)	2006	3	60	0.0699	0.0106
Illinois	0.0555***	(3.16)	2009	15	48	(0.0158)	0.0148
Alabama	-0.0111	(-0.42)	2011	23	40	0.0043	0.0139
California	0.0307	(1.10)	2011	23	40	(0.0044)	0.0159
Massachusetts	0.0766***	(4.80)	2014	35	28	(0.0115)	0.0231
Nebraska	0.0345**	(2.45)	2014	35	28	0.0045	0.0167
Rhode Island	0.1283***	(3.67)	2015	39	24	(0.0287)	0.0703
Connecticut	0.0630**	(2.05)	2016	43	20	0.0018	0.0885
Louisiana	0.2031***	(10.81)	2016	43	20	0.0000	0.2467
Tennessee	-0.0092	(-0.61)	2016	43	20	0.0060	0.0127
Kentucky	-0.0023	(-0.05)	2018	51	12	0.0295	0.0199
Montana	-0.1005***	(-3.98)	2018	51	12	0.0242	0.0015
Oregon	-0.0630**	(-2.26)	2018	51	12	0.0222	0.0374
Indiana	-0.1450***	(-4.21)	2019	55	8	0.0962	0.0176
New Jersey	0.1537***	(2.83)	2019	55	8	0.0192	0.1125
Colorado	-0.0447	(-0.85)	2019	55	8	0.0276	0.0765
Hawaii	0.5477***	(3.88)	2020	59	4	(0.0117)	0.2858
Missouri	0.1533	(0.94)	2020	59	4	0.0243	0.0796
North Carolina	0.2686***	(5.44)	2020	59	4	(0.0384)	0.2882
New Mexico	0.4025***	(11.13)	2020	59	4	(0.0319)	0.3851
Vermont	-0.0120	(-0.28)	2020	59	4	0.0024	0.0000

6.3. Summary Statistics – Innovation Quantity & Quality

Table 6.5 details the sample selection for the firm-year sample. My final sample has 87,656 firm-year observations. Table 6.6 next reports the breakout of observations by state. While every state is present in the sample, California does encompass nearly twenty percent of the observations and is home to many innovative industries (Mukherjee et al. 2017). Table 6.7 shows if there are concurrent adoption of other state tax laws with the adoption of MBS. All seven states adopted MBS for services concurrently, and California also adopted a single sales factor apportionment methodology concurrently. In robustness tests, I examine these as alternate shocks that could be driving my findings.

Table 6.5 Firm-Year Sample Selection Criteria

Criteria	**Observations**
Compustat universe between 1992 and 2014	264,858
Exclude firms with missing permno	(98,638)
Exclude firms in non-patenting industries	(31,206)
Exclude firms in the utility and financial industries (SIC code 4000 - 4949 and 6000 to 6799)	(26,448)
Exclude firms with missing headquarter location	(15,880)
Exclude firms with missing control variables	(997)
Exclude firms with a Minnesota headquarter	(3,138)
Exclude firms with just one firm-year observation	(895)
Total firm-year observations	**87,656**

Table 6.6 Sample Distribution by Headquarter State

State	Obs.	State	Obs.	State	Obs.	State	Obs.	State	Obs.
AK	77	HI	193	ME	111	NM	96	TN	1,288
AL	468	IA	420	MI	1,598	NV	855	TX	8,599
AR	383	ID	232	MO	1,289	NY	7,752	UT	786
AZ	1,235	IL	3,665	MS	210	OH	2,896	VA	2,114
CA	16,974	IN	963	MT	67	OK	854	VT	123
CO	2,590	KS	503	NC	1,513	OR	1,000	WA	1,660
CT	2,250	KY	459	ND	21	PA	3,625	WI	1,186
DE	255	LA	618	NE	353	RI	306	WV	120
FL	4,072	MA	5,047	NH	357	SC	380	WY	75
GA	2,371	MD	1,468	NJ	4,085	SD	94		

Table 6.7 Concurrent Adoption of State Policies

	IA	GA	IL	AL	CA	MA	NE
MBS Intangibles Adoption	1996	2006	2009	2011	2011	2014	2014
MBS Services Adoption	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Statutory Tax Rate Increase	No	No	No	No	No	No	No
Statutory Tax Rate Decrease	No	No	No	No	No	No	No
Combined Reporting Adoption	No	No	No	No	No	No	No
R&D Credit Change	No	No	No	No	No	No	No
NOL Change	No	No	No	No	No	No	No
Single Sales Factor Adoption	No	No	No	No	Yes	No	No

In Table 6.8, I report the descriptive statistics of the measures used in the firm-year regression models. All continuous firm variables are winsorized at the top and bottom 1 percent. While one third of my observations are located in a state that adopt MBS, roughly five percent of my observations are located in a state that adopts MBS in the post period. The mean number of patents filed per year by a firm is 12.12 in my sample. This is consistent with prior literature, as Mukherjee et al. (2017) have a mean of 9.11 for number of patents filed, Atanassov and Liu (2020) have a mean of 5.12, and Li et al. (2021) have a mean of 13.4. The standard deviation of my number of patents filed per year is 124.38, which is highly skewed because there are many firm-year observations with zero patents (76 percent). However, this is also consistent with prior studies, as Mukherjee et al. (2017) have a standard deviation of 75.10, Atanassov and Liu (2020) have a standard deviation of 54.99, and Li et al. (2021) have a standard deviation of 119.30. The ratio of patent assignments located in a treated state is 38 percent.

Table 6.8 State-Year Sample Descriptive Statistics

Variable	N	Mean	Std. Dev.	P25	Median	P75
$Patent_{t+3}$	87,656	12.12	124.38	0.00	0.00	0.00
$Citation_{t+3}$	87,656	0.28	1.11	0.00	0.00	0.00
$Value_{t+3}$	87,656	16.33	165.09	0.00	0.00	0.00
MBS Assign Ratio	45,340	0.38	0.44	0.00	0.06	0.95
Treat	87,656	0.33	0.47	0.00	0.00	1.00
Post*Treat	87,656	0.05	0.21	0.00	0.00	0.00
SIZE	87,656	5.33	2.13	3.76	5.24	6.78
ROA	87,656	(0.05)	0.32	(0.08)	0.04	0.10
NOL	87,656	0.39	0.49	0.00	0.00	1.00
LEV	87,656	0.17	0.20	0.00	0.10	0.28
CFO	87,656	0.01	0.23	(0.02)	0.06	0.12
CAPEX	87,656	0.06	0.07	0.02	0.04	0.07
R&D	87,656	0.35	1.76	0.00	0.00	0.08
ΔR&D	87,656	(0.01)	0.83	(0.00)	0.00	0.00
Tax Rate	87,656	0.07	0.03	0.06	0.08	0.09
Sales Factor	87,656	0.58	0.25	0.50	0.50	0.60
R&D Credit	87,656	0.06	0.05	0.00	0.06	0.10
Addback	87,656	0.18	0.38	0.00	0.00	0.00
Combined Reporting	87,656	0.39	0.49	0.00	0.00	1.00
Budget	87,656	0.07	0.15	0.01	0.09	0.16
GDP	87,656	12.94	0.96	12.34	12.96	13.69
Unemployment	87,656	6.03	1.90	4.73	5.60	6.95
Zero $Patents_{t+3}$	87,656	0.76	0.43	1.00	1.00	1.00

I also provide Pearson and Spearman correlations for the main variables of interest in Table 3 Panel E. I find significantly positive correlations between my Post*Treat variable and three of my four outcome variables. $Ln(Citation)_{t+3}$ is the only variable to have a significant negative association with Post*Treat. Overall, this provides initial evidence that following the adoption of MBS, innovation quantity increases for firms headquartered in adopting states, compared to firms headquartered in non-adopting states. As for patent quality, with the relation for Ln(Citation)$_{t+3}$ and Ln(Citation)$_{t+3}$ as negative and positive, respectfully, no clear takeaway can be had. Finally, Post*Treat is positively and significantly associated with firms locating their patent assignments in adopting states.

Table 6.9 Correlation Table

		(1)	(2)	(3)	(4)	(5)
(1)	Ln(Patent)$_{t+3}$	1	0.8911*	0.9842*	0.14*	0.0250*
(2)	Ln(Citation)$_{t+3}$	0.6342*	1	0.8814*	0.135*	-0.0198*
(3)	Ln(Value)$_{t+3}$	0.8952*	0.4934*	1	0.1394*	0.0214*
(4)	MBS Assign Ratio	0.0732*	0.0924*	0.0487*	1	0.2155*
(5)	Post*Treat	0.0375*	-0.0149*	0.0289*	0.2375*	1

6.4. Main Results – Innovation Quantity & Quality

To provide more direct evidence of the effects of MBS on innovation, I examine the effects of MBS on the quantity of innovation in Table 6.10. The coefficient on Post*Treat is -0.1254 and -0.0488 respectively across the first two columns, significant at the one and five percent level, respectively. These results indicate that being headquartered in a state that has adopted an MBS statute is negatively associated with the number of patents filed three years later. Specifically, the number of patents filed by firms headquartered in MBS states declines by 4.76 percentage points following the adoption of MBS, which is equivalent to 0.58 patents (4.76%* 12.12) and 0.46 percent of its standard deviation (0.58 ÷ 124.38).[7] The magnitude of the effect I document is comparable to the effects recorded by prior literature on the impact of state taxed on innovation.[8]

The coefficient on my Post*Treat variable is also the opposite sign found in my univariate correlations in Table 6.9. In untabulated analyses, I examine how the fixed effects influence my main results. Excluding all fixed effects, but including control variables, I find a negative and insignificant coefficient on Post*Treat, which suggests the importance of control variables for my analysis. Including year fixed effects causes the coefficient to become positive, but still insignificant. State fixed effects cause Post*Treat to be positive and significant, but firm fixed effects subordinate the other fixed effects and cause Post*Treat to be negative and significant. Given that my design is a staggered difference-in-differences, firm and year fixed effects are a requisite of my design, and the state fixed effects, while controlling for state invariant unobservable characteristics that could drive a relation between MBS and firm innovation, are not driving the negative and significant results in Table 6.10.

As for the control variables, SIZE and CFO are positive and significantly associated with innovation, while LEV is negative and significantly associated with innovation, which is in line with expectations from prior literature. ROA and Tax Rate

[7] From Table 6.10, Exp (-0.0488)-1 = -4.76%.
[8] Specifically, Mukherjee et al. (2017) find that the average state income tax rate increase leads to a 5.3 to 5.5 percentage point decrease in patent quantity. Atanassov and Liu (2020) similarly find that the average state income tax rate increase leads to a 4.1 to 5.1 percentage point decrease in patent quantity. Finally, Li et al. (2022) document a 4.77 percent decrease in patent quantity following the adoption of addback statutes in a state.

both being negative and significant is unexpected, however. In untabulated tests, I include Ln(Patent)t as a control variable, and doing so causes ROA to become insignificant while not changing the significance of any of the other variables. For Tax Rate, I find in untabulated tests that the significance is sensitive to the inclusion of Zero $Patents_{t+3}$. Removing that control variable also removes significance for Tax Rate. Furthermore, if I examine firms in each treatment state alone, the positive significance is only present for the Massachusetts subsample. Finally, inferences are unchanged if I follow Atanassov and Liu and substitute Tax Rate for indicator variables for major tax rate increases and decreases. The adjusted R squared for the regression is 90.2 percent, which suggests the model fits well overall, and is in line with models using patents as a dependent variable from prior literature, such as Atanassov and Liu (2020) at 72 percent and Li et al. (2021) at 88 percent.

I next estimate the effects of MBS laws on the quality of innovation in the remaining columns of Table 6.10. For both the columns with and without controls, I find a negative and significant correlation between both measures of patent quality and MBS. Specifically, the adoption of MBS in a state is associated with a decline of 2.8 percent in the truncation-adjusted number of citations on a patent filed three years later for firms headquartered in the state. Similarly, I document a 7.55 percent decline in the economic value of patents filed three years later.[9]

[9] From Table 3 Panel A, Exp (-0.0284)-1 = -2.8% and Exp (-0.0785)-1 = -7.55%.

Overall, these findings suggest the adoption of MBS statutes both reduce the level of corporate innovation for affected firms, as well as the quality of innovation for firms. This result supports the earlier finding that MBS is associated with an increase in state corporate revenues, as an increase in the MTR of intangible income should lead to a decline in innovation. Additionally, the decline in innovation is also consistent with MBS constraining corporate tax planning by diminishing firm ability to control where intangible income is sourced to.

Table 6.10 Market-Based Sourcing and Innovation

Dependent Variable:	Ln(Patent) t+3	Ln(Patent) t+3	Ln (Citations) t+3	Ln (Citations) t+3	Ln(Value) t+3	Ln(Value) t+3
Post*Treat	-0.1254***	-0.0488**	-0.0552***	-0.0284***	-0.0916***	-0.0785***
	(-3.76)	(-2.04)	(-5.45)	(-3.24)	(-3.08)	(-2.92)
SIZE		0.0314***		-0.0035***		0.0231***
		(9.49)		(-2.84)		(5.58)
ROA		-0.0342***		0.0054		-0.0167*
		(-3.89)		(1.26)		(-1.82)
NOL		0.0021		-0.0020		0.0059
		(0.28)		(-0.72)		(0.70)
LEV		-0.0469**		-0.0179**		-0.0485**
		(-2.53)		(-2.32)		(-2.26)
CFO		0.0551***		-0.0184**		0.0207
		(4.31)		(-2.42)		(1.43)
CAPEX		0.0102		0.0110		0.0197
		(0.30)		(0.71)		(0.49)
R&D		-0.0028		0.0015		-0.0064***
		(-1.55)		(1.28)		(-2.81)
ΔR&D		0.0029		-0.0006		0.0056***
		(1.48)		(-0.49)		(2.79)
Tax Rate		0.9563**		-0.3947***		0.4327
		(2.07)		(-2.93)		(0.89)
Sales Factor		0.00591		0.0237*		0.0768*
		(0.18)		(1.87)		(1.91)
R&D Credit		-0.0023		-0.0239		-0.0063
		(-0.02)		(-0.52)		(-0.04)
Addback		0.0020		-0.0043		0.0041
		(0.14)		(-0.82)		(0.23)
Combined Reporting		0.0010		-0.0110		-0.0289
		(0.05)		(-1.45)		(-1.25)
Budget		-0.0270		0.0017		-0.018
		(-1.17)		(0.15)		(-0.69)
GDP		0.1128		-0.0692**		0.1280
		(1.41)		(-2.40)		(1.38)
Unemployment		-0.0031		-0.0002		0.0029
		(-0.69)		(-0.09)		(0.55)

Table 6.10 Continued

Dependent Variable:	Ln(Patent) $_{t+3}$	Ln(Patent) $_{t+3}$	Ln (Citations) $_{t+3}$	Ln (Citations) $_{t+3}$	Ln(Value) $_{t+3}$	Ln(Value) $_{t+3}$
Zero Patents $_{t+3}$		-1.3389***		-0.5429***		-0.7073***
		(-87.91)		(-77.83)		(-32.29)
Constant	0.5271***	-0.1352	0.1461***	1.4954***	0.3996***	-0.9197
	(340.37)	(-0.13)	(310.54)	(3.99)	(289.03)	(-0.76)
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	87,656	87,656	87,656	87,656	87,656	87,656
Adj. R^2	0.7984	0.9022	0.4867	0.6915	0.8463	0.8756

In Tables 6.11 through 6.13, I disaggregate Post*Treat into the seven states that comprise the estimated treatment effect and present information on the number of firm-year observations and average value of the dependent variable. Table 6.11 presents the disaggregation for Ln(Patent) $_{t+3}$ and only California exhibits a significant negative coefficient, while Alabama and Nebraska exhibit significant positive coefficients. California's coefficient suggests that the number of patents for firms headquartered in the state declined by 12.03 percentage points following the adoption of MBS, which is notably higher than the estimate from Table 6.10.[10] Overall, this suggests that the negative association between MBS and innovation quantity is mainly driven by firms headquartered in California. California is a state with significant R&D and high taxes, and firms could have previously relocated patents out-of-state as part of their tax planning. However, significant positive coefficients for Alabama and Nebraska suggest

[10] From Table 3 Panel B, Exp (-0.0488)-1 = -4.76%.

that for certain states, MBS could be beneficial for firms. These states likely have firms that have more out-of-state customers and could benefit from the law change. However, both Alabama and Nebraska feature a low number of post-treatment observations, which suggests very few firms could have benefitted.

Table 6.11 Heterogeneous Treatment Effects – Patent Count

	DV: Ln(Patent)$_{t+3}$		Year Treated	**Observations**		**Average**	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	-0.0904	(-0.89)	1996	85	335	0.4881	0.3650
Georgia	0.0590	(1.24)	2006	1,658	713	0.2877	0.2830
Illinois	-0.0196	(-0.38)	2009	2,917	748	0.6890	0.7098
Alabama	0.0493*	(1.83)	2011	430	38	0.2720	0.3213
California	-0.1282***	(-3.29)	2011	14,902	2,072	0.7523	1.0413
Massachusetts	0.0487	(1.00)	2014	4,896	151	0.6792	1.0124
Nebraska	0.0804**	(2.10)	2014	339	14	0.4739	0.3530

Tables 6.12 and Table 6.13 present the disaggregation for Ln(Citation)$_{t+3}$ and Ln(Value)$_{t+3}$, respectively. In Table 6.12, Illinios, California, and Massachusetts exhibit a significant negative coefficient, which provides evidence that firms in multiple states exhibit a decline in innovation quality after the adoption of MBS. However, in Table 6.13, only California exhibits a significant negative coefficient, while Massachusetts exhibits a significant positive coefficient. Together, these two tables provide strong evidence that California exhibited a decline in patent quality following MBS, but mixed evidence as to other states exhibiting a change in patent quality. Overall, these three tables provide evidence that firms headquartered in California were strongly affected by MBS laws, but firms in other states less so.

Table 6.12 Heterogeneous Treatment Effects – Patent Citations

	DV: Ln(Citation)$_{t+3}$		Year Treated	Observations		Average	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	0.0133	(0.49)	1996	85	335	0.1138	0.0817
Georgia	0.0103	(0.63)	2006	1,658	713	0.1112	0.0689
Illinois	-0.0428**	(-2.28)	2009	2,917	748	0.1825	0.0997
Alabama	0.0154	(0.76)	2011	430	38	0.0804	0.0246
California	-0.0318**	(-2.34)	2011	14,902	2,072	0.2236	0.2149
Massachusetts	-0.0547**	(-2.00)	2014	4,896	151	0.2040	0.1798
Nebraska	0.0310	(0.91)	2014	339	14	0.1115	0.0374

Table 6.13 Heterogeneous Treatment Effects – Patent Value

	DV: Ln(Value)$_{t+3}$		Year Treated	Observations		Average	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	-0.1268	(-1.23)	1996	85	335	0.3314	0.2504
Georgia	0.0133	(0.22)	2006	1,658	713	0.2476	0.2621
Illinois	-0.0816	(-1.28)	2009	2,917	748	0.5796	0.6028
Alabama	-0.0520	(-0.47)	2011	430	38	0.1541	0.1146
California	-0.1516***	(-3.53)	2011	14,902	2,072	0.5608	0.7809
Massachusetts	0.1125**	(2.05)	2014	4,896	151	0.4677	0.7334
Nebraska	-0.1771	(-1.35)	2014	339	14	0.3406	0.1235

6.5. Cross-Sectional Analysis

While my primary tests indicate that MBS statutes have a negative effect on a firm’s overall innovation level, I next explore which firms are most sensitive to these laws. First, I cross-section on patent-intensity, which I measure two different ways. First, I follow Kile and Phillips (2009) to classify high-technology firms and I create an indicator, High-Tech, if a firm is in a high-technology industry. Next, I use a firm’s industry royalty income, as a higher level of royalty income signifies that a firm is more reliant on the licensing and selling of intangibles, which would be directly impacted by a change in sourcing rules. I obtain royalty income by three-digit NAICS code by year from the Internal Revenue Service's Statistics of Income data from 1998 to 2014. I then create an indicator for firms in the top decile ranking of the royalty income for each year.

Tables 6.14 and 6.15 reports the regressions results for these two cross-sectional tests as both subsamples and three-way interactions. For both measures, the cross-section is significantly negative for when the respective indicator variable is set equal to one, suggesting that firms in high-technology industries, as well as firms with higher industry royalty amounts, are more affected by MBS statutes. This provides reassurance that the firms most expected to be affected by intangible sourcing laws are.

Table 6.14 Market-Based Sourcing and Innovation by High-Tech Industry

Dependent Variable:		$Ln(Patent)_{t+3}$			$Ln(Citations)_{t+3}$			$Ln(Value)_{t+3}$	
Sample:	High-Tech = 0	High-Tech = 1	All	High-Tech = 0	High-Tech = 1	All	High-Tech = 0	High-Tech = 1	All
Post*Treat	0.0118	-0.0901**	0.0282	-0.0094	-0.0337**	0.0001	-0.0152	-0.1264***	-0.0094
	(0.46)	(-2.08)	(1.16)	(-0.96)	(-2.07)	(0.01)	(-0.52)	(-2.59)	(-0.32)
Post*Treat* High-Tech			-0.1626***			-0.0601***			-0.1456***
			(-3.71)			(-4.06)			(-2.95)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	55,328	32,328	87,656	55,328	32,328	87,656	55,328	32,328	87,656
Adj. R^2	0.9124	0.8887	0.9024	0.7012	0.6695	0.6917	0.8834	0.8686	0.8757

Table 6.15 Market-Based Sourcing and Innovation by Royalty Income

Dependent Variable:		$Ln(Patent)_{t+3}$			$Ln(Citations)_{t+3}$			$Ln(Value)_{t+3}$	
Sample:	Royalty = 0	Royalty = 1	All	Royalty = 0	Royalty = 1	All	Royalty = 0	Royalty = 1	All
Post*Treat	0.0217	-0.0951**	0.0517*	-0.0013	-0.0527***	0.0119	0.0002	-0.0971**	0.0353
	(0.69)	(-2.17)	(1.90)	(-0.11)	(-3.37)	(0.99)	(0.01)	(-2.07)	(1.09)
Post*Treat* Royalty			-0.1399***			-0.0577***			-0.1342***
			(-3.92)			(-4.25)			(-3.44)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	27,069	25,507	52,576	27,069	25,507	52,576	27,069	25,507	52,576
Adj. R^2	0.9179	0.9096	0.9139	0.6647	0.6754	0.6781	0.9003	0.8990	0.8998

I next examine the effect that a firm's state tax avoidance has on MBS. Prior literature has documented associations between state tax rates and innovation, where higher tax rates are associated with less innovation (Mukherjee et al. 2017; Atanassov and Liu 2020). Firms that have engaged in greater state tax planning are likely to be more susceptible to MBS laws, as MBS eliminates the benefit from favorably located intangibles in different states. Firms that have engaged in less state tax planning could be more affected by MBS by not having located their intangibles optimally. To test this, I create an indicator variable set to one for firm-year observations with a below median state ETR for that year. In Table 6.16, I find a negative significant coefficient for $Ln(Patent)_{t+3}$ in columns 2 and 3, which suggests that firms that engage in greater state tax planning are more negatively effected by MBS laws. Results for the patent quality tests are more mixed. For $Ln(Citations)_{t+3}$, the first column is negatively significant, which suggests that firms that engage in less tax planning are more affected by MBS laws, but the three-way interaction is insignificant. For $Ln(Value)_{t+3}$, negative significant coefficients across the first two columns suggests that there is no significant difference between the two groups. Overall, this suggests that firms that engage in greater state tax planning exhibit a greater decrease in innovation following the adoption of MBS.

Finally, I examine the extent to which firms have R&D within their headquarter state. If firms locate their patent assignments where their R&D is located, then MBS should be beneficial for firms, as it would increase the likelihood of firms to generate nowhere income. This would lead to an increase in innovation for firms. Conversely, if firms relocate patent assignments away from where the R&D is, then MBS would instead increase the likelihood of firms to have double taxed income, which would restrain innovation. To test this, I create an indicator variable set equal to one if a firm has an above average proportion of their inventors located in the firm's headquarter state. A firm's inventors are likely located where a firm's R&D centers are. An inventor is observable for a firm-year if a patent has been filed with the inventor's name and address on it.

In Table 6.17, I find in my subsample regressions that firms with a greater proportion of their inventors in MBS states have lower quantity of patents and value of patents. However, I find that the decrease in patent citations is in my subsample with a lower proportion of inventors. I find the three-way interaction between Post*Treat and my indicator variable negative and significant. Together these results provide some evidence that firms with a higher proportion of inventors in their headquarter state after the adoption of MBS have a significant decline in both the quantity and quality of innovation. This suggests that where firms locate their innovative activities is separate from where firms locate their intangibles, which can lead to a significant decline in innovation following the adoption of MBS.

Table 6.16 Market-Based Sourcing and Innovation by Median State ETR

Dependent Variable:	Ln(Patent)t+3			Ln(Citations)t+3			Ln(Value)t+3		
Sample:	Low State ETR = 0	Low State ETR = 1	All	Low State ETR = 0	Low State ETR = 1	All	Low State ETR = 0	Low State ETR = 1	All
Post*Treat	-0.0446	-0.1137***	-0.0322	-0.0355***	-0.0004	-0.0362***	-0.1006***	-0.0987**	-0.0929***
	(-1.31)	(-3.13)	(-1.02)	(-2.97)	(-0.02)	(-3.27)	(-2.65)	(-2.48)	(-2.59)
Post*Treat* State ETR			-0.0786**			0.0174			-0.0140
			(-2.10)			(1.07)			(-0.32)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	40,477	23,608	64,085	40,477	23,608	64,085	40,477	23,608	64,085
Adj. R2	0.9146	0.8981	0.9059	0.7057	0.6621	0.6905	0.8959	0.8676	0.8802

Table 6.17 Market-Based Sourcing and Innovation by Inventor Location

Dependent Variable:	$Ln(Patent)_{t+3}$			$Ln(Citations)_{t+3}$			$Ln(Value)_{t+3}$		
Sample:	High Inventor = 0	High Inventor = 1	All	High Inventor = 0	High Inventor = 1	All	High Inventor = 0	High Inventor = 1	All
Post*Treat	0.0003	-0.1476**	0.0079	-0.0156**	0.0008	-0.0018	-0.0053	-0.1925***	-0.0134
	(0.01)	(-2.31)	(0.41)	(-2.27)	(0.03)	(-0.23)	(-0.26)	(-2.71)	(-0.60)
Post*Treat* Inventor			-0.1683***			-0.0799***			-0.1956***
			(-3.40)			(-5.16)			(-3.60)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	68,299	19,357	87,656	68,299	19,357	87,656	68,299	19,357	87,656
Adj. R^2	0.8984	0.8720	0.9026	0.6587	0.6214	0.6919	0.8533	0.8717	0.8760

6.6. Main Results – Patent Assignment Location

My third hypothesis examines whether firms respond to the change in sourcing laws by where their patent assignments are located. Firms may move their patent assignments to capitalize on the variation is sourcing laws across states. Leaving patent assignments in COP states increases the potential for intangible income to become double taxed, and therefore firms are incentivized to move their patent assignments to MBS states. To measure where a firm's patents are located, I use patent assignment locations to create a ratio of the percent of patents located in MBS states each year.

Table 6.18 presents the regression results of MBS on a patent assignments in MBS states. I find a significantly positive effect with and without control variables, which is consistent with firms reacting to the MBS laws by moving patent assignments to states with those laws. This result is important because it suggests that firms are responsive to sourcing laws and MBS diminishes the benefit from assigning patents to tax advantageous jurisdictions, such as Delaware (Dyreng et al. 2013). In Table 6.19, I disaggregate Post*Treat into the seven states that comprise the estimated treatment effect and present information on the number of firm-year observations and average value of the dependent variable. Notably, no states are significant, though five (two) states have positive (negative) coefficients. This suggests the importance of a staggered difference-in-difference model to show the overall effects in aggregate. Overall, I document that MBS laws not only lead to a decline in innovation, but firms respond by moving patents to the states that adopt these laws.

Table 6.18 Market-Based Sourcing and Patent Assignment

Dependent Variable:	MBS Assign Ratio	MBS Assign Ratio
Post*Treat	0.0119*	0.0130*
	(1.71)	(1.75)
SIZE		-0.0007
		(-0.37)
ROA		-0.0055
		(-1.06)
NOL		-0.0020
		(-0.64)
LEV		-0.0052
		(-0.61)
CFO		0.0080
		(1.17)
CAPEX		0.0024
		(0.10)
R&D		-0.0017**
		(-2.33)
ΔR&D		0.0013**
		(2.15)
Tax Rate		-0.0636
		(-0.40)
Sales Factor		-0.0007
		(-0.06)
R&D Credit		-0.0511
		(-0.82)
Addback		0.0153***
		(2.70)
Combined Reporting		-0.0030
		(-0.46)
Budget		0.0055
		(0.64)
GDP		-0.0420
		(-1.21)
Unemployment		-0.0017
		(-0.94)
Zero $Patents_{t+3}$		-0.0010
		(-0.36)
Constant	0.3841***	0.9546**
	(942.51)	(2.08)

Table 6.18 Continued

Dependent Variable:	MBS Assign Ratio	MBS Assign Ratio
Fixed Effects	Firm, Year, State	Firm, Year, State
Observations	45,288	45,288
Adj. R^2	0.9384	0.9386

Table 6.19 Heterogeneous Treatment Effects – MBS Assign Ratio

	DV: MBS Assign Ratio		Year Treated	**Observations**		**Average**	
	Coefficient	T-Statistic		Pre	Post	Pre	Post
Iowa	-0.0787	(-1.39)	1996	36	152	0.9624	0.8999
Georgia	0.0212	(1.02)	2006	698	351	0.7218	0.7292
Illinois	0.0279	(1.52)	2009	1697	477	0.7331	0.7348
Alabama	0.0677	(1.18)	2011	184	12	0.7117	0.7095
California	0.0148	(1.39)	2011	9,332	1,536	0.8347	0.8364
Massachusetts	0.0135	(1.08)	2014	3,414	114	0.8036	0.7965
Nebraska	-0.0194	(-1.07)	2014	141	6	0.6049	0.6096

6.7. Robustness Test – Concurrent State Law Changes

I next provide several tests to help mitigate concerns about the confounding effects of other state tax policy changes. First, as a robustness test, I examine the adoption of market-based sourcing for service income. When all seven treatment states adopted MBS for intangible income, these states also adopted MBS for service income concurrently. A concern could be that the effect is being driven by the adoption on MBS for service income instead of MBS for intangible income. During my sample period, eight other states adopted MBS for service income, but not for intangible income. I use the adoption of MBS for service income for those states as a falsification test to ensure that firm innovation is affected by the change in sourcing of intangible income, not the change in sourcing for service income.

Second, I use the adoption of a single sales factor as a robustness test. Both the weighting and the calculation of the sales factor can affect the sourcing of intangible income. However, the adoption of a single sales factor should not affect innovation without MBS being in place. Specifically, a single sales factor under COP essentially embodies the property and payroll factors. Even with additional weight given to the sales factor, a single sales factor under COP should not significantly affect a firm's innovation. I exploit the staggered adoption of single sales factors across states to test if this does affect a firm's innovation.

Table 6.20 details the results of both of these robustness tests across my different outcome variables. For both falsification tests, I do not find that either of these state laws are associated with a change in firm innovation. Overall, these tests help mitigate concerns about confounding state tax law changes.

Table 6.20 Robustness Test – Concurrent State Law Changes

Treatment:	**Adoption of MBS for Service Income**			
Dependent Variable:	$Ln(Patent)_{t+3}$	$Ln(Citations)_{t+3}$	$Ln(Value)_{t+3}$	MBS Assign Ratio
Post*Treat	-0.0187	-0.0064	-0.0431	0.0086
	(-0.53)	(-0.42)	(-1.07)	(0.77)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	58,242	58,242	58,242	27,119
Adj. R^2	0.9063	0.6865	0.8790	0.8670

Table 6.20 Continued

Treatment:	Adoption of a Single Sales Factor			
Dependent Variable:	$Ln(Patent)_{t+3}$	$Ln(Citations)_{t+3}$	$Ln(Value)_{t+3}$	MBS Assign Ratio
Post*Treat	0.0132	0.0096	0.0118	-0.0043
	(0.76)	(1.42)	(0.51)	(-0.58)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	70,601	70,601	70,601	34,408
Adj. R^2	0.9062	0.6834	0.8756	0.9303

6.8. Robustness Test – Treatment Measures

For my main analysis, treatment is set equal to one if a firm is headquartered in a state that adopts MBS. This measurement assumes that a firm's headquarter state is where a firm has a nexus. I try two different alternate measurements of treatment. First, I identify a firm as treated if the most mentioned state in a firm's 10-K report has adopted MBS. A firm's annual report contains detailed information regarding a firm's financial operations, and the geographic location of a firm's sales, property, and employees. García and Norli (2012) count the number of times a state is mentioned in four sections of the 10-K: "Item 1: Business", "Item 2: Properties", "Item 6: Consolidated Financial Data", and "Item 7: Management's Discussion and Analysis". I use the data provided by the authors, and hand-collect additional observations from Direct Edgar to expand the data to 2014.

Second, I measure treatment if a firm has customers located in a state adopting MBS. Out-of-state firms who have customers in an MBS state are more likely to be exposed to double taxation, having their intangible income taxed both in their home state and in their customer's state. This measure is distinct from the previous headquarter and state 10K mention measures, as those measures capture where a firm locates its intangibles. To measure if a firm has customers in MBS states, I leverage firm significant customer disclosures. Firms are required to disclosure the existence and sales of any customers that represent more than 10 percent of total firm revenues. I set treatment equal to one if a firm has significant customers headquartered in a state that adopts MBS.

Table 6.21 presents the alternate measurements of treatment. For 10K mentions, number of patents, patents citations and patent value are negative and significant. However, the ratio of patents held in MBS states are insignificant. These results help validate using headquarter state as a measurement of treatment. For significant customer disclosures, Post*Treat is not significant for any of the measured outcomes, although it is close for citations (t-stat -1.52, p-value .129) and assignment ratio (t-stat 1.35, p-value .177). These results suggest that there is no significant change in innovation in response to firms having customers located in MBS states. This could potentially be due to firms having nexus and a tax liability in those states, but not one large enough to cause a significant change to firm innovation, and that both firm headquarter and top 10K mention provides a stronger measure of significant nexus.

Table 6.21 Robustness Test – Alternate Measures of Treatment

Treatment:	**Top 10K State Mention**			
Dependent Variable	$Ln(Patent)_{t+3}$	$Ln(Citations)_{t+3}$	$Ln(Value)_{t+3}$	MBS Assign Ratio
Post*Treat	-0.0435*	-0.0298***	-0.0796***	0.0010
	(-1.78)	(-3.08)	(-2.86)	(0.13)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	61,541	61,541	61,541	33,732
Adj. R^2	0.9139	0.7060	0.8963	0.9479

Treatment:	**Significant Customer Disclosures**			
Dependent Variable	$Ln(Patent)_{t+3}$	$Ln(Citations)_{t+3}$	$Ln(Value)_{t+3}$	MBS Assign Ratio
Post*Treat	-0.0103	-0.0246	-0.0474	0.0120
	(-0.23)	(-1.52)	(-0.95)	(1.35)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	21,419	21,419	21,419	12,630
Adj. R^2	0.9043	0.7123	0.8761	0.9564

6.9. Robustness Test – Different Dependent Variable Leads

For my main analysis, I used a three-year lead variable for my innovation quantity and quality outcomes. As discussed earlier, a three-year lead variable better matches the long-term nature of innovation – the adoption of a state law in year t is unlikely to have a significant effect on patents being filed in year t. Following Mukherjee et al. (2017) and Atanassov and Liu (2020), I also show my dependent variables with a zero-, one-, and two-year lead in Table 6.22. To take advantage of the smaller number of lead years for my dependent variable, I also expand my sample up to 2017 to take advantage of additional states adopting MBS and treated firm-year observations.

In Table 6.22, For Ln(Patent), I show a significant positive relation between the adoption of MBS and patent quantity when there are zero lead years. This relation becomes positive and insignificant when there is one lead year, and negative and insignificant for when there is two lead years. These results suggest that my main result is fragile to my design specification. However, there are several reasons that this might not be true. First, it isn't clear ex ante why MBS would have an immediate effect on innovation, given the gradual nature of innovation. Second, This result could be influenced by a low number of observations in recently treated states in those samples.[11] Finally, in untabulated tests with different lead variables with just my original sample from 1992 to 2014, Ln(Patent) is insignificant for zero and one leads, and significantly negative for two leads.

For Ln(Citations), the association between Post*Treat and the dependent variable is significant across all four specifications. For Ln(Value) the relation is insignificant across zero and one leads, but significant for a two year lead. This provides comfort that my measurement of innovation quality is not as fragile to design specification. Overall, this table shows that my results are reliant on choice of a lead dependent variable, but the use of a three-year lead variable is consistent with prior literature.

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[11] For the sample extending to 2017, Rhode Island (2015) has 26 observations in the post period, Tennessee (2016) has 83, Louisiana (2016) has 24, and Connecticut (2016) has 110.

Table 6.22 Robustness Test – Alternate Measures of Treatment

Variable:	$Ln(Patent)_{t+k}$			
	k = 0	k = 1	k = 2	k = 3
Post*Treat	0.0422*	0.0053	-0.0406	-0.0488**
	(1.70)	(0.22)	(-1.60)	(-2.04)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Sample	1992-2017	1992-2016	1992-2015	1992-2014
Observations	96,046	93,332	90,592	87,656
Adj. R^2	0.8353	0.8359	0.8414	0.9022

Variable:	$Ln(Citations)_{t+k}$			
Time:	k = 0	k = 1	k = 2	k = 3
Post*Treat	-0.0307***	-0.0447***	-0.0483***	-0.0284***
	(-3.24)	(-4.69)	(-4.86)	(-3.24)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Sample	1992-2017	1992-2016	1992-2015	1992-2014
Observations	96,046	93,332	90,592	87,656
Adj. R^2	0.5044	0.4937	0.4956	0.6915

Variable:	$Ln(Value)_{t+k}$			
Time:	k = 0	k = 1	k = 2	k = 3
Post*Treat	0.0228	-0.0114	-0.0541**	-0.0785***
	(1.00)	(-0.49)	(-2.13)	(-2.92)
Controls	YES	YES	YES	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Sample	1992-2017	1992-2016	1992-2015	1992-2014
Observations	96,046	93,332	90,592	87,656
Adj. R^2	0.8702	0.8660	0.8630	0.8756

6.10. Robustness Test – R&D

One limitation in my study is that my sample period ends at 2014 and only contains the first seven states to adopt MBS. This limitation is due to using patents as a measure of innovation. To help circumvent this issue, I use R&D as my dependent variable. Doing this allows me to expand my sample to 2019, include ten additional state adoptions of MBS, and have additional post-period observations for my other treated states.

I provide tests using R&D expenditures as the dependent variable in Table 6.23. R&D is measured two ways: as the R&D scaled by lagged sales, and then the natural logarithm of one plus that amount. I additionally control for whether a firm is missing R&D in Compustat. For both versions of the dependent variable, I find that the adoption of MBS is associated with a negative and significant decrease in R&D, relative to firms headquartered in states with COP. This finding it consistent with MBS statutes negatively impacting R&D investment and innovation activities.

Table 6.23 Robustness Test – R&D

Dependent Variable	$R\&D_{t+3}$	$R\&D_{t+3}$	$Ln(R\&D)_{t+3}$	$Ln(R\&D)_{t+3}$
Post*Treat	-0.0933***	-0.0880**	-0.0212***	-0.0188**
	(-2.76)	(-2.33)	(-2.90)	(-2.34)
Controls	NO	YES	NO	YES
Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	84,142	84,142	84,142	84,142
Adj. R^2	0.5432	0.5451	0.6776	0.6798

6.11. Robustness Test – Stacked Difference-in-Differences

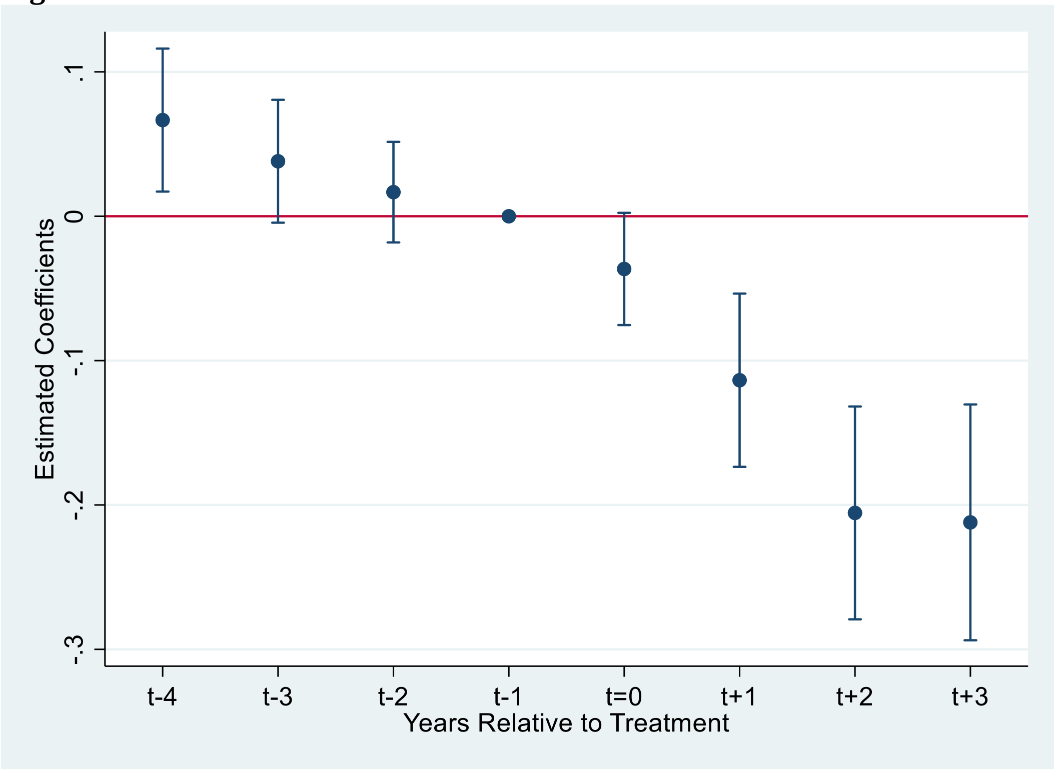
Recent literature evaluating the generalized difference-in-differences design suggests that the estimator does not provide valid estimates of the average treated effect of the treatment group (e.g., de Chaisemartin and D'Haultføeuille 2020; Goodman-Bacon 2021). One remedy suggested for this is employing a "stacked cohort" difference-in-differences design (Baker et al. 2022; Barrios 2021). To accomplish this, I create event-specific datasets that include states enacting MBS in the event year and all other states that do not adopt MBS during my sample. I limited my sample period to four years before and after adoption of MBS. This specification also better accounts for the significant pre- or post- periods for certain states, as few states were treated at the start of my sample.

I replicate my main results using the stacked difference-in-differences design in Table 6.24. Results remain similar to those in previous tables. With this design, I also test the parallel trends assumption to ensure that firms were not reacting to the law prior to its enactment. Figure 6.1 shows the time trend coefficients becoming negative following treatment for Ln(Patents)$_{t+3}$, which helps fulfill the parallel trends assumption.

Table 6.24 Robustness Test – Stacked Difference-in-Differences

Dependent Variable	Ln(Patent)$_{t+3}$	Ln(Citations)$_{t+3}$	Ln(Value)$_{t+3}$	MBS Assign Ratio
Post*Treat	-0.0827***	-0.0238***	-0.0697***	0.0129**
	(-3.89)	(-2.79)	(-3.35)	(2.39)
Controls	YES	YES	YES	YES
Cohort Fixed Effects	Firm, Year, State	Firm, Year, State	Firm, Year, State	Firm, Year, State
Observations	90,377	90,377	90,377	45,346
Adj. R^2	0.9435	0.7053	0.9326	0.9597

Figure 6.1 Parallel Trends Test



6.12. Replication – Atanassov and Liu (2020)

To validate my data and mitigate concerns regarding my use of patents as a dependent variable, I replicate and extend the findings of Atanassov and Liu (2020). Atanassov and Liu examine the effect of corporate income tax rates on corporate innovation. Specifically, the authors exploit significant changes in state tax rates (at least 100 basis points) to test the effect of state tax rates on corporate patent filings. The first three columns of Table 6.25 show that a tax decrease is significantly associated with more patents, a tax increase is significantly associated with less patents, and the combined changes in tax rates are associated with a significant decrease in patents filed.

To replicate Atanassov and Liu (2020), I take my initial sample and first limit it to 2006. Next, I incorporate the same control variables as the authors, following their

Appendix B. The authors measure if a firm is affected by a state if it is the largest state of business for a firm, as measured by the most mentioned state from 10K reports collected by García and Norli (2012). The authors identify eight states with significant tax decreases and ten states with significant tax increases during their sample period of 1988 to 2006 (Atanassov and Liu 2020 Table 1). However, as my sample is starting from 1993, I include only seven significant decreases and five increases.

Columns four through six show my replication of Atanassov and Liu's Table 3A with my data from 1993 to 2006. Similar to the authors, I document a significantly positive association between a significant decrease in state tax rates and patent filings. I do not document a significant relation for either TAXINCR or TAXCHG, although my coefficients are in the same direction the authors' coefficients. The difference may be due to the difference between our samples, as my sample starts in 1993 and five of the ten state tax rate increases occurred between 1989 to 1991. For columns seven through nine, I extend the sample to 2014, which allows me to incorporate additional significant state tax rate changes. With this sample, I continue to document a positive significant relation for state tax rate decreases, and I find a negative significant relation for overall changes in tax rate, which is in line with Atanassov and Liu's findings. Overall, I mostly replicate the findings documented by Atanassov and Liu (2020), which provides additional comfort with my sample selection and patent measures.

Table 6.25 Replication of Atanassov & Liu (2020)

Sample:	**Atanassov & Liu (2020) Table 3A**			**Replication (1993-2006)**			**Replication (1993-2014)**		
Dependent Variable	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$	Ln $(Patent)_{t+3}$
TAXDCR	0.098***			0.0314**			0.0301**		
	(0.032)			(0.015)			(0.013)		
TAXINCR		-0.041**			-0.0029			-0.0096	
		(0.020)			(0.015)			(0.016)	
TAXCHG			-0.048***			-0.0136			-0.0172*
			(0.016)			(0.009)			(0.009)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed Effects	Firm, Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year
Sample Period	1988 - 2006	1988 - 2006	1988 - 2006	1993 - 2006	1993 - 2006	1993 - 2006	1993 - 2014	1993 - 2014	1993 - 2014
Observations	73,065	73,065	73,065	44,119	44,119	44,119	59,512	59,512	59,512
Adj. R^2	0.72	0.72	0.72	0.8488	0.8488	0.8488	0.8277	0.8277	0.8277

Columns one to three are reprinted from Atanassov and Liu (2020) Table 3A columns one, three, and five.

7. CONCLUSION

This study examines whether the adoption of market-based sourcing statutes by U.S. states affects corporate innovation. MBS requires firms to source intangible income to where the benefit is derived, instead of where the intangible is held, which changes what state a firm's intangible income is sourced to. Intangible income may become exposed to double taxation, as well as the potential to not be taxed at all. Firms may be able to take advantage of the variation across state sourcing laws or may have their tax planning constrained by no longer being able to determine where income is sourced. As a result, the projected net present value of patents and innovation may change.

I first find that MBS is associated with increased state corporate tax revenue collections, which suggests that MBS does lead to an increase in taxes on firms. I next directly examine the effect of MBS on firm innovation and find that the adoption of MBS statutes has a negative effect on firm innovation. Specifically, the number of patents treated firms filed decreased by 4.76 percentage points and the number of patent citations decreased by 2.8 percentage points, which is economically significant and similar in magnitude in recent studies on state tax policies and innovation (Mukherjee et al. 2017; Atanassov and Liu 2020). Following prior studies on state taxes and innovation, this finding suggests that MBS leads to an increase in the marginal tax rate on intangible income, which then decreases firm innovation. Upon disaggregating the Post*Treatment variable by adopting state, I find the effect I document is concentrated in mainly California for both the change in patent quantity and quality. While this may limit the generalizability of the results documented in the study, California is home to a large number of innovative firms that are more susceptible to sourcing rules and still provides important insight on how sourcing laws can affect firms. Finally, I document that a firm's proportion of patents in states that adopt MBS increases as well, in line with firms mitigating the risk of intangible income becoming double taxed and maximizing the change to have income be taxed in no states.

In additional analysis, I find that my results are stronger for patent-intensive firms, firms that engage in higher state tax planning, and firms with a greater proportion of inventors located in their headquarter state. My results are robust to alternate state tax law shocks, measures of treatment, dependent variables, and regression design choices.

Overall, I find that the adoption of MBS statutes has a significant negative effect on corporate innovation. This finding contributes to the literature on market-based sourcing and has important implications for domestic policy makers by documenting unintended consequences resulting from MBS policies. This study also contributes to the literature on taxes and innovation by examining a tax policy that specifically targets innovation, but not intended to affect innovation. Whereas prior literature shows that changes in tax rates as well as tax laws restricting income shifting can affect innovation (e.g., Mukherjee et al. 2017; Atanassov and Liu 2020, Li et al. 2021), this study shows that other state tax laws, such as state sourcing laws, can also be important determinants of firm innovation. Finally, this study is important for international policy makers looking to adopt new revenue sourcing rules, as those laws may have implications for the level and location of firm innovative activities.

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APPENDIX A

ADOPTION OF MARKET-BASED SOURCING STATUTES FOR INTANGIBLE INCOME ACROSS STATES

State	**Market Based Sourcing Statute**	**State**	**Market Based Sourcing Statute**
Alabama	1/1/2011	Montana	1/1/2018
Alaska		Nebraska	1/1/2014
Arizona		Nevada	
Arkansas		New Hampshire	
California	1/1/2011	New Jersey	7/31/2019
Colorado	1/1/2019	New Mexico	1/1/2020
Connecticut	1/1/2016	New York	
Delaware		North Carolina	1/1/2020
Florida		North Dakota	
Georgia	1/1/2006	Ohio	
Hawaii	1/1/2020	Oklahoma	
Idaho	1/1/2022	Oregon	1/1/2018
Illinois	1/1/2009	Pennsylvania	
Indiana	1/1/2019	Rhode Island	1/1/2015
Iowa	3/1/1996	South Carolina	
Kansas		South Dakota	
Kentucky	1/1/2018	Tennessee	1/1/2016
Louisiana	1/1/2016	Texas	
Maine		Utah	
Maryland		Vermont	1/1/2020
Massachusetts	1/1/2014	Virginia	
Michigan		Washington	
Minnesota	1/1/1987	West Virginia	1/1/2022
Mississippi		Wisconsin	
Missouri	1/1/2020	Wyoming	

Notes: Data collected from Checkpoint. When Checkpoint does not disclose the year of adoption, I further check the relevant state's tax code.

APPENDIX B

COP & MBS EXAMPLES

Firm A is located in State X and State Y and licenses intangibles to customers in both states. Both states have a 5% corporate tax rate. Firm A has the following fact pattern below:

State	Tax Rate	Intangible Location Sales	Customer Location Sales	Property	Payroll
X	5%	90%	10%	90%	90%
Y	5%	10%	90%	10%	10%

Firm A's apportionment to the two states, assuming both states use a three-factor apportionment model (sales, property, and payroll), would be the following:

	Cost of Performance	Market Based Sourcing
State X	(90% + 90% + 90%)/3 = 90%	(10% + 90% + 90%)/3 = 63%
State Y	(10% + 10% + 10%)/3 = 10%	(90% + 10% + 10%)/3 = 37%

With both states having the same tax rate, shifting from COP to MBS does not change a firm's overall tax burden, but instead changes which state Firm A's income is apportioned to. However, if both states used a single-sales factor apportionment model instead of a three-factor apportionment model, the apportionment to each state would then be the following:

	Cost of Performance	Market Based Sourcing
State X	90%	10%
State Y	10%	90%

Like with three-factor apportionment, a shift from COP to MBS with single-sales factor apportionment shifts where a firm's taxable income is being apportioned. However, the shift of apportioned income to from State X to State Y is more dramatic.

Example 2

Using the same fact pattern as example 1, instead allow the two states to not have an identical state tax rate. Below, let State X have a 10% tax rate, State Y have a 5% tax rate, and Firm A to have $100 of taxable income:

State	Tax Rate	Intangible Location Sales	Customer Location Sales	Property	Payroll
X	10%	90%	10%	90%	90%
Y	5%	10%	90%	10%	10%

Firm A then has the following taxes owed in States X and Y, depending on the sourcing and apportionment rules:

Three-Factor Apportionment		
	Cost of Performance	Market Based Sourcing
State X	(90%*100)*.1 = 9	(63%*100)*.1 = 6.3
State Y	(10%*100)*.05 = .5	(37%*100)*.05 = 1.85
Total Tax	9.5	8.15
Single Sales Factor Apportionment		
	Cost of Performance	Market Based Sourcing
State X	(90%*100)*.1 = 9	(10%*100)*.1 = 1
State Y	(10%*100)*.05 = .5	(90%*100)*.05 = 4.5
Total Tax	9.5	5.5

As MBS shifts Firm A's income from State X to State Y, Firm A benefits with a reduction of state income tax owed. This reduction is magnified by states only having single sales factor apportionment. If State X instead had a lower tax rate than State Y, then the opposite effect would occur: Firm A's state tax liability would increase from MBS shifting its income out of State X to State Y.

Example 3

Both previous examples assumed that both State X and State Y used the same sourcing methodology, either COP or MBS. In my main sample, only seven states have adopted MBS for intangibles, and as of 2022, only twenty-five states have, so the assumption that both State X and State Y have identical sourcing methodologies is unlikely to be true. One state having COP and another state having MBS can have therefore dramatically different effects on a firm.

Assume Firm A locates its intangibles in State X and it licenses an intangible to a customer in State Y. State X uses COP, while State Y uses MBS. Under COP, State X would include the royalties from the patent license in its calculation of its sales factor, as the patent was located in the state. However, under MBS, State Y would also include the royalties from the patent license in its calculation of its sales factor, as the customer is located in the state. In this scenario, the patent royalties are now being taxed in both states, and this double taxation would be detrimental to firms.

Alternatively, assume that State X uses MBS, while State Y uses COP. State X would not include the royalties in its sales factor because the customer is not located in the state. State Y would not include the royalties in its sales factor because the patent was not located in the state. As a result, the income is not taxed in either state, which is known as "nowhere" income. States can prevent this by including a throwout statute, which adjusts a state's sales factor to ensure that nowhere income is taxed in a state.

The following table encapsulates the potential ramifications based on the sourcing rules employed by the customer's and the seller's states:

Ramifications of Multiple State Sourcing Methodologies		
	Seller's State - COP	Seller's State - MBS
Customer's State - COP	Income is sourced to the Seller's State.	Income is sourced to neither state **unless** the Seller's State has a throwout law.
Customer's State - MBS	Income is sourced to **both** states.	Income is sourced to the Customer's State.

APPENDIX C

VARIABLE DEFINITIONS

Variable	Definition	Source
Dependent Variables		
Corp Rev / GDP	Quarterly state corporate income tax collections divided by quarterly state gross domestic product.	US Census; Bureau of Economic Analysis
Ln(Corp Rev)	The natural logarithm of one plus the quarterly state corporate income tax collections.	US Census
Ln(Patents)	The natural logarithm of one plus the number of patents filed in the year t+3.	Kogan et al. (2017)
Ln(Citations)	The natural logarithm of one plus the average truncation adjusted citations received by patents filed in the year t+3.	Kogan et al. (2017)
Ln(Value)	The natural logarithm of one plus the total dollar value of patents filed in the year t+3.	Kogan et al. (2017)
MBS Assign Ratio	The ratio of a firm's patents assigned to MBS states divided by total patents in the year t.	USPTO Assignment Dataset
R&D	R&D expenditures scales by sales in the year t+3. Missing R&D expense is set to 0 for all firms.	Compustat
Ln(R&D)	The natural logarithm of one plus R&D expenditures scaled by sales in the year t+3. Missing R&D expense is set to 0 for all firms.	Compustat
Independent Variables		
*Post*Treat*	Indicator variable set equal to one if a firm is operating in a state that has adopted market-based sourcing for intangibles.	CCH; Various
Cross-Section Variables		
High-Tech	An indicator set equal to 1 for firms that are in high-technology industries.	Kile & Phillips (2009) Table 5
Royalty	An indicator set equal to 1 for firms with the top decile ranking of a firm's three-digit industry NAICS code annual royalty income.	IRS Statistics of Income
State ETR	An indicator set equal to 1 for firms with below median state effective tax rates. State ETR is measured following Shevlin et al. (2017).	Compustat

Inventor	An indicator set equal to 1 for firms with a proportion of inventors located in their headquarter state above the annual average ratio.	Patents View
Firm Level Control Variables		
Size	Log of the market value of equity (PRCC_F * CSHO).	Compustat
ROA	Pre-Tax income (PI) scaled by assets.	Compustat
NOL	Indicator variable, which equals 1 if the firm has tax loss carryforward (TLCF) at the beginning of year, and 0 otherwise. Missing values are set to 0.	Compustat
Leverage	Long-term debt (DLTT) deflated by total assets (AT) at the beginning of year t. Missing values are set to 0.	Compustat
CFO	Operating cash flows, computed as operating cash flow (OANCF) deflated by total assets (AT) at the beginning of year t.	Compustat
Capex	Capital expenditures (CAPX) deflated by total assets (AT) at the beginning of year t.	Compustat
R&D	R&D expenditures (XRD) deflated by sales (SALE) in year t-1. Missing R&D expense is set to 0 for all firms.	Compustat
ΔR&D	The change in R&D expenditures.	Compustat
Total States	The number of states mentioned by a firm's annual 10K filing.	García & Norli (2012)
Total Customers	The number of major customers disclosed by a firm.	Compustat
Missing R&D	An indicator set equal to 1 for firms that are missing R&D expense in Compustat.	Compustat
State Level Control Variables		
Tax Rate	State corporate income tax rate.	Tax Foundation; World Tax Bank
Sales Factor	The state's sales factor for its apportionment.	CCH; Giroud & Rauh (2019)
R&D Credits	Weighted average state R&D credit.	Checkpoint; Westlaw; Wilson (2009)
Addback	An indicator variable set equal to 1 if a state has addback statutes in year t, and 0 otherwise.	Li et al. (2021) Appendix B
Combined Reporting	An indicator variable set equal to 1 if a state has combined reporting statutes in year t, and 0 otherwise.	CCH; Dyreng et al. (2013) Table 2

Budget	A state’s total revenue less expenditures, divided by total expenditures.	US Census
GDP	Natural log of a state's GDP.	Bureau of Economic Analysis
Unemployment Rate	The annual average of a state's unemployment rate.	Bureau of Labor Statistics
Population	Natural log of a state’s population.	US Census