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The Influence of Corporate Income Taxes on Investment Location: Evidence from Corporate Headquarters Relocations

Abstract

This study examines the effects of jurisdictions' corporate taxes and other policies on firms' headquarters (HQ) location decisions. Using changes in state corporate income tax rates across time and states as the setting, we find that a one-percentage-point increase in the HQ state corporate income tax rate increases the likelihood of firms relocating their HQ out of the state by 16.8%, and an equivalent decrease in the HQ state rate decreases the likelihood of HQ relocations by 9.1%. Exploiting the unique tax policy features within the state apportionment system lends strong support to the interpretation that taxation drives this effect. Our analyses also demonstrate that state income tax features affect the destination of the HQ move. We contribute to the literature on corporate decision-making by showing how state income taxation affects a real corporate decision that has significant economic consequences for the company and the state.

JEL: *D22;H25;H73*

Keyword: *Corporate Tax Rate; Headquarters Relocation; State Apportionment System*

1. Introduction

Corporate managers and governments engage in complex interactions as managers strive to maximize after-tax value and governments attempt to encourage economic development while simultaneously raising tax revenues. As part of this process, firms often organize their operations to reduce their exposure to higher-tax jurisdictions. Anticipating this response, governments either lower tax rates or implement measures to curb income shifting. Anecdotal evidence suggests that managing corporate tax liabilities is one of the drivers of corporate headquarters (HQ) relocation. For example, the factors cited for General Electric (GE) relocating its HQ from Fairfield, Connecticut, to Boston, Massachusetts, in 2016, included a change from a 9% state tax rate to a lower rate and a negotiated $145 million incentive, in addition to benefits such as being in a vibrant new area in a major city that offered better access to high-tech workers relevant to the firm's new strategic theme (Lohr 2016, Marks 2016). In this paper, we focus on the relation between U.S. states' corporate income tax rates and companies' decision to move their HQ. This investigation is important because a common strategy in many jurisdictions is to employ various tax policies, including tax rates, to retain and/or attract firms.

While HQ relocation is one of many corporate investment decisions, it has at least two unique features that warrant detailed examination. First, it is a discrete investment decision that generally holds the level of investment constant. In other words, relocation does not greatly affect the level of investment because a firm had an HQ before relocation and it will have an HQ after relocation. Other corporate investments (e.g., cross-border acquisitions and foreign direct investment) often conflate changes in both investment levels and location. Studying HQ moves allows us to largely separate the effect of choice of investment location from the level of investment. Second, documenting the effect of a tax policy on the decision to move a firm's HQ (or to keep it in its current location) is challenging because the decision involves many factors, with the corporate income tax being just one. The above example of GE relocating

its HQ highlights an empirical challenge: a firm's decision to move its corporate HQ occurs alongside other corporate policies and is influenced by other state factors, making causal effects difficult to identify.[1]

We address the identification issues associated with examining the relation between jurisdictions' tax policies and HQ expatriations, using tax data from U.S. states. Ljungqvist et al. (2017) and Heider and Ljungqvist (2015) exploit changes in state corporate tax rates across time and across states as quasi-experiments, while controlling for other state tax and non-tax factors.[2] The staggered nature of changes to state corporate income tax provides a set of counterfactuals about how HQ relocations would have occurred in the absence of tax rate changes, which helps us to disentangle the effects of state income tax rates from the other push/pull factors that drive relocation (Heider and Ljungqvist 2015). Our approach is also in the spirit of the seminal paper by Cummins et al. (1996), which employs tax reforms in 14 OECD countries to identify the significant effects of tax changes on investment.

To develop our hypothesis on the effect of changes in the state corporate tax rates on HQ relocation, we assume that prior to any change in the state corporate tax rate, a firm's HQ location is determined by the cost-benefit tradeoffs of being in one location versus another. For example, some firms locate their HQ in a high-tax state in exchange for access to a highly skilled labor force. Firms consider relocating their HQ only when the marginal benefits exceed the marginal costs. Because our empirical strategy regresses changes in HQ locations on shocks to state corporate income tax rates, our design maps well onto the above conceptual framework of disruptions to location equilibrium.

First, using a sample of relocating and non-relocating firms between 1998 and 2018, we establish a strong and robust positive association between state corporate tax rate changes and the likelihood of HQ relocation after including extensive controls for other income-tax-related, economic, and political factors

[1] One of these factors is taxes on bases other than income; prior research suggests that these taxes can influence corporate investment location. Desai et al. (2004) find that higher foreign indirect tax rates faced by U.S. multinationals are associated with lower property, plant, and equipment in U.S. affiliates. Similarly, using Bureau of Economic Analysis data, Robinson (2012) finds a significant negative association between firms' non-income taxes (sales, excise, and property taxes; import/export duties; license fees; and fines) and their ratio of foreign to total sales.
[2] Heider and Ljungqvist (2015) and Ljungqvist et al. (2017) examine the effects of tax rate changes on firms' leverage choices and corporate risk-taking, respectively. We similarly focus primarily on corporate income taxes, even though it is only one of many factors involved in corporate decision-making.

at the firm and state levels.[3] This evidence is robust to the inclusion of firm fixed effects, alleviating concerns that our results are attributable to omitted time-invariant firm characteristics (e.g., industry and governance practices). Economically, the effect is significant: the average marginal effect of a one-percentage-point increase in the HQ state corporate income tax rate increases the likelihood of firms relocating their HQ by 16.8%, and an equivalent decrease in the HQ state rate decreases the likelihood of firm relocations by 9.1%.

We conduct many robustness tests to rule out alternative explanations, including verifying the parallel treads assumption and applying additional fixed effects and other control variables. Although we cannot definitely rule out the possibility that a correlated omitted variable explains our collective results, such a variable would have to be (i) correlated with corporate investment decisions, in particular with HQ relocation choices, (ii) vary systematically with the staggered changes in the state apportionment formula over time, and (iii) cause a systematic difference in the likelihood of relocations among firms with different tax filing requirements. Although we believe that it is unlikely that a correlated omitted factor is responsible for our results, we undertake additional analyses to address the identification assumptions underlying our difference-in-differences framework, which we describe in detail below. These analyses are consistent with our inferences from the main tests.

We exploit features of the state apportionment system to conduct a more nuanced analysis of state tax policy and to provide further support for a causal interpretation of the observed effect. Specifically, we note that the apportionment system allocates corporate income based on inputs (property and payroll) and output (sales). A firm's HQ includes a significant amount of property and payroll, causing its location to alter the allocation of income across states. Over time, states change the factor weights to encourage more

[3] Although an implicit assumption of our analyses is that managers make relocation decision based on changes to statutory tax rates, in our tests, we explicitly incorporate many nuances of the tax system into managers' evaluations of the effects of tax rate changes, as described in further detail below. It is possible that managers consider other measures of tax rates more directly in their HQ relocation decision (Devereux and Griffith 2003, Graham et al. 2017). For example, Devereux and Griffith (2003) argue that relocation decision depends on a weighted average of an effective marginal tax rate and an adjusted statutory tax rate, where the weights depend on the profitability of the investment. Unfortunately, like prior state-level research, data for theoretically stronger measures are unavailable at the firm-state level. However, changes in these measures are likely to be correlated with statutory tax rate changes.

within-state firm activities. Relying on these cross-state and cross-time variations in factor weights, we find evidence that states with low or no weights on property and payroll have a weaker relation between corporate tax rate changes and HQ relocations, consistent with tax rates driving the main results.

Second, states have increasingly added measures to prevent corporations from successfully avoiding state taxes. In typical investment models in the extant literature (e.g., Hasset and Hubbard 2002), capital and labor yield output that is taxed; however, the HQ does not follow the typical model. The HQ is an overhead cost that can be placed in a location separate from directly productive assets. Conventional multi-jurisdictional tax planning would recommend that such assets be placed in jurisdictions with a higher tax rate, not ones with a lower tax rate.[4] Under apportionment systems, tax planning is more nuanced. Separately incorporated subsidiaries *may* not be subject to apportionment, depending on the state's rules. Mintz and Smart (2004) show that income shifting can be facilitated across Canadian provinces by separately incorporating activities within different provinces because tax consolidation is not done in Canada. If the state *requires* consolidation, the firm cannot separately incorporate the HQ and avoid the adverse effects of high corporate tax rates. For states that require consolidation, we find that increasing the tax rate is a stronger predictor of relocation.

We also consider how the size of the firm's existing operations in non-HQ states affects the likelihood of relocation. Greater cross-state distribution can facilitate HQ relocation because existing establishments in other states can serve as a known new home for the HQ, lowering the cost of relocation. Yet, a wide geographic footprint makes a firm's tax liability less dependent on the tax rate changes of any particular state, reducing the benefits of relocating (Gupta and Mills 2002). We find some evidence that having more activities outside the HQ state augments the response to a change in tax rate.

Having established the role of corporate income taxes in the decision to leave a state, we also consider the role of state policies in the location to which the firm moves. Obviously, economic factors such as real gross state product (GSP) growth and industry clusters are important factors in the choice.

[4] See, for example, Hines and Rice (1994), Klassen and Laplante (2012b), Martini et al. (2012), Dharmapala (2014), and De Simone et al. (2017).

Similar to our analyses of expatriations, increases (decreases) in the state income tax rate decrease (increase) the likelihood that the firm will choose a particular state for its new establishment. Lower corporate income taxes overall and lower weight on the property and payroll in the apportionment formula are also associated with choosing a particular state. Firms are also more likely to relocate to a state that has a lower corporate income tax rate than the state the firm is leaving.

This paper makes several contributions to the literature. First, we provide an examination of how taxation policy affects HQ relocation by incorporating features of the state corporate tax system. We exploit staggered changes in state corporate tax rates, and we apply unique HQ relocation data (Heider and Ljungqvist 2015, Ljungqvist et al. 2017). Various settings and field studies empirically examine the relation between taxes and investment location (e.g., Bartik 1985, Papke 1991, Hines and Rice 1994, Chirinko and Wilson 2008, Wilson 1993, Single 1999, Strauss-Kahn and Vives 2009), and in particular, decisions to move particular operations (Williams 2018, Lester 2019).[5] Unlike prior empirical work that uses association-type design choices and often only includes the corporate income tax rate, our research strengthens the identification of the effects of taxation policy on firms' HQ relocation within the United States by capitalizing on specific state income tax components and conducting a more detailed analysis of tax policy instruments. Our findings complement the existing literature on corporate inversions, which often entail greater costs, attract more media attention and regulatory scrutiny, and are mainly driven by U.S. federal tax avoidance (e.g., Desai and Hines 2002, Cloyd et al. 2003, Babkin et al. 2017).[6] Our study highlights that firms strategically choose their HQ location to minimize taxes even within the United States.

Second, our paper adds to the literature on state tax planning, an important issue in its own right. Managers maximize firm value by pursuing opportunities to reduce tax liabilities as long as the expected incremental benefits exceed the incremental cost (Slemrod 2004, Scholes et al. 2014). For example, Petroni and Shackelford (1995) document evidence consistent with property/casualty insurers structuring their

[5] For example, in his study of multinational tax incentives and offshoring of U.S. jobs, Williams (2018) finds a significant association between tax incentives and both the likelihood that a foreign country hosts offshored U.S. jobs and the number of U.S. jobs it hosts.

[6] None of the HQ relocations we study involve inversions to locations outside the United States.

cross-state expansion to mitigate overall state tax and regulatory costs. Dyreng et al. (2013) find that the firms that are the most likely to implement a common Delaware-based state tax avoidance strategy have significantly lower state effective tax rates. Our paper complements this stream of literature by highlighting how state corporate tax rates and other related measures affect HQ location, suggesting that state corporate income tax policy is an effective policy tool in attracting and retaining business more broadly.

Lastly, understanding whether and how corporate taxes affect corporate decisions has important implication for tax policies. At the international level, the European Union is debating a system by which firms would consolidate their European activities into a single tax calculation, with the earnings apportioned among the member states. This so-called Common Consolidated Corporate Tax Base system shares many features with the present state-level system within the United States. Even with an apportionment system, U.S. state governments still adopt various tax rates and structures to retain or attract businesses (Gupta and Hofmann 2003, Cline et al. 2010, Cline et al. 2011, Cohn 2015, Wilson 2015). Our analysis suggests that this system would encourage HQ relocation, but firms would continue to respond to specific features of the tax system and to anti-avoidance measures.

Within the United States, many states are considering raising their corporate tax rates to deal with budget shortfalls due to the Covid-19 pandemic and the associated economic fallout. Our study suggests that states that choose to do so may risk losing business HQ. Where a firm locates its HQ can have significant economic effects on the local community, including job creation and knowledge spillover benefits (Jaffe et al. 1993, Garcia-Mila and McGuire 2002). A recent joint report by the Tax Foundation and KPMG, *Location Matters: The State Tax Costs of Doing Business*, states the following:

> State and local taxes represent a significant business cost for corporations operating in the U.S. and can have a material effect on net operating margins. Consequently, business location decisions for new manufacturing facilities, corporate HQ relocations, and the like are often influenced by assessments of relative tax burdens across multiple states. (Tax Foundation and KPMG 2015, p. 1)

Explicitly evaluating the outcomes of the interactions between components within the state tax apportionment formula, our paper provides timely and comprehensive evidence of state tax planning via HQ relocations.

2. Hypothesis Development

Klassen and Shackelford (1998), Dyreng et al. (2013), and the Tax Foundation and KPMG (2015) provide useful background for multi-jurisdictional tax planning at the state level. Briefly, when firms expand their operations into multiple states, state taxation becomes more complex because firms are subject to taxation in each state where they have a presence. Further, each state has its own set of tax policies and rates on the income earned within its borders. Therefore, each state computes and collects tax on the share of the profits earned from activity within its borders.

A key structural feature of state corporate income tax in the United States is the apportionment formula used to attribute multi-state firms' income among the jurisdictions in which they have nexus (Gupta and Hofmann 2003, Tax Foundation and KPMG 2015). A corporation's business income is apportioned among states according to the portions of its sales, payroll, and property in each state. In theory, these factors fairly reflect the income attributable to activities in each state. Specifically, a multi-state firm's income tax payable x in state i is computed by the following formula (ignoring state-specific credits):

$$x_i = \left\{\left[\left(w_i^S \times \frac{s_i}{S}\right) + \left(w_i^L \times \frac{l_i}{L}\right) + \left(w_i^P \times \frac{p_i}{P}\right)\right] \times \pi\right\} \times r_i, \quad (1)$$

where π is the firm's U.S. taxable income; r_i is the statutory corporate tax rate in state i; s_i, l_i, and p_i are, respectively, the firm's sales, payroll, and property in state i; S, L, and P are the firm's total sales, payroll, and property, respectively; and w_i^S, w_i^L, and w_i^P are the factor weights in state i for sales, payroll, and property, respectively, and these weights sum to one.[7] Thus, the term in square brackets is the percentage of a firm's income taxable in state i and the term in curly brackets is the firm's income taxable in state i. Note that empirically, for all states,

$$w_i^L = w_i^P = \frac{1}{2}\left(1 - w_i^S\right). \quad (2)$$

Substituting Equation (2) into Equation (1) leads to the following equation:

[7] We provide a more detailed discussion of these factors in the next section.

$$x_i = \left[w_i^S \times \frac{s_i}{S} \times \pi + \frac{1}{2}\left(1 - w_i^S\right)\left(\frac{l_i}{L} + \frac{p_i}{P}\right) \times \pi \right] \times r_i . \quad (3)$$

Because a state's tax is based on Equation (3), a firm can lower its state tax liability by relocating its HQ to a state with a lower tax rate. First, assuming that state *i* has a high tax rate, relocating the HQ out of state *i* decreases the proportion of a firm's payroll and property in the state, $\frac{l_i}{L} + \frac{p_i}{P}$. With all other terms within the square brackets being held constant, this move will decrease the percentage of a firm's income that is taxable at a high tax rate, r_i, as well as decrease the amount of state taxes the firm pays, assuming the destination state, *j*, has a lower tax rate.[8] In sum, given the apportionment formula, it is clear that even if a firm is already operating in state *i* (e.g., selling goods and services to residents of that state), corporate HQ location in state *i* is strongly related to the firm's state *i* tax liability. The question, however, is whether the income tax is sufficient to alter firms' HQ location at the margin.

The key objective of our study is to examine how changes in corporate taxes in the state where the HQ is located influence relocation. The simple framework guiding our analysis is as follows. With regard to a firm's HQ location in the current state, we assume that the firm takes into account the costs and benefits that arise from all relevant factors (e.g., the availability of a labor force to staff its HQ, wages, proximity to its suppliers and customers, and taxes). At one point, the firm is in an "optimal" HQ location and subsequent factors have not evolved and overcome the costs of relocation. We then rely on changes in corporate tax rates in the current state to identify relocation decisions that are likely to be caused by the mechanics of the state corporate income tax system. We argue that a change in the HQ state corporate tax rate alters firms' equilibrium HQ location choice, providing a catalyst for firms, especially those that are more sensitive to the state tax burden in their HQ state, to either consider a potential HQ relocation if the rate increases or to

[8] The effect of HQ relocation on the proportion of a firm's sales, s_i/S, is ambiguous because the effect of HQ location on state sales is contingent on many factors, including whether the state is an important market for the firm and whether a firm's HQ location affects customer goodwill.

be more likely to remain in place if the rate decreases.[9] In terms of Equation (3), we note that the derivative of x_i with respect to r_i is positive. Hence, our hypothesis, stated in alternative form, is as follows:

> *When there is an increase (decrease) in state corporate tax rates, firms are more (less) likely to relocate their corporate HQ out of the state.*

3. Empirical Design

3.1. Sample Selection

We select our sample based on several criteria. First, to identify corporate relocations within the United States, we determine HQ location by the disclosed business address on firms' annual 10-K filings. We obtain these data from Professor Bill McDonald's website. While the data include all filings from 1994 to 2018, the Securities and Exchange Commission did not require online filing until May 1996 and data availability is limited for control variable construction in earlier years; therefore, our sample period begins with 1998.[10]

To be included in the sample, each firm-year observation is required to have financial information available in the Compustat database and the necessary state-level information available from a variety of sources, such as the Bureau of Economic Analysis and state government websites. We further restrict the sample to non-financial firms (SIC 6000–6999). We thus have a final sample of 9,913 firms and 87,881 firm-year observations for our sample period. We obtain the data on changes in state corporate income tax rates from Heider and Ljungqvist (2015) and Ljungqvist et al. (2017), which are supplemented with our own manual search.[11] Table A1 in the internet appendix presents a list of states that changed their corporate tax rates and the number of firms (within our sample) in each state when the changes occurred.

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[9] As noted in the introduction, the fact that many migration factors exist and might be unobservable or not measurable by the researcher could result in significant endogeneity concerns. A firm chooses the location of its HQ based on several possibly correlated factors. Hence, relying on an analysis that focuses on a disruption to the location equilibrium and controlling for observable factors helps to mitigate such concerns.

[10] https://sraf.nd.edu/data/augmented-10-x-header-data/. To determine the location of a firm's headquarters, all of the fields appearing in the headers on 10-K forms (including 10-K405, 10KSB, and 10KSB40 forms) were parsed. The Edgar online filing system was gradually phased in from 1994 to 1998. We do not use location data from Compustat because Compustat backfills the address of a firm's current HQ location for previous years.

[11] To identify the changes, Heider and Ljungqvist (2015) use data obtained from the Tax Foundation, the *Book of the States*, via a search of the "Current Corporate Income Tax Developments" published in the *Journal of State Taxation*,

3.2. Empirical Design and Identification

We use a difference-in-differences approach to identify the effect of corporate tax rate increases on HQ relocation. We examine the effect of a state's corporate tax rate changes in year $t-1$ on a firm that relocates its HQ out of the state the following year.[12] We lag all of our independent variables by one year to mitigate the concern that corporate relocation decisions may drive tax policy changes. To the extent that firms relocate in anticipation of a tax rate increase or take more than one year to complete a relocation after the tax rate increases, the likelihood of a significant association between corporate tax rate changes and HQ relocation is reduced. Following Heider and Ljungqvist (2015) and Ljungqvist et al. (2017), we specify a difference-in-differences regression in the following form:

$$HQ\ Relocation_{i,s,t} = \beta_0 + \beta_1 \Delta HQ\ Corporate\ Tax\ Rate_{s,t-1} + \Delta Controls_{i,s,t-1} + FE + \varepsilon_{i,s,t} \quad (4)$$

where i, s, and t index firms, states, and years, respectively, and $HQ\ Relocation_{i,s,t}$ is an indicator equal to 1 if a firm relocates its HQ to another state between years $t-1$ and t, 0 otherwise. Note that relocation is, by construction, a change variable. Our independent variable of interest is the change in the firm's HQ state corporate income tax rate from year $t-2$ to year $t-1$ ($\Delta HQ\ Corporate\ Tax\ Rate_{s,t-1}$). The coefficient ($\beta_1$) tests the hypothesis and measures the effect of changes in state corporate tax rates on the likelihood of relocation. $\Delta Controls_{s,t-1}$ denote a vector of state-level and firm-level control variables measured in changes from year $t-2$ to year $t-1$, and FE denotes industry and year fixed effects (Heider and Ljungqvist 2015, Ljungqvist et al. 2017). We cluster standard errors at the state level according to the state where the HQ is located in year $t-1$.[13] We use a linear probability model to better accommodate higher dimensional fixed effects, but we also report marginal effect estimates using a logit model in our robustness tests.

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and from state codes accessed through Lexis-Nexis. In states with more than one tax bracket, Heider and Ljungqvist (2015) report the change to the top bracket. Following their approach, we extend the sample period to 2018.

[12] It is important to note that a firm may already expect the tax change prior to year $t-1$ because of previous deliberations about it. We focus on the year of the actual change in corporate tax rates to be consistent with Heider and Ljungqvist (2015) and to avoid having to make a judgment about the likelihood of a change's passage based on deliberations.

[13] Our results remain robust if we cluster standard errors at the firm level or at both the firm and year levels. We report our main results using alternative clustering in the internet appendix.

A major advantage of our design is that it mitigates bias due to omitted correlated variables because relocation decisions might be endogenous to correlated factors. In addition to first differencing, staggered changes in corporate tax rates across states help to create a set of counterfactuals (i.e., matched firms that experience different tax amounts, including no change to corporate tax rates). These counterfactuals allow us to better test our hypotheses of how "tax shocks" to HQ state corporate tax rates affect relocation decisions. Fixed effects also help to mitigate concerns that our results might be affected by various time- and industry-invariant factors that are omitted. Hence, there are fewer endogeneity concerns with our research design than with a regression specification that examines location characteristics and the level of corporate tax rates (e.g., Strauss-Kahn and Vives 2009).

Nevertheless, we recognize that changes in corporate tax rates are not random and hence are not pure shocks to the equilibrium HQ location decision. For example, such changes might be correlated with other economic factors that could drive relocation decisions. To further address concerns about endogeneity, we include an extensive array of controls that could be associated with changes in state tax rates and corporate HQ relocation. Specifically, we control for various other state tax policies that might coincide with changes in state corporate tax rates, state economic situation, and industry- and firm-level factors.

3.3. Measurement of the Control Variables

States may change tax rates in response to changes in local economic conditions. Specifically, states may change their corporate income taxes because of local demand shocks or other changes in their economic conditions. However, the benefits of being in the state may offset such changes. To the extent that economic conditions also affect firms' relocation propensity, any observed correlation between taxes and the likelihood of relocation could be spurious. To mitigate this concern, we control for changes in state-level economic conditions using the state-level real GSP growth rate (Δ*Real GSP*).

While we focus on changes in corporate tax rates to determine the causal effect of tax rates on HQ relocation, concurrent changes to other state tax policies may possibly drive changes to corporate tax rates as well as corporate relocations. For example, a few states changed the state appointment formula during our sample period, and the possibility exists that firms relocated in response to this policy, which happened

to be correlated with changes in corporate tax rates. Thus, we control for changes in the weight on the sales factor in the state apportionment formula (Δ*Sales Factor Weight*). Furthermore, we control for the statutory tax rate differential with neighboring states (Δ*Bordering States Tax Diff*), as a state's business environment might be affected by "beauty contests" with neighboring states. Ljungqvist et al. (2017) show that states differ in their tax loss-offset provisions. For example, as of 2011, about a third of states allow firms to offset current losses against income earned in the past two or three years, and all states allow firms to carry current losses forward for periods ranging from 5 to 20 years. We define the variables Δ*Carryforward* and Δ*Carryback* as measuring the changes in carryforward and carryback periods, respectively. In addition, we control for additional features of the state tax system including the presence of anti-avoidance measures such as unitary combined reporting with addback rules (Δ*Both Combined & Addback*) and throwback or throwout rules (Δ*Throwback-throwout*).[14]

Some states implement a business receipt tax in lieu of or in conjunction with corporate income tax. To understand the sensitivity of our results to alternative forms of corporate taxation, we manually search various state government websites to identify any implementation of a gross receipt tax over the sample period. We identify 21 states that are implementing or once implemented business receipt tax during our sample period. A business receipt tax might be specified by industries or by gross revenue. For example, Washington implemented different business receipt tax rates for its retail, wholesaling, manufacturing, and servicing industries. California implemented a business receipt tax solely based on gross revenue regardless of industries. We define the *Gross Receipt Tax* dummy as 1 if a state implemented some form of a business receipt tax in year *t* and use lagged changes in the regressions.

While changing the corporate tax rate is a policy dial that state governments can turn to attract or retain corporate business (typically focused on non-HQ activities), other policies can be made to increase

[14] We obtain historical information about state tax characteristics, including factor weights, the use of combined or separate filing, and the use of addback rules from several sources, including state government websites, the Tax Foundation, Tax Analyst, and Wolters Kluwer CCH. The information on factor weights is obtained from http://tax.cchgroup.com/onlinestore/productimages/vol1-pages489-505.pdf. Over our sample period, nine states change their factor weights, with all of the changes increasing the weight on the sales factor.

state business friendliness. We measure the overall state business environment by the business friendliness index developed by CNBC. The business friendliness index is a composite index that evaluates states' legal, regulatory, and overall economic climates for businesses and individuals.[15] We hand-collected the state-year-level data from the business friendliness index for our sample period.[16] We take the business friendliness index as a composite measure that encompasses both the quantitative and qualitative aspects of business environments that investors might value, in addition to the specific social and economic controls in the regression. In addition to the business friendliness index above, we include the state governor's party affiliation as another variable to capture the overall state business environment. *Democratic Governor* is an indicator that takes a value of 1 if the state governor is a Democrat.

We control for other non-income tax corporate policies or subsidies that might affect corporate relocation decision.[17] We include variables for job creation tax credits (Δ*Job Creation Tax Credit*), job training subsidies (Δ*Job Training Subsidies*), R&D tax credits (Δ*R&D Tax Credits*), and investment tax credits (Δ*Investment Tax Credits*). We also include other sources of state tax revenue. In particular, we control for property tax abatement (Δ*Property Tax Abatement*), the personal income tax rate (Δ*Personal Tax Rate*), and the capital gains tax rate (Δ*LT Capital Gain Tax Rate*).[18]

[15] The index is based primarily on publicly available data from federal government databases. Where government statistics are not available, CNBC seeks neutral and/or ideologically diverse data sources to prevent ideological bias.

[16] One limitation of controlling the business friendliness index is that this information is not available for the sample period before 2007 or for Washington DC. In our regressions, we impute the missing observations as 0 and define *Friendliness Missing* to indicate missing observations in the variable to control for potential bias. Our results are robust to restricting the sample with non-missing *Business Friendliness* information (untabulated).

[17] State governments sometimes offer firms inducements as a means of attracting or keeping business activities in the state (Cline et al. 2010, 2011). For example, in 2009, Michigan offered General Motors $2.1 billion in tax credits over a 20-year period to encourage within-state investment and job creation (Livengood 2015). Mattera et al. (2013) show that 16 of the Fortune 50 companies received inducements from state and local governments. We hand-collect information on firm-specific packages provided by state governments from the Good Jobs First's Subsidy Tracker database (www.goodjobsfirst.org). A total of 1,091 sample firms received special tax treatments or subsidies from state or local governments at some point during our sample period. In untabulated results, we find that firms are significantly less likely to relocate when they receive firm-specific state benefits, and our conclusions are not affected by controlling for firm-specific state benefits.

[18] For some of the state tax features included (*Job Creation Tax Credit*, *Job Training Subsidies*, *R&D Tax Credits*, *Investment Tax Credits*, or *Property Tax Abatement*), we are not able to obtain information for some states due to data availability. The number of observations with missing state tax features accounts for about 12% of our sample. In the regressions, we impute the missing state tax features as 0 and control for potential bias by including *State Tax Features Missing*, a dummy variable that equals 1 if *Job Creation Tax Credit*, *Job Training Subsidies*, *R&D Tax Credits*, *Investment Tax Credits*, or *Property Tax Abatement* is missing, 0 otherwise. In untabulated robustness tests, we find that the results are not sensitive to restricting the sample with non-missing observations in these variables.

Aside from the various state-level controls we discussed above, we control for changes in various firm-level variables that have previously been shown to affect corporate tax decisions (Strauss-Kahn and Vives 2009, Heider and Ljungqvist 2015): Δ*Firm Size* as measured by changes in the log of total assets; changes in growth opportunities (Δ*Market-to-Book*); changes in property, plant, and equipment over total assets (Δ*Capital Intensity*); and changes in revenue (Δ*Sales*). Gupta and Mills (2002) model how expanding operations across states affects state tax liability. They find a curvilinear relationship between the number of cross-state subsidiaries and the state tax liability. Therefore, we include Δ*Multi-State Operations*, which we define as the changes in the natural logarithm of the number of states where the firm has a material subsidiary operation.

We also control for the effects of firm maturation on HQ relocation. We follow Dickinson (2011) and use the cash flows from operations, financing, and investment to distinguish the stages of growth, maturity, and decline. We define three indicator variables, Δ*Growth Stage*, Δ*Mature Stage*, and Δ*Decline Stage*, which respectively indicate firm-years that are entering into one of these three phases of firm lifecycle. To control for changes in HQ relocation likelihood due to the firm's merger and acquisition (M&A) activity, we control for *M&A*, which is an indicator variable that takes a value of 1 if the firm engages in M&A activity in the past three years, and 0 otherwise.[19] Finally, we include *Industry Cluster*, which is an indicator variable that takes a value of 1 if the firm's industry is one of the major industries in the HQ state, to capture the degree to which a state is attractive to companies that are in the same industry as the firm.

In addition to state-level and firm-level controls, we incorporate a combination of fixed effects to further address omitted variables bias. We include industry (3-digit NAICS industry) and year fixed effects to control for cross-sectional variation in the propensity to relocate due to unobservable industry characteristics or macroeconomic trends. For example, industry merger waves could drive corporate HQ to

[19] Our conclusions are not affected if we exclude firm-year observations with recent M&A activity.

relocate, and industry fixed effects would absorb these effects in our estimates.[20] In robustness tests, we further include firm fixed effects to account for potential confounding effects from omitted time-invariant firm characteristics.

4. Results

4.1. Descriptive Statistics

Table 1 presents the number of cross-state HQ relocations over a sample period from 1998 to 2018. We find a total of 1,850 instances of relocations during our sample period, with 966 firms (52%) relocating to lower-tax states. In each year, an average of about 2.11% of sample firms relocated their HQ. These corporate relocations do not appear to be clustered in periods that correspond with merger waves or technology changes. In addition, we manually check every relocation to ensure that we are not capturing corporate inversion. We find that none of the firms in our sample relocated internationally.

Table 2, Panel A provides the descriptive statistics. All the continuous variables are winsorized at the 1st and 99th percentiles. The average change in the corporate tax rate in our sample is about −0.05%, with a standard deviation of 0.5%, suggesting a large variation in corporate tax rates across states and over time. Table 2, Panel B reports the pairwise correlations. Corporate HQ relocation is positively associated with corporate tax rate changes at the 10% level, lending some initial support to our hypothesis.

4.2. Main Results

Table 3 provides the results for the tests of our hypotheses. We progressively add control variables and different fixed effects to our model to assess the sensitivity of our results. Column (1) reports the results for the specification with industry and year fixed effects only. Angrist and Pischke (2009) show that the inclusion of poorly measured control variables might potentially bias the treatment coefficient. To mitigate this "bad control" problem, Column (1) reports the results excluding all control variables, except for fixed effects. Column (2) includes both industry and year fixed effects along with time-varying firm and state control variables. Columns (3) and (4) include industry×year joint fixed effects. Consistent with our

[20] Our results are similar if we use alternative industry classifications such as the Fama–French 48-industry classification or 2-digit SIC codes.

hypothesis that predicts a positive association between the corporate tax rate changes and the likelihood of HQ relocation, we find a positive coefficient on corporate tax rate changes across all columns. Across different specifications, we find that the effect of corporate tax rate changes on relocation likelihood is between 22 and 25 basis points. Given that the sample mean of *Relocation* is 0.022, our estimate suggests that a one-percentage-point increase in the HQ corporate tax rate will lead to an approximately 10% to 13% increase in the likelihood of HQ relocation.[21]

In terms of other state policy characteristics that might affect relocation decision, we find that changes in anti-tax avoidance rules such as combined reporting with addback rules, business friendliness, and job training subsidies affect the probability of an HQ relocation. The estimates in Table 3 show that other firm characteristics affect the likelihood of relocation, including changes in size, growth stage, and M&A activity. More importantly, our main results are robust to the inclusion of these variables. We believe that our main results are unlikely to be driven by an omitted state-level factor, but a few of these factors are also important. While some corporate income tax changes are part of a broader reform package, our data do not suggest that these other features are systematically related to HQ relocation or that they alter the role of the tax rate. Overall, Table 3 provides strong evidence that a change in corporate tax rates will positively affect the likelihood of HQ relocation.

To understand whether the relocation likelihood is symmetric around tax increases vis-à-vis tax decreases, we follow Ljungqvist et al. (2017) and modify Equation (4) by replacing our variable of interest $\Delta HQ\ Corporate\ Tax\ Rate_{s,t-1}$ with two variables measuring the magnitude of a tax increase

[21] We can assess the relative importance of income taxes to businesses' state tax burden by looking at aggregate state tax revenues, as reported in the Census Bureau's Annual Survey of State Government Tax Collections. Across all states and Washington DC, the state corporate income tax revenue for 2019 is $58 billion. This amount accounts for approximately 52% of business-related taxes, which add up to $111 billion in 2019, if we consider business-related taxes to include corporate income tax, alcoholic beverage licenses, amusement licenses, corporations in general licenses, occupation and business licenses, documentary and stock transfer taxes, and severance taxes. The proportion of state corporate income tax revenue to state business-related taxes varies across states, from 0% to 91%, with a mean of 51%. If we expand the denominator to include state taxes on individuals, on which most state taxes are levied, then state corporate income tax revenue accounts for approximately 5.3% of total state tax revenue.

($\Delta Corporate\ Tax\ Rate_{s,t-1}^{(+)}$) or a tax decrease ($\Delta Corporate\ Tax\ Rate_{s,t-1}^{(-)}$) in a firm's HQ state. We report the results in Table 4.

We find that firms are more likely to relocate to other states when corporate tax rates increase, but the relocation likelihood is reduced when the home state reduces its corporate tax rates. In particular, we find that the coefficient on tax increases is positive and significant at the 5% level, suggesting that the relocation likelihood increases following an increase in the state tax rate in the previous year. In addition, we find a statistically significant decrease in the tendency to relocate following decreases in corporate tax rates. The economic magnitude is much larger when the corporate tax rate increases. The coefficient estimates reported in Column (2) of Table 4 suggest that a one-percentage-point tax rate increase or decrease is associated with a 16.8% increase and a 9.1% decrease in the likelihood of HQ relocation, respectively.

4.3. Robustness Tests

First, to further mitigate concerns that our results might be confounded by omitted variable bias, we include firm fixed effects in addition to the industry and year fixed effects in the baseline specifications. The benefit of including firm fixed effects is that it controls for any time-invariant firm characteristics that might have an impact on either changes in tax policy or the likelihood of relocation. We report our findings in Panel A of Table 5. Across all four columns, we continue to find robust results.[22]

Second, we examine whether firms with exposure to different levels of state tax changes exhibit parallel trends before the event to assess the validity of the parallel-trends assumption. The difference-in-differences research design we use makes the crucial assumption that in the absence of an event, the two groups of firms would have continued to exhibit the same trend in the outcome. The parallel-trends assumption facilitates inferences about the causal effect of the event by allowing the unaffected group to be used as a counterfactual against which the affected group can be compared. Following Heider and Ljungqvist (2015) and Ljungqvist et al. (2017), we re-estimate Equation (4) to include the leads and lags of tax increase and decrease indicators covering the six years around any tax changes. We present the results

[22] When we include firm fixed effects, the number of observations is slightly lower because the observations that are either singleton or collinear with firm fixed effects are excluded from estimation.

of this specification in Panel B of Table 5. Consistent with our earlier findings reported in Tables 3 and 4, the results indicate that only tax changes at year $t-1$ are statistically significant. None of the point estimates for the other terms are statistically significant at conventional levels, consistent with the maintained assumption that firms with different levels of exposure to state tax changes exhibit similar or parallel trends. This outcome provides further evidence that changes in HQ state corporate tax rates affect the likelihood of corporate HQ relocation.

In the internet appendix, we discuss and report the results of additional robustness tests, which we briefly discuss here. First, to further address concerns that unobserved changes in local economic conditions might affect the likelihood of corporate HQ relocations for reasons unrelated to the tax change itself, we restrict our sample to firms with an HQ in a border region. We perform an adjacent-county analysis, in which we include only firms with HQ located within 10 miles of state borders on each side. This test exploits the fact that economic conditions are likely to be similar across state borders, while the effects of the tax rate changes stop at the border. We continue to find similar results (Section A1 of the internet appendix). Second, our results are robust to excluding firms that are in either California or New York, both of which may offer many factors unrelated to income tax that firms may find attractive (Section A2). Third, tax policies could be influenced by firms' lobbying efforts. We find similar results when we exclude states with a small number of HQ firms, as the collective lobbying effort of firms in these states is likely to have a greater influence on state tax policy (Section A3). Fourth, we assess sensitivity of our results to alternative econometric specifications. We consider alternative regression specifications such as a logit model or a conditional logit model, alternative clustering of standard errors, and controlling for additional social demographic variables such as labor unionization or years to election (Sections A4-A6).

Overall, we find that these alternative specifications do not affect our inferences concerning the relation between corporate tax rates and HQ relocation.[23]

[23] Our analyses rest on the premise that firms on average reap tax benefits when they relocate to another state. In Section A8 of the internet appendix, we find that our sample firms experience, on average, a reduction in state effective tax rates (ETR) between 0.52 and 0.61 percentage points after their HQ relocation, which is an economically significant decrease given that the state ETR has a sample mean of 5%.

5. Factors Beyond the Corporate Income Tax Rate

5.1. Apportionment Factor Weights on Property and Payroll

Equation (3) indicates that the relation between changes in state income taxes and state corporate income tax rates varies with the weight of the sales factor. The Uniform Division of Income for Tax Purpose Act (UDITPA), introduced in 1957, proposes a three-factor model for apportioning the income of a corporation that is taxable in more than one state: a sales factor, a property factor, and a payroll factor. However, in *Moorman Manufacturing Co v. Bair* [437 U.S. 267 (1978)], the Supreme Court ruled that the three-factor formula was not constitutionally required and that Iowa could use a sales-only formula.

One common critique of equally weighting the three components in the state tax apportionment formula is that it creates a disincentive for capital investment and job creation in the state (Weiner 1999, Tax Foundation and KPMG 2015). Since 1978, many states have increased the weight of the sales factor (and hence reduced weight on the property and payroll factors), with some relying on the sales factor completely. Many states argue that placing less weight on the property and payroll factors provides state tax relief to businesses that have significant property and payroll in the state, thereby rewarding those businesses (Griffith 2014). Consistent with this claim, Goolsbee and Maydew (2000) find that for the average state, cutting the payroll weight from one-third to one-quarter leads to a 1.1% increase in manufacturing employment (see also Goolsbee et al. 2000). Gupta and Hofmann (2003) show that new capital expenditures by corporations in the manufacturing sector are decreasing based on the product of the corporate tax rate and the property factor weight.

In this section, we focus on the interaction between tax rate changes and the level of the factor weights because the role of the factor weights relates directly to the tax rate, as evident from Equation (3). Referring to the state tax apportionment formula, assume that the weight on the sales factor for a state is 100% and that the weights on the payroll and property factors are 0%. Further assume that having the HQ in the state affects the amounts of property and payroll, but not the amount of sales, in the state. In this extreme case, a change in the state corporate tax rate does not alter incentives to change the amounts of property and payroll in the state because the apportionment formula weights for these amounts are zero. In

other words, we predict that the likelihood of HQ relocation is less sensitive to any state tax rate changes in state-years with lower factor weights on property and payroll.

To test the effects of the differing features of the state tax system, we extend Equation (4) by including *Condition*, an interaction between *ΔHQ Corporate Tax* and various other features.

$$HQ\ Relocation_{i,s,t} = \beta_0 + \beta_1 \Delta HQ\ Corporate\ Tax\ Rate_{s,t-1} + \beta_2 Conditon_{i,s,t-1} + \beta_3 \Delta HQ\ Corporate\ Tax\ Rate_{s,t-1} \times Conditon_{i,s,t-1} + \Delta Controls_{i,s,t-1} + FE + \varepsilon_{i,s,t} \quad (5)$$

Because *Condition* is measured at *t*−1, it captures the interaction effect of a pre-existing condition (i.e., existing prior to relocation) and corporate tax rate changes on the likelihood of HQ relocation. From a research design perspective, the use of an exogenous shock coupled with a pre-existing condition facilitates inferences about how this condition moderates the outcome driven by the shock. For this test, *Condition* is the property and payroll factor weight. We create an indicator variable, *Low Property & Payroll Weights*, that is equal to 1 if the sales factor in the state tax apportionment formula at year *t*−1 is more than double-weighted, and 0 otherwise.

The results in Column (1) of Table 6, Panel A show that the coefficient on *ΔHQ Corporate Tax Rate* is significantly positive at the 1% level, suggesting that the tax sensitivity of HQ relocation remains strong for firms headquartered in states with high apportionment weights on property and payroll (*Low Property & Payroll Weights* = 0). Despite the insignificant negative coefficient on the interaction term *ΔHQ Corporate Tax Rate* × *Low Property & Payroll Weights* (*t* = −1.30), we fail to show that the overall effects of state income tax rate changes on HQ relocation is significantly different from zero for firms headquartered in states with low appointment weights on property and payroll ($(\beta_1) + (\beta_2) = 0.0012$, *t* = 0.99). These findings are consistent with our expectation that state tax rate changes play a smaller role for firms with an HQ located in a state that imposes lower weights on property and payroll when calculating taxes. As noted earlier, one key reason that many states place lower weights on the property and payroll

factors is to encourage the within-state location of business activities. Our evidence provides further proof of this tendency.[24]

5.2. State Income Tax Policies Directed at Aggressive State Tax Planning

The application of the state's apportionment formula, represented by Equation (3), varies by state, as noted above. One feature of the apportionment formula is that it may be applied to each legal corporation rather than to the consolidated group. Two common strategies to locate income in low-tax-rate states is to separately incorporate low margin activities, such as the HQ, in high-tax-rate states and minimize cross-state charges, or to separately incorporate high margin activities, such as intangible assets, in low-tax-rate states and maximize cross-state charges.

In recent years, U.S. states have implemented various measures to combat aggressive tax-planning strategies that take advantage of the opportunities offered by state tax rules. For example, many states have implemented combined reporting and expense addback statutes. Combined reporting requires businesses to report the operations of all related entities involved in a single (or unitary) business on a combined basis (i.e., consolidated reporting). Expense addback statutes or "addback" rules require adding back deductions related to the use of single-purpose entities, such as the use of passive investment companies (Fox and Luna 2010). These expenses are typically charged to the HQ. Both anti-avoidance measures are adopted by states aiming to deter aggressive state-level tax-motivated income shifting and hence increase the share of tax revenue from corporate income tax sources (Fox and Luna 2002). We predict that the tax sensitivity of HQ relocation is stronger for firms with an HQ located in state-years with both anti-avoidance measures.[25]

The results of considering these anti-avoidance policies is reported in Column (2) of Table 6, Panel A. The coefficient on the interaction terms *ΔHQ Corporate Tax Rate × Both Combined & Addback* is

[24] In un-tabulated tests, we extend the cross-sectional analysis to tax rate increases and cuts and find that the effect is mainly driven by corporate tax rate increases, meaning that the positive relation between tax rate increases and the departure of the HQ is significantly reduced when low or no weight is placed on property and payroll. In our inbound analysis presented below and in the internet appendix, we explore whether a state's appointment weights on property and payroll and whether the interaction of a state's corporate income tax rate level and its appointment weights on property and payroll have a significant effect on likelihood that a state will be the destination of the HQ move.

[25] We also considered the presence of throwback/throwout rules as another form of anti-avoidance provision in our cross-sectional analysis. The results (untabulated) show that the interaction of state tax rate changes and the presence of throwback/throwout rules in the HQ state does not have a statistically significant coefficient.

positive and significant at the 10% level. Our results suggest that requiring combined reporting and having addback rules increase the sensitivity of firms' tax liability to state corporate tax rate increases. Overall, firms are more likely and willing to relocate when tax rates increase, especially when the state has anti-avoidance rules targeted at forcing combined reporting.[26]

5.3. The Extent of Existing Operations in non-HQ States

The previous two cross-sectional tests focus on features of state tax system. In this section, we examine how the cross-state distribution of existing establishments affects cross-state HQ relocations to deepen our understanding of managerial decision-making in the context of HQ relocation decisions. Having existing activities across more states affects both the costs and benefits of relocating the corporation's HQ. On one hand, greater cross-state distribution can facilitate HQ relocation if the firm has existing establishments in other states that can serve as a known new home for the HQ, which lowers the cost of relocation. On the other hand, a wide geographic spread of operations makes a firm's tax liability less dependent on the tax rate changes of any particular state. In this case, the benefits of relocating are also reduced. Gupta and Mills (2002) model how the expansion of operations across states affects state tax liability. They find a curvilinear relationship between the number of cross-state subsidiaries and the state tax liability. While an HQ relocation is different than a typical cross-state expansion, the broad features should still apply. Hence, the net impact on the likelihood of relocation will depend on the marginal impact on relocation costs and benefits and on tax liability. Thus, the effect of the magnitude of cross-state operations on the relocation likelihood is an empirical question.

We first create an indicator variable, *High Number of Non-HQ States*, that takes a value of 1 if the number of states where the firm has material subsidiary operations is higher than the sample mean in year $t-1$, and 0 otherwise. We use the data reported on the firm's 10-K, Exhibit 21. We report the results of this analysis in Panel B of Table 6. We find that the main effect of this variable is negative and significant at

[26] When we separate tax rate increases and tax rate decreases, the effect of *Both Combined & Addback* is observed only for increases in the tax rate (untabulated), consistent with the results for the factor weights, described above.

the 1% level, suggesting that firms are less likely to relocate if they operate in many states. However, the interaction with the tax rate change is not statistically different from zero.

To further explore the state distribution of operations, we collect the sales and employee distribution across states, which are only available for a subsample of firms. We then create two variables, *High Non-HQ State Sales* and *High Non-HQ Employment*, that equal 1 if the firm's proportion of sales and employment, respectively, outside the HQ state is greater than the sample mean. We use establishment-level data from the National Establishment Time Series (NETS) when estimating Equation (5) with these variables.[27] The coefficients on the main effects of these two alternative proxies are negative, like that on the number of establishments. The interaction of these indicators with the change in tax rate variable have positive and significant coefficients at the 5% level.

Collectively, these results suggest that, absent a tax rate change, firms that have a broader geographic footprint are less likely to relocate their HQ, all else equal. However, some evidence shows that a larger base of operations outside the HQ state may amplify the incentive to relocate that a change in tax rate creates by lowering the cost of the relocation.

6. Inbound Analysis

Our analyses thus far focus on outbound relocations: how a change in the corporate tax rate in the state where the HQ is located affects its out-of-state relocation. An equally interesting question centers on understanding inbound relocations—that is, how a change in the state's corporate tax rate affects firms' HQ relocation to the state. To analyze inbound relocations, we adopt a different research design because of the unique challenges in matching a particular state's tax rate changes with a firm's decision about whether to relocate there. We focus on the same sample of firms that relocate their HQ during our sample period. At each point in time, given that a firm's HQ is already located in either one of the 50 states or Washington DC, each relocating firm can have 50 relocation choices based on various factors, including corporate tax

[27] The NETS database provides detailed employment and sales data at the establishment level; however, our sample size is limited by the availability of our NETS data.

rate changes.[28] In our sample, there were 1,850 relocations during our sample period, resulting in an initial sample of 92,500 (1,850×50) for the inbound analysis. Our dependent variable, *Destination State*, is an indicator variable that takes a value of 1 for the state to which a firm relocates its HQ, and 0 otherwise. We estimate the following firm-state-level linear probability model:

$$Destination\ State_{i,s,t} = \alpha_0 + \alpha_1 Destination\ State\ Tax\ Increase_{s,t-1} + \alpha_2 Destination\ State\ Tax\ Decrease_{s,t-1} + \alpha_3 Destination\ State\ Tax\ Increase_{s,t-2} + \alpha_4 Destination\ State\ Tax\ Decrease_{s,t-2} + Controls_{i,s,t-1} + FE + \varepsilon_{i,s,t} \quad (6)$$

where *i*, *s*, and *t* index HQ-relocating firms, states, and the year of relocation, respectively, and *Destination State Tax Increase* (*Decrease*) is an indicator variable that equals 1 for a destination state corporate income tax rate increase (decrease) in state *s* in years *t*−1 and *t*−2, 0 otherwise. We include the same set of control variables related to state-level tax, economic, and political factors as before.

Table 7 presents the results for the inbound analysis. In Column (1), we find that relocating firms deem a state to be significantly less attractive as a destination state when it increased its income tax rate in year *t*−1. The coefficient of −0.0081 (*t* = −2.14) on *Destination State Tax Increase*$_{s,t-1}$ implies that the probability that a state will be a relocating firm's destination drops by 40.5% after a tax rate increase in year *t*−1. Our results also suggest that state tax increases at year *t*−2 do not have a significant effect on firms' choice of destination state. For state tax decreases, we find that firms' destination state decisions are not affected by state tax decreases at year *t*−1 but are significantly affected by state tax decreases at year *t*−2. The coefficient of 0.0401 (*t* = 3.38) on *Destination State Tax Decrease*$_{s,t-1}$ suggests that a state is twice as likely to become home to a relocating firm after the state decreases its tax rate in year *t*−2. These results are consistent with our premise that state income tax rate changes have a significant influence on firms' HQ location decisions and reinforce our main findings.

In terms of the control variables, we find that the level of the corporate tax rate and the factor weights on property and payroll have significant negative effects on relocating firms choosing the state as

[28] Dyreng et al. (2015) adopt a similar research design in their analysis of U.S. multinationals' choices of foreign holding company locations.

their destination. Our estimate suggests that a one percentage point higher state corporate income tax rate is associated with approximately 9% lower probability of a firm choosing to relocate its HQ to that state. The coefficient on *Destination Property & Payroll Weights* is significantly negative, consistent with our expectation that firms find a state with higher factors weights on property and payroll to be less favorable when it comes to choosing a new HQ location. Not surprisingly, we also find that state economic factors have a strong favorable effect on a state's being a home state. In particular, the coefficients on both state GSP growth rate and industry cluster (i.e., the degree to which a state's major industries match well with the relocating firm) are positive and significant. Among the other state-year characteristics, we find that firms are less likely to call a state home when the state has a Democratic governor, when the neighboring state tax rate differential is higher, or when the state has a throwback or throwout rule. Our results also suggest that the provision of job creation tax credits and job training subsidies are viewed favorably by firms in their HQ relocation decisions.

We next examine whether the relative state corporate rates between origin and potential destination states affect relocation likelihood. *Origin minus Destination State Tax Rate* is calculated as the corporate income rate of the origin state minus that of the potential destination state. Results in Column (2) show that the *Origin minus Destination State Tax Rate* is positively associated with relocation likelihood. In other words, when the relative difference in destination and home state tax rates is greater such that the firm can enjoy more tax savings when moving to the destination state, we find that there is a greater likelihood of the firm moving to that destination state.[29]

7. Conclusion

Corporate HQ relocations have significant economic consequences, not just for the firms themselves but also for the source and destination locations. Motivated by these consequences and the recent focus on corporate HQ relocation across states, we conduct a comprehensive analysis of the

[29] In Section A7 of the internet appendix, we extend the analysis in Column (1) by interacting the *Destination Property and Payroll Weights* with the *Destination State Corporate Tax Rate*, and the analysis in Column (2) by interacting the *Destination Property & Payroll Weights* with the *Origin minus Destination Tax Rate*. In both cases, we find that higher property and payroll weights reduce the attractiveness of the state as a destination for the HQ.

phenomenon of tax-motivated HQ relocations within the United States by relying on exogenous changes in the corporate tax rates of the state where the HQ is located as a quasi-experimental setting. State corporate income tax rate changes, as opposed to changes in other state tax instruments, provide a strong setting for our research question because the staggered changes across time and states allow us to draw strong causal inferences on the effects of HQ state corporate tax changes. More importantly, by focusing on state corporate income tax changes, we can use the state apportionment formula as a theoretical foundation to make cross-sectional predictions that further strengthen identification of the effects of tax changes.

We document strong evidence that plausibly exogenous changes in HQ state corporate tax rates alter the likelihood of cross-state corporate HQ relocation. Further analyses show that the tax sensitivity of HQ relocation is influenced by state income tax apportionment formula and anti-avoidance measures.

We also explore a variety of additional state policies, relating to both corporate income tax and other policies. Among these many policies, we only document that (i) the requirement that corporate income taxes be reported on a combined basis increases the probability of relocating and (ii) job training subsidies reduce the probability of relocating. Including these many policy variables does not alter our main conclusions, and we believe that the tax rate change is not simply a proxy for another state-level factor. For this to be true, a correlated omitted state-level factor would have to differentially affect firms subject to different anti-avoidance measures or those subject to different apportionment rules. Moreover, to explain our cross-sectional results, an omitted state-level shock variable would also have to vary systematically with industry and year (when we control for industry and year fixed effects) and also within firms (when we control for firm fixed effects). Although we believe it is unlikely that a correlated omitted state-level factor is responsible for our results, we acknowledge that we cannot completely rule out this possibility.

Overall, our paper contributes to an improved understanding of the real effect of tax policies. Our findings provide important insights into the economic consequences of state tax changes, which will be of interest to policy makers and state governments, particularly when states have incentives to engage in tax competition to retain or attract firms.

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Appendix A
Variable Definitions

Variable	Definition and Construction
HQ Relocation	Indicator coded as 1 if the firm's headquarters (HQ) relocates to a different state between years $t-1$ and t, 0 otherwise. We obtain historical corporate HQ location information from Professor Bill McDonald's website at https://sraf.nd.edu/data/augmented-10-x-header-data.
Δ*HQ Corporate Tax Rate*	Change in the firm's HQ state corporate income tax rate in percentage points from year $t-2$ to year $t-1$.
Δ*HQ Corporate Tax Rate* $^{(+)}$	Positive change in the firm's HQ state corporate income tax rate in percentage points from year $t-2$ to year $t-1$. A negative change is coded as 0.
Δ*HQ Corporate Tax Rate* $^{(-)}$	The absolute value of negative change in the firm's HQ state corporate income tax rate in percentage points from year $t-2$ to year $t-1$. Positive change is coded as 0.
Δ*Real GSP*	State real GDP growth, measured as the change in state real GDP from $t-2$ to $t-1$, divided by the state's real GDP in $t-2$ times 100 (U.S. Bureau of Labor Statistics).
Δ*Sales Factor Weight*	Change in weight on the sales factor of the firm's HQ state's tax apportionment formula from year $t-2$ to year $t-1$. We obtain historical information on state factor weights from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.
Δ*Bordering States Tax Diff*	Change in the difference between a state's corporate income tax rate and the highest corporate income tax rate of any of its neighboring states (in percentage points) from year $t-2$ to year $t-1$. Historical state tax rates are obtained from the Tax Foundation.
Δ*Carryforward*	Change in the firm's HQ state carryforward period from year $t-2$ to year $t-1$. We obtain historical information on the state carryforward period from Wolters Kluwer CCH.
Δ*Carryback*	Change in the firm's HQ state carryback period from year $t-2$ to year $t-1$. We obtain historical information on the state carryback period from Wolters Kluwer CCH.
Δ*Both Combined & Addback*	*Both Combined & Addback* is an indicator variable coded as 1 if the HQ state-year requires both combined reporting and an addback rule for state corporate income tax purposes. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on state addback rule adoption from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.
Δ*Throwback-throwout*	*Throwback-throwout* is an indicator variable coded as 1 if the HQ state-year adopts either a throwback or throwout rule in year $t-1$. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on state throwback/throwout rule adoption from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.
Δ*Gross Receipt Tax*	*Gross Receipt Tax* is an indicator variable coded as 1 if the HQ state-year imposes a gross receipt tax. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. Data Source: State government websites.

Δ*Business Friendliness*	*Business Friendliness* is the business friendliness index of the HQ state. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. Data Source: CNBC. We impute the missing observations of this variable as 0 in the regressions.
Business Friendliness Missing	Indicator variable coded as 1 if information on the business friendliness index of the HQ state is missing (i.e., for the sample period before 2007 or for Washington DC).
Δ*Democratic Governor*	*Democratic Governor* is an indicator variable coded as 1 if the HQ state governor's party affiliation is Democratic. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions.
Δ*Job Creation Tax Credit*	*Job Creation Tax Credit* is an indicator variable coded as 1 if the HQ state-year enacts tax credits for job creations. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on job creation tax credits from several sources, including state government websites, the W.E. Upjohn Institute for Employment Research, and the National Conference of State Legislatures (NCSL). We impute the missing observations of this variable as 0 in the regressions.
Δ*Job Training Subsidies*	*Job Training Subsidies* is an indicator variable coded as 1 if the HQ state-year provides customized job training subsidies. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on job training subsidies from the W.E. Upjohn Institute for Employment Research. We impute the missing observations of this variable as 0 in the regressions.
Δ*R&D Tax Credits*	*R&D Tax Credits* is an indicator variable coded as 1 if the HQ state-year offers R&D tax credits. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. Historical information on R&D tax credits is obtained from several sources, including Wilson (2009), state government websites, the W.E. Upjohn Institute for Employment Research, NCSL, and Appendix B of Falato and Sim (2014). We impute the missing observations of this variable as 0 in the regressions.
Δ*Investment Tax Credits*	*Investment Tax Credits* is an indicator variable coded as 1 if the HQ state-year offers investment tax credits. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on investment tax credits from several sources, including Wilson (2009), state government websites, the W.E. Upjohn Institute for Employment Research, and NCSL. We impute the missing observations of this variable as 0 in the regressions.
Δ*Property Tax Abatement*	*Property Tax Abatement* is an indicator variable coded as 1 if the HQ state-year offers property tax abatements. Lag changes (from year $t-2$ to year $t-1$) are used in the regressions. We obtain historical information on property tax abatements from state government websites and the W.E. Upjohn Institute for Employment Research. We impute the missing observations of this variable as 0 in the regressions.
State Tax Features Missing	Indicator variable coded as 1 if information on *Job Creation Tax Credit*, *Job Training Subsidies*, *R&D Tax Credits*, *Investment Tax Credits*, or *Property Tax Abatement* is missing.
Δ*Personal Tax Rate*	Change in the firm's HQ state personal income tax rate in percentage points from year $t-2$ to year $t-1$. We obtain historical state tax rates from Daniel Feenberg's website on the National Bureau of Economic Research (NBER) at https://users.nber.org/~taxsim/state-rates.

Δ*LT Capital Gain Tax Rate*	Change in the firm's HQ state long-term capital gain tax rate in percentage points from year *t*−2 to year *t*−1. We obtain historical state tax rates from Daniel Feenberg's website on NBER at https://users.nber.org/~taxsim/state-rates.
Δ*Firm Size*	Change in firm size from year *t*−2 to year *t*−1; firm size is measured as the natural logarithm of total assets. (Compustat: AT).
Δ*Market-to-Book*	Change in the market-to-book ratio from year *t*−2 to year *t*−1; the market-to-book ratio is measured as the market value of equity over total assets, where the market value of equity is defined as [the fiscal year-end closing price × the number of common shares used in earnings per share + the liquidation value of preferred stock + long-term debt + short-term debt − deferred taxes and investment tax credits]. (Compustat: prcc_f × cshpri + pstkl + dltt + dlc − txditc).
Δ*Capital Intensity*	Change in capital intensity from year *t*−2 to year *t*−1; capital intensity is measured as property, plant, and equipment over total assets (Compustat: PPENT).
Δ*Sales*	Change in sales from year *t*−2 to year *t*−1, divided by sales at year *t*−1 times 100 (Compustat: SALE).
Δ*Multi-State Operations*	Change in the natural logarithm of the number of U.S. states where the firm has a material subsidiary from year *t*−2 to year *t*−1. (Form 10-K Exhibit 21).
Δ*Growth Stage*	Indicator coded as 1 if the firm's life cycle reaches the growth stage in year *t*−1 (from the introduction stage in year *t*−2), 0 otherwise. Following Dickinson (2011), a firm-year is considered to be in the growth stage when both its operating and financing cash flows are positive and its investment cash flows are negative.
Δ*Mature Stage*	Indicator coded as 1 if the firm's life cycle reaches the mature stage in year *t*−1 (from growth stage in year *t*−2), 0 otherwise. Following Dickinson (2011), a firm-year is considered to be in the mature stage when operating cash flows are positive and both investment cash flows and financing cash flows are negative.
Δ*Decline Stage*	Indicator coded as 1 if the firm's life cycle reaches the decline stage in year *t*−1 (from the shake-out stage in year *t*−2), 0 otherwise. Following Dickinson (2011), a firm-year is considered to be in the decline stage when operating cash flows are negative and investment cash flows are positive.
M&A	Indicator coded as 1 if the firm engages in merger and acquisition activities in years *t*, *t*−1, and *t*−2, 0 otherwise.
Industry Cluster	Indicator variable coded as 1 if the firm's SIC2 industry is a major industry cluster in state *j* in year *t*−1. A firm's SIC2 industry is a major industry if the proportion of Compustat firms in the industry in state *j* in year *t*−1 is above the sample median.
Low Property & Payroll Weights	Indicator variable coded as 1 if the sales factor in the state tax apportionment formula at year *t*−1 is more than double-weighted, and 0 otherwise. We obtain historical information on state factor weights from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.
Both Combined & Addback	Indicator variable coded as 1 if the HQ state-year requires both combined reporting and an addback rule for state corporate income tax purposes at year *t*−1. We obtain historical information on state addback rule adoption from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.

High Number of Non-HQ States	Indicator variable coded as 1 if the number of non-HQ states (within the United States) in which firm *i* has at least one material subsidiary in year *t* is above the sample median using the firm's 10-K Exhibit 21.
High Non-HQ State Sales	Indicator variable coded as 1 if the aggregate sales volume from non-HQ states for firm *i* in year *t* is above the sample median. Aggregate sales volume is the sum of establishment-level sales for firm *i* in year *t* for establishments located outside of the firm's HQ state from the *National Establishment Time-Series* (NETS), and 0 otherwise.
High Non-HQ State Employment	Indicator variable coded as 1 if the aggregate employment from non-HQ states for firm *i* in year *t* is above the sample median. Aggregate employment is the sum of establishment-level employment for firm *i* in year *t* for establishments located outside of the firm's HQ state from NETS, and 0 otherwise.
Destination State	Indicator variable coded as 1 if the state is the destination state for a firm's new HQ location, 0 otherwise.
Origin minus Destination State Tax Rate	The corporate income tax rate of the origin state minus that of the destination state
Destination Property & Payroll Weights	The combined weight on the property and payroll factors of the firm's HQ state's tax apportionment formula. We obtain historical information on state factor weights from several sources, including state government websites, the Tax Foundation, and Wolters Kluwer CCH.

Table 1. HQ Relocation by Year

This table tabulates the number of firms that engage in HQ relocation across states by year.

Year	*Relocation* = 0	*Relocation* = 1			Total sample	Percent relocating
		Total	Lower tax rate	Higher/same tax rate		
1998	4,818	146	69	77	4,964	2.94
1999	5,100	134	61	73	5,234	2.56
2000	4,967	126	74	52	5,093	2.47
2001	5,012	119	59	60	5,131	2.32
2002	5,104	117	54	63	5,221	2.24
2003	4,782	138	68	70	4,920	2.80
2004	4,526	121	65	56	4,647	2.60
2005	4,547	110	56	54	4,657	2.36
2006	4,409	98	53	45	4,507	2.17
2007	4,138	72	30	42	4,210	1.71
2008	3,965	59	34	25	4,024	1.47
2009	3,874	74	47	27	3,948	1.87
2010	3,745	59	43	16	3,804	1.55
2011	3,646	58	33	25	3,704	1.57
2012	3,547	64	32	32	3,611	1.77
2013	3,479	56	31	25	3,535	1.58
2014	3,551	85	43	42	3,636	2.34
2015	3,550	76	41	35	3,626	2.10
2016	3,355	49	26	23	3,404	1.44
2017	3,070	46	24	22	3,116	1.48
2018	2,846	43	23	20	2,889	1.49
Total	86,031	1,850	966	884	87,881	2.11

Table 2. Descriptive Statistics
Panel A: Summary Statistics

Variables	N	Mean	St. Dev.	Q1	Median	Q3
HQ Relocation	87,881	0.022	0.144	0.000	0.000	0.000
Δ*HQ Corporate Tax Rate*	87,881	−0.047	0.494	0.000	0.000	0.000
Δ*Real GSP*	87,881	−0.001	0.006	−0.001	0.000	0.003
Δ*Sales Factor Weight*	87,881	0.014	0.089	0.000	0.000	0.000
Δ*Bordering States Tax Diff*	87,881	−0.045	0.667	0.000	0.000	0.022
Δ*Carryforward*	87,881	0.029	2.092	0.000	0.000	0.000
Δ*Carryback*	87,881	−0.001	0.248	0.000	0.000	0.000
Δ*Both Combined & Addback*	87,881	0.003	0.054	0.000	0.000	0.000
Δ*Throwback-throwout*	87,881	0.002	0.109	0.000	0.000	0.000
Δ*Gross Receipt Tax*	87,881	0.000	0.001	0.000	0.000	0.000
Δ*Business Friendliness*	87,881	−1.455	6.205	0.000	0.000	0.000
Business Friendliness Missing	87,881	0.554	0.497	0.000	1.000	1.000
Δ*Democratic Governor*	87,881	0.028	0.335	0.000	0.000	0.000
Δ*Job Creation Tax Credits*	87,881	−0.040	0.291	0.000	0.000	0.000
Δ*Job Training Subsidies*	87,881	0.004	0.060	0.000	0.000	0.000
Δ*R&D Tax Credits*	87,881	0.022	0.181	0.000	0.000	0.000
Δ*Investment Tax Credits*	87,881	0.002	0.058	0.000	0.000	0.000
Δ*Property Tax Abatement*	87,881	0.003	0.104	0.000	0.000	0.000
State Tax Features Missing	87,881	0.121	0.327	0.000	0.000	0.000
Δ*Personal Tax Rate*	87,881	0.031	0.441	0.000	0.000	0.000
Δ*LT Capital Gain Tax Rate*	87,881	0.026	0.382	0.000	0.000	0.000
Δ*Firm Size*	87,881	0.070	0.338	−0.058	0.041	0.165
Δ*Market-to-Book*	87,881	−0.132	14.007	−0.595	0.000	0.596
Δ*Capital Intensity*	87,881	−0.015	0.152	−0.025	−0.001	0.014
Δ*Sales*	87,881	0.188	0.776	−0.032	0.045	0.196
Δ*Multi-State Operations*	87,881	0.020	0.417	0.000	0.000	0.000
Δ*Growth Stage*	87,881	0.120	0.325	0.000	0.000	1.000
Δ*Mature Stage*	87,881	0.138	0.345	0.000	0.000	1.000
Δ*Decline Stage*	87,881	0.053	0.223	0.000	0.000	0.000
M&A	87,881	0.387	0.492	0.000	0.000	1.000
Industry Cluster	87,881	0.392	0.616	0.000	0.000	1.000
Δ*Business Friendliness*	51,691	−3.116	10.99	−4.000	0.000	2.000
Δ*Job Creation Tax Credits*	77,251	−0.045	0.310	0.000	0.000	0.000
Δ*Job Training Subsidies*	77,251	0.004	0.064	0.000	0.000	0.000
Δ*R&D Tax Credits*	77,251	0.025	0.193	0.000	0.000	0.000
Δ*Investment Tax Credits*	77,251	0.002	0.062	0.000	0.000	0.000
Δ*Property Tax Abatement*	77,251	0.003	0.111	0.000	0.000	0.000

Notes: This panel reports the summary statistics for the variables used in the regressions. All variables are defined in Appendix A.

Panel B: Correlations

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	*HQ Relocation*															
2.	*ΔHQ Corporate Tax Rate*	0.007														
3.	*ΔReal GSP*	−0.016	−0.001													
4.	*ΔSales Factor Weight*	−0.002	0.015	0.082												
5.	*ΔBordering States Tax Diff*	0.006	−0.073	−0.041	0.002											
6.	*ΔCarryforward*	0.009	−0.018	0.108	0.024	−0.099										
7.	*ΔCarryback*	0.005	−0.003	0.199	0.031	−0.087	0.443									
8.	*ΔBoth Combined & Addback*	0.014	0.003	−0.126	0.054	−0.033	−0.001	−0.179								
9.	*ΔThrowback-throwout*	0.009	0.006	0.049	−0.071	−0.264	0.283	0.098	0.132							
10.	*ΔGross Receipt Tax*	−0.001	0.032	−0.053	−0.034	0.014	−0.084	−0.058	−0.028	−0.036						
11.	*ΔBusiness Friendliness*	0.018	−0.047	−0.018	−0.124	0.033	−0.015	−0.038	0.015	−0.016	0.023					
12.	*Business Friendliness Missing*	0.026	−0.021	−0.001	−0.095	0.041	−0.020	−0.013	0.000	−0.003	0.027	0.837				
13.	*ΔDemocratic Governor*	0.001	−0.003	0.000	0.139	−0.004	0.034	0.038	0.017	0.048	0.035	−0.007	0.019			
14.	*ΔJob Creation Tax Credit*	−0.002	−0.014	−0.004	0.078	−0.042	−0.006	0.005	0.007	0.009	0.012	−0.025	−0.040	0.039		
15.	*ΔJob Training Subsidies*	−0.001	−0.020	−0.009	−0.008	−0.021	−0.014	−0.012	0.000	0.011	−0.003	0.045	0.054	−0.006	0.008	
16.	*ΔR&D Tax Credit*	0.003	0.032	0.001	−0.017	−0.013	−0.004	0.002	−0.006	−0.003	0.022	0.064	0.075	−0.021	0.061	−0.007
17.	*ΔInvestment Tax Credit*	0.009	−0.049	−0.001	−0.001	0.005	−0.009	−0.005	−0.002	−0.007	0.040	0.050	0.056	−0.001	0.054	−0.002
18.	*ΔProperty Tax Abatement*	−0.001	0.003	0.000	0.096	−0.008	0.003	0.004	−0.002	−0.005	0.001	−0.019	0.015	0.003	0.075	−0.002
19.	*State Tax Features Missing*	0.000	0.017	0.029	−0.041	−0.009	−0.009	0.007	0.001	0.019	−0.011	−0.171	−0.222	−0.017	0.051	−0.023
20.	*ΔPersonal Tax Rate*	−0.003	0.063	0.002	−0.032	0.006	0.006	0.004	−0.001	0.007	−0.002	−0.056	−0.037	0.028	−0.129	−0.004
21.	*ΔLT Capital Gain Tax Rate*	−0.005	0.058	0.000	−0.032	−0.002	0.004	0.002	−0.001	0.008	−0.001	−0.066	−0.044	0.021	−0.120	−0.004
22.	*ΔFirm Size*	0.008	−0.007	−0.009	0.008	0.021	0.003	−0.002	0.011	−0.007	0.003	0.026	0.031	0.009	−0.007	0.002
23.	*ΔMarket-to-Book*	0.002	−0.004	0.003	0.001	0.013	0.003	−0.004	0.008	−0.002	0.002	−0.004	−0.006	−0.001	−0.002	0.009
24.	*ΔCapital Intensity*	−0.009	0.002	0.000	0.001	0.007	−0.003	−0.004	0.004	−0.002	−0.003	−0.039	−0.042	−0.008	−0.010	0.003
25.	*ΔSales*	0.015	−0.008	−0.009	−0.005	0.010	−0.005	−0.003	0.012	−0.005	0.004	0.039	0.052	0.009	0.004	0.003
26.	*ΔMulti-State Operations*	0.006	−0.002	0.004	−0.003	0.006	−0.007	−0.006	0.003	−0.002	−0.001	0.045	0.055	0.012	−0.005	−0.002
27.	*ΔGrowth Stage*	−0.015	−0.001	0.000	−0.004	0.001	0.000	0.000	0.000	0.001	0.000	0.017	0.015	0.004	−0.007	0.004
28.	*ΔMature Stage*	−0.015	0.001	0.007	−0.003	−0.002	−0.002	0.001	−0.004	0.000	−0.004	0.007	−0.001	0.000	−0.004	−0.005
29.	*ΔDecline Stage*	0.027	0.000	−0.003	−0.008	−0.001	0.001	0.000	−0.002	0.000	0.002	0.027	0.044	0.002	0.008	0.010
30.	*M&A*	−0.019	−0.002	−0.004	0.005	−0.002	−0.004	−0.008	0.001	−0.003	0.007	−0.012	−0.018	0.003	−0.014	−0.002
31.	*Industry Cluster*	−0.018	−0.020	0.050	0.040	−0.026	0.015	0.049	−0.027	0.014	−0.024	−0.078	0.083	0.018	0.044	−0.010

Panel B: Correlations (continued)

		16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
17.	Δ*Investment Tax Credit*	0.076														
18.	Δ*Property Tax Abatement*	−0.003	−0.001													
19.	*State Tax Features Missing*	−0.044	−0.011	−0.011												
20.	Δ*Personal Tax Rate*	−0.004	−0.010	−0.004	−0.045											
21.	Δ*LT Capital Gain Tax Rate*	−0.004	−0.009	−0.004	−0.050	0.863										
22.	Δ*Firm Size*	0.015	0.007	−0.010	−0.013	−0.009	−0.012									
23.	Δ*Market-to-Book*	0.001	0.002	−0.001	0.004	0.004	0.004	0.024								
24.	Δ*Capital Intensity*	−0.007	−0.001	−0.004	0.022	0.003	0.003	0.248	0.015							
25.	Δ*Sales*	0.015	0.003	0.002	−0.018	−0.011	−0.011	0.299	0.002	−0.012						
26.	Δ*Multi-State Operations*	0.007	−0.001	0.000	−0.010	−0.005	−0.008	0.081	0.005	0.017	0.039					
27.	Δ*Growth Stage*	0.006	0.005	−0.002	−0.003	0.000	−0.001	0.171	0.010	0.114	0.033	0.018				
28.	Δ*Mature Stage*	−0.002	0.005	0.000	0.001	0.000	−0.001	−0.074	0.001	−0.066	−0.031	−0.015	−0.148			
29.	Δ*Decline Stage*	0.005	0.001	−0.001	−0.021	0.005	0.006	−0.150	−0.003	−0.053	−0.004	−0.007	−0.087	−0.095		
30.	*M&A*	−0.013	0.012	0.008	−0.013	0.003	0.005	0.082	0.000	−0.013	0.009	0.021	0.098	0.092	−0.066	
31.	*Industry Cluster*	0.065	−0.012	0.033	−0.142	0.068	0.064	0.011	−0.004	−0.004	0.018	0.012	−0.015	−0.037	0.040	−0.047

Notes: This panel reports the Pearson correlations among the variables used in the regressions. Shaded values are significant at (at least) the 10% level (two-tailed). All variables are defined in Appendix A.

Table 3. Effects of State Corporate Tax Changes on HQ Relocation Likelihood

Dependent variable: *HQ Relocation*

	(1)	(2)	(3)	(4)
Δ*HQ Corporate Tax Rate*	0.0023***	0.0022***	0.0025***	0.0024***
	(3.60)	(4.60)	(3.47)	(4.73)
Δ*Real GSP*		−0.3593**		−0.3673**
		(−2.46)		(−2.55)
Δ*Sales Factor Weight*		0.0042		0.0033
		(0.31)		(0.24)
Δ*Bordering States Tax Diff*		0.0026		0.0028
		(1.31)		(1.35)
Δ*Carryforward*		0.0005		0.0005
		(0.92)		(0.87)
Δ*Carryback*		0.0043		0.0042
		(0.97)		(0.94)
Δ*Both Combined & Addback*		0.0303**		0.0317***
		(2.55)		(2.68)
Δ*Throwback-throwout*		0.0096		0.0098
		(0.99)		(1.03)
Δ*Gross Receipt Tax*		−0.0588		−0.0835
		(−0.43)		(−0.61)
Δ*Business Friendliness*		−0.0002***		−0.0002***
		(−4.79)		(−4.37)
Business Friendliness Missing		0.0328***		0.0336***
		(17.29)		(16.05)
Δ*Democratic Governor*		−0.0007		−0.0010
		(−0.42)		(−0.61)
Δ*Job Creation Tax Credit*		−0.0009		−0.0012
		(−0.64)		(−0.77)
Δ*Job Training Subsidies*		−0.0056*		−0.0065*
		(−1.84)		(−1.89)
Δ*R&D Tax Credit*		0.0207		0.0199
		(1.03)		(0.98)
Δ*Investment Tax Credit*		−0.0013		−0.0005
		(−0.58)		(−0.22)
Δ*Property Tax Abatement*		0.0004		0.0003
		(0.13)		(0.12)
State Tax Features Missing		0.0072**		0.0072**
		(2.03)		(2.13)
Δ*Personal Tax Rate*		0.001		0.0013
		(0.54)		(0.73)
Δ*LT Capital Gain Tax Rate*		−0.0017		−0.0020
		(−1.10)		(−1.31)
Δ*Firm Size*		0.0054**		0.0051**
		(2.57)		(2.42)
Δ*Market-to-Book*		0.0000		0.0000
		(0.40)		(0.50)
Δ*Capital Intensity*		−0.0066*		−0.0073*
		(−1.83)		(−1.97)
Δ*Sales*		0.0012		0.0012
		(1.33)		(1.25)
Δ*Multi-State Operations*		0.0009		0.0009
		(1.22)		(1.30)
Δ*Growth Stage*		−0.0063***		−0.0062***

		(−4.22)		(−4.41)
Δ*Mature Stage*		−0.0053***		−0.0058***
		(−4.21)		(−4.22)
Δ*Decline Stage*		0.0141***		0.0141***
		(4.30)		(4.11)
M&A		−0.0051***		−0.0054***
		(−3.70)		(−3.65)
Industry Cluster		−0.0021***		−0.0021***
		(−3.36)		(−3.15)
Fixed effects	Industry + Year	Industry + Year	Industry×Year	Industry×Year
Observations	87,881	87,881	87,881	87,881
R^2	0.01	0.01	0.03	0.03

Notes: This table reports the coefficient estimates for the tests of hypothesis. We estimate the regression using a linear probability model. Δ indicates lag changes (from year $t-2$ to year $t-1$). For brevity, we do not report fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 4. Tax Increases vis-à-vis Tax Decreases

Dependent variable: *HQ Relocation*

	(1)	(2)
Δ*HQ Corporate Tax Rate* (+)	0.0035**	0.0037**
	(2.50)	(2.53)
Δ*HQ Corporate Tax Rate* (−)	−0.0019**	−0.0020**
	(−2.16)	(−2.33)
Control variables	Included	Included
Fixed effects	Industry + Year	Industry×Year
Observations	87,881	87,881
R^2	0.01	0.03

Notes: This table reports additional analysis on the asymmetry between responses to tax rate changes. We estimate the regression using a linear probability model. Δ indicates lag changes (from year *t*−2 to year *t*−1). Δ*HQ Corporate Tax Rate* (+) is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* (−) is the absolute value of the tax decrease in percentage points. For brevity, we do not report fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 5. Robustness Tests
Panel A: Firm Fixed Effects

Dependent variable: *HQ Relocation*

	(1)	(2)	(3)	(4)
Δ*HQ Corporate Tax Rate*	0.0021***		0.0023***	
	(3.36)		(2.89)	
Δ*HQ Corporate Tax Rate* (+)		0.0036**		0.0038**
		(2.13)		(2.37)
Δ*HQ Corporate Tax Rate* (−)		−0.0016**		−0.0018**
		(−2.36)		(−2.23)
Control variables	Included	Included	Included	Included
Fixed effects	Firm + Year	Firm + Year	Firm + Industry×Year	Firm + Industry×Year
Observations	86,498	86,498	86,495	86,495
R^2	0.18	0.18	0.20	0.20

Notes: This table reports the coefficient estimates for the tests of hypothesis. We estimate the regression using a linear probability model. Δ indicates lag changes (from year *t*−2 to year *t*−1). Δ*HQ Corporate Tax Rate* (+) is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* (−) is the absolute value of the tax decrease in percentage points. We include the set of control variables used in Table 3, Panel A. For brevity, we do not report the control variables and fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 5. Robustness Tests, Continued
Panel B: Parallel Trend Tests

Dependent variable: *HQ Relocation*

		(1)	(2)
Δ*HQ Corporate Tax Rate* $^{(+)}$	at $t = +1$	0.0004	0.0004
		(0.18)	(0.17)
	at $t = 0$	−0.0015	−0.0010
		(−1.14)	(−0.74)
	at $t = -1$	0.0025**	0.0021***
		(2.64)	(2.83)
	at $t = -2$	−0.0002	0.0005
		(−0.14)	(0.30)
	at $t = -3$	0.0010	0.0008
		(0.51)	(0.41)
	at $t = -4$	0.0010	0.0010
		(0.66)	(0.56)
Δ*HQ Corporate Tax Rate* $^{(-)}$	at $t = +1$	−0.0006	−0.0002
		(−0.43)	(−0.14)
	at $t = 0$	−0.0005	−0.0002
		(−0.30)	(−0.13)
	at $t = -1$	−0.0015**	−0.0016**
		(−2.01)	(−2.21)
	at $t = -2$	0.0001	−0.0002
		(0.11)	(−0.28)
	at $t = -3$	−0.0007	−0.0007
		(−1.48)	(−1.27)
	at $t = -4$	−0.0012	−0.0016
		(−0.95)	(−1.04)
Control variables		Included	Included
Fixed effects		Industry + Year	Industry×Year
Observations		50,872	50,872
R^2		0.01	0.03

Notes: This panel reports the results of tests of the identification in our main results. We estimate the regression using a linear probability model. Δ indicates lag changes (from year $t-2$ to year $t-1$). Δ*HQ Corporate Tax Rate* $^{(+)}$ is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* $^{(-)}$ is the absolute value of the tax decrease in percentage points. We include the set of control variables used in Table 3. For brevity, we do not report the control variables and fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 6. Cross-Sectional Tests
Panel A: Additional State Policies

Dependent variable: *HQ Relocation*

	(1)	(2)
(β_1) Δ*HQ Corporate Tax Rate*	0.0039***	0.0026***
	(2.75)	(5.10)
(β_2) Δ*HQ Corporate Tax Rate* × *Low Property & Payroll Weights*	−0.0027	
	(−1.30)	
(β_3) Δ*HQ Corporate Tax Rate* × *Both Combined & Addback*		0.0043*
		(1.72)
(β_4) *Low Property & Payroll Weights*	−0.0033*	
	(−1.78)	
(β_5) *Both Combined & Addback*		−0.0033
		(−1.17)
(β_1) + (β_2)	0.0012	
	(0.99)	
(β_1) + (β_3)		0.0068***
		(2.92)
Control variables	Included	Included
Fixed effects	Industry×Year	Industry×Year
Observations	87,881	87,881
R^2	0.03	0.03

Notes: This panel reports the coefficient estimates for the tests of hypothesis. We estimate the regression using a linear probability model. Δ indicates lag changes (from year $t-2$ to year $t-1$). Δ*HQ Corporate Tax Rate* $^{(+)}$ is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* $^{(-)}$ is the absolute value of the tax decrease in percentage points. We include the set of control variables used in Table 3. For brevity, we do not report the control variables and fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 6. Cross-Sectional Tests, Continued
Panel B: Impact of Having Existing Operations in Other States

Dependent variable: *HQ Relocation*

	(1)	(2)	(3)
(β_1) Δ*HQ Corporate Tax Rate*	0.0031***	0.0028*	0.0028*
	(6.65)	(1.81)	(1.83)
(β_2) Δ*HQ Corporate Tax Rate* × *High Number of Non-HQ States*	−0.0017		
	(−1.43)		
(β_3) Δ*HQ Corporate Tax Rate* × *High Non-HQ State Sales*		0.0010**	
		(2.28)	
(β_4) Δ*HQ Corporate Tax Rate* × *High Non-HQ State Employment*			0.0010**
			(2.39)
(β_5) *High Number of Non-HQ States*	−0.0058***		
	(−6.61)		
(β_6) *High Non-HQ State Sales*		−0.0018	
		(−1.26)	
(β_7) *High Non-HQ State Employment*			−0.0021
			(−1.20)
(β_1) + (β_2)	0.0015		
	(1.33)		
(β_1) + (β_3)		0.0038***	
		(2.71)	
(β_1) + (β_4)			0.0038***
			(2.71)
Control variables	Included	Included	Included
Fixed effects	Industry ×Year	Industry ×Year	Industry ×Year
Observations	87,881	38,702	38,702
Sample period	1998–2018	1999–2013	1999–2013
R^2	0.03	0.03	0.03

Notes: This panel reports the coefficient estimates for the tests of hypothesis. We estimate the regression using a linear probability model. Δ indicates lag changes (from year *t*−2 to year *t*−1). Δ*HQ Corporate Tax Rate* $^{(+)}$ is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* $^{(-)}$ is the absolute value of the tax decrease in percentage points. We include the set of control variables used in Table 3. For brevity, we do not report the control variables and fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table 7. Inbound Analysis: Determinants of the HQ Destination State for Relocating Firms

Dependent variable: *Destination State*

	(1)	(2)
Destination State Tax Increase t–1	−0.0081**	−0.0058
	(−2.14)	(−1.52)
Destination State Tax Decrease t–1	−0.0047	−0.0067
	(−0.95)	(−1.27)
Destination State Tax Increase t–2	0.0041	0.0077
	(0.65)	(1.28)
Destination State Tax Decrease t–2	0.0401***	0.0311***
	(3.38)	(3.04)
Destination State Corporate Tax Rate	−0.0018***	
	(−3.11)	
Origin minus Destination State Tax Rate		0.0014***
		(3.02)
Destination Property & Payroll Weights	−0.0234***	−0.0229***
	(−6.55)	(−6.63)
Other Destination State Characteristics:		
Real GSP Growth	0.0045**	0.0042*
	(2.03)	(1.92)
Bordering States Tax Diff	−0.0004**	−0.0005***
	(−2.56)	(−3.52)
Industry Cluster	0.0326***	0.0326***
	(21.82)	(21.87)
Democratic Governor	−0.0031***	−0.0031***
	(−3.22)	(−3.19)
Business Friendliness	−0.0001	−0.0000
	(−0.60)	(−0.43)
Gross Receipt Tax	0.0001	0.0015
	(0.89)	(0.70)
Carryforward	0.0002	0.0001
	(−0.35)	(0.62)
Carryback	−0.0052	−0.0001
	(−0.56)	(−0.07)
Both Combined & Addback	0.0001	−0.0000
	(0.02)	(−0.01)
Throwback-throwout	−0.0070***	−0.0068***
	(−3.23)	(−3.19)
Job Creation Tax Credits	0.0130**	0.0125**
	(2.39)	(2.29)
Job Training Subsidies	0.0095***	0.0094***
	(3.28)	(3.24)
R&D Tax Credit	−0.0031	−0.0045
	(−1.05)	(−1.54)
Investment Tax Credit	0.0447	−0.0045
	(0.97)	(−1.13)
Property Tax Abatement	−0.0053	0.0389
	(−1.07)	(0.83)
Personal Tax Rate	0.0003	0.0002
	(0.42)	(0.34)
LT Capital Gain Tax Rate	−0.0007	−0.0007
	(−1.13)	(−1.18)
Business Friendliness Missing	−0.0038	−0.0032

	(−0.68)	(−0.46)
State Tax Features Missing	−0.0031	−0.0033
	(−0.71)	(−0.74)
Fixed effects	Origin State + Year	Origin State + Year
Observations	92,500	92,500
R^2	0.03	0.03

Notes: This table reports the results on the determinants of the HQ destination state for relocating firms. We estimate the regression using a linear probability model. For brevity, we do not report fixed effects. *Origin minus Destination Tax Rate* is the corporate income tax rate of the origin state minus that of the destination state. All variables are defined in Appendix A. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the relocating firm level. ***, **, and * represent statistical significance.

Internet Appendix

This appendix outlines results from additional analyses.

A1. Adjacent-County Analysis

Our identification strategy rests on the assumption that state corporate income tax changes do not systematically coincide with variations in local business cycles or other state-level policies or conditions. To the extent that local shocks independently affect firms' operational decisions, some or all of the relocation choices may reflect the effects of a local economic shock that may be spuriously correlated with corporate tax changes. For example, if states raised taxes during economic downturns and such downturns motivated firms to relocate, we would observe a spurious correlation between taxes and relocations. Our specifications have already controlled for observed state economic and policies. In addition, our specifications incorporate industry and year fixed effects to rule out the concern that our results are driven by correlated factors that are unobservable at the industry level.

To further address concerns that unobserved changes in local economic conditions might affect the likelihood of corporate HQ relocation for reasons unrelated to the tax change itself, we restrict our sample to firms with an HQ in a border region. We perform an adjacent-county analysis, in which we only include firms with HQ located within 10 miles of state borders on each side. This test exploits the fact that economic conditions are likely to be similar across state borders, while the effects of the tax rate changes stop at the border. We view this as a sharp discontinuity because the test compares both treatment and control firms with the same non-tax features, allowing us to difference away any effects from unobserved confounding local factors (e.g., social, economic, and political conditions) that are centric to certain geographic locations and that might drive relocation decisions. In other words, the purpose of the test is to address the concern that a relocation decision is driven by an omitted economic or social variable that happens to be correlated with tax rate changes.

We identify a firm's county based on its zip code from the Centers for Disease Control and Prevention. We re-estimate our main specification with our treatment and control firms being restricted to

firms with an HQ located within 10 miles of a state border. This restrictive sample criterion significantly reduces our sample size to 7,894 firm-year observations with 792 unique firms and 196 cross-state HQ relocations with 207 relocating firms (2.6%). However, the analysis facilitates inferences about the causal effect of tax rate changes by allowing a more economically similar group to be used as a counterfactual against which to compare the relatively more affected group. We present this analysis in Table A2. We continue to find a positive significant effect of changing corporate tax rates on the likelihood of relocation. Note that the estimated sensitivities of corporate relocation to tax rate changes in both columns are larger than those in Tables 3 and 4. One explanation is that narrowing the sample of control firms to those sharing arguably similar (regional) economic conditions removes the heterogeneity driven by local economic conditions. Overall, these results lend further support to a causal interpretation of the relationship between tax changes and corporate relocation.

A2. Excluding California and New York Headquarters

Among our sample firms, California and New York are the two most popular states in which to locate an HQ. Their popularity may suggest that they have attributes that many businesses find attractive, and relocating out of those states could present a higher switching cost. In particular, our results may be affected by firms that chose to remain in California or New York after these states' respective tax cuts. Therefore, to ensure the robustness of our results, we exclude firms headquartered in California and New York and re-estimate our main results. As shown in Column (1) of Table A3, the coefficient on *ΔHQ Corporate Tax Rate* remains significantly positive, suggesting that our findings are not affected by firms headquartered in California and New York.

A3. Lobbying to Change Tax Rates

Prior research suggests that tax policies may be influenced by firms' lobbying efforts (Baloria and Klassen 2018, Brown et al. 2015). State tax policy changes not being entirely exogenous is likely to be a bigger concern for states with a small number of HQ firms because the collective lobbying effort of these firms probably has a greater influence on state tax policy. As another robustness check, we exclude states

with fewer than 1% of the sample firms from the estimation.[30] The findings provided in Column (2) of Table A3 suggest that our results are unlikely to be the product of local firms' lobbying efforts.

A4. Controlling for Additional Social and Economic Changes

To alleviate the concern that other unobservable socioeconomic factors may drive our results, we control for the state-year unemployment (Δ*Unemployment Rate*) and unionization rates (Δ*State Unionization*). State political considerations may affect tax policies such as state corporate tax rates. Heider and Ljungqvist (2015) provide a detailed political background for each major corporate tax change in our sample. They find that none of the corporate tax changes appears to be driven by any particular firm's lobbying activities, reducing the reserve causality concern that states change their tax rates to attract particular firms. Instead, Heider and Ljungqvist (2015) find that changes to state corporate tax policies might be related to election cycles, the governor's political affiliation, and the state's budget balance. We control for election cycles by the number of years until the next state election (*Years to State Election*).

The results, reported in Column (3) of Table A3, indicate that the variables of interest remain significant at the 1% level, suggesting that our results are not sensitive to these additional controls. Because none of the additional control variables is statistically significant at the conventional level, for brevity we do not tabulate the results for the additional controls. Note that the inclusion of the additional control variables does not subsume the results of the existing control variables in our benchmark specification.

A5. Alternative Econometric Models: Logit and Conditional Logit Specifications

Our baseline model uses a linear probability model to estimate the relation between corporate tax rate changes and the likelihood of relocation. The choice of model reflects a tradeoff between the underlying distributional assumption of our dependent variable, the need to use high-dimensional fixed effects to control for potential omitted variable bias, and the difficulty in interpreting interaction variables in a non-linear model. We re-estimate the relation using a logit regression with state, year, and industry fixed effects.

[30] In this test, we dropped 23 states that have fewer than 1% of the firms in the sample. The excluded states are Alabama, Arkansas, South Carolina, North Dakota, South Dakota, Delaware, Maine, Montana, Mississippi, Idaho, Iowa, Kansas, Kentucky, Louisiana, Nebraska, Nevada, New Hampshire, New Mexico, Oklahoma, Rhode Island, Vermont, West Virginia, and Wyoming.

In addition, to incorporate firm fixed effect into the logit specification, we estimate a conditional logit model (McFadden 1973). However, the tradeoff for including firm fixed effects in the logit framework is a significant loss of observations.

Columns (4) and (5) of Table A3 report the marginal effects using logit and conditional logit estimations, respectively. The effect of *ΔHQ Corporate Tax Rate* is significantly positive in both specifications. In Column (4), the economic magnitude is such that for a 1% increase in the corporate tax rate, the likelihood of relocation increases by 32 basis points, implying a 14.5% decrease in the likelihood of HQ relocation. In Column (5), the marginal effect of *ΔHQ Corporate Tax Rate* is 0.0191. Given that the unconditional mean of *HQ Relocation* is 0.1248 in this estimation, the marginal effect estimate corresponds to a 15.3% decrease in the likelihood of HQ relocation. Overall, this outcome suggests that our results are not sensitive to alternative econometric models.

A6. Alternative clustering

In our baseline specification, we cluster the standard errors at the headquarters-state level. This accounts for arbitrary correlations of the error terms (i) across different firms in a given state of location and year (a cross-sectional correlation) and (ii) across different firms in a given state of location over time (across-firm serial correlation) (Petersen 2009). Cross-sectional correlation is a concern because all firms with HQ located in a given state are affected by the same "shock," namely, the change in the corporate tax rates. In this section, we consider alternative ways to account for cross-sectional and serial correlation. Column (6) of Table A3 re-estimates the baseline specification clustering standard errors at firm level to account for correlations of error terms within the same firm over time. Column (7) reports the results with two-way clustering at the firm and year levels (Gow et al. 2010). This approach accounts for correlations among different firms in the same year and different years in the same firm. In both cases, we continue to find a positive association between corporate tax rate changes and the probability of HQ relocation.

A7. Inbound Analysis: The interaction of a state's corporate income tax rate and the weight on the property and payroll in the apportionment formula

In the paper, we find that firms are more likely to relocate to a state with lower corporate income taxes overall, and also more likely to relocate to a state that has a lower corporate income tax rate than the state the firm is leaving. In addition, our results also suggest that lower weight on the property and payroll in the apportionment formula are also associated with choosing a particular state. In this section, we consider how apportionment factor weights affect the value of tax difference and consequently, the likelihood of inbound relocation. To better understand the interaction effect, consider the following hypothetical example:

Consider a single-state firm moved from a state with 6% tax rate with double sales factor weight (50% on sales), its state tax liability would be 6%*50%*HQ's share of property and assets*income, or 3.0% of the income allocated to the HQ (assume zero in-state sales). If the same firm moved to a state with 4% tax rate with double sales factor weight, its new tax liability in the new state would be 4%*50%*HQ's share of property and assets*income, or 2.5% of the income allocated to the HQ. However, if the same firm moved to a state with 4% tax rate with equal factor weights (33% on each factor), its new tax liability in the new state would become 4%*67%*HQ's share of property and assets*income, or 2.67% of the income allocated to the HQ.

The intuition from the above example is that it would be more advantageous for a firm to move into a state that has relatively lower state corporate tax rate, except that a larger (lower) weight on the property and payroll factors (sales factor) in the apportionment formula reduces the tax benefits of moving. To run the analysis, we re-estimate Equation (6) by including the interaction of *Destination State Corporate Tax Rate* and *Destination Property & Payroll Weight*. We present our results in Table A4 in the internet appendix. In Column (1), we find a positive and statistically significant coefficients on both *Destination State Corporate Tax Rate* and *Destination Property & Payroll Weights*, consistent with our earlier results. Moreover, coefficient of the interaction between *Destination State Corporate Tax Rate* and *Property & Payroll Weight* positive and significant (Coeff = 0.0054, *t*-statistics = 5.79), suggesting that when either tax

rate or the apportionment weight on property and payroll of a state is high enough, firms would be unlikely to find that state as the destination.

Similarly, we also consider the interaction effect of *Origin minus Destination State Tax Rate*×*Destination Property & Payroll Weight*. We expect the coefficient on this interaction variable to be negative, implying that a decline in tax benefit from the higher apportionment factors reduces the likelihood of inbound relocation. In Column (2), the results that the coefficient of the interaction between *Origin minus Destination Tax Rate* and *Property & Payroll Weight* negative and significant (Coeff = −0.0031, *t*-statistics = −3.95). These results are consistent with the interpretation that relocation likelihood is positively associated with potential tax benefits, but when the value of tax benefits is reduced by state apportionment formula, the likelihood of relocation is reduced.

A8. Effect of Headquarters Relocation on Firms' State Effective Tax Rate

Our analyses rest on the premise that firms on average reap tax benefits when they relocate to another state. To estimate the tax savings from HQ relocation, we estimate the following specification:

$$State\ ETR_{i,t} = \alpha_0 + \alpha_1 PostRelocation_{i,t} + Controls_{i,s,t-1} + FE + \varepsilon_{i,s,t} \qquad \text{(IA1)}$$

where *State ETR* is the total state tax expense divided by the pre-tax domestic income for firm *i* in year *t*. *PostRelocation* is an indicator variable equal to 1 for the years after a firm relocates its HQ to another state, and 0 otherwise. The coefficient α_1 estimates the effect of HQ relocation on state ETR. We control for the state's sales factor weight and an indicator for state-years when combined reporting is required or when addback rules are enacted. In additional to these state-level variables, we control for known firm-level determinants of state ETR, including firm size, firm growth, leverage, R&D expenditures, capital intensity, intangibles, domestic pre-tax profitability, *NOL*, Δ*NOL*, multi-national indicator, and multi-state operations. We estimate Equation (IA1) with firm, state, and year fixed effects.

A firm's decision to relocate its HQ is not a random choice. Firms that can benefit from an HQ relocation via lower taxes are more likely to relocate. Therefore, to mitigate the concern that the observed HQ relocation effect on state ETR is not driven by the selection, we select a group of control firms that share similar firm characteristics, using propensity score matching on industry and the set of state- and

firm-level determinants of HQ relocation as in Table 3. Note that these covariates are matched based on one year before the treated firms' HQ relocation. Following Shipman et al. (2017), we compile the matched sample using the 1:1 nearest neighbor matching technique without replacement and a caliper set at 0.03. The matching process results in 359 matched control firms with 359 treated (i.e., relocating) firms, for which we find no significant differences in means across all covariates between the treatment and control samples in the year prior to the treated firms' HQ relocations.[31] We then use this sample of treatment and matched control firms to estimate Equation (IA1). Using the matched sample approach, we replace firm fixed effects with industry fixed effects. We include *RelocatingFirm*, an indicator for firms that ever relocated their HQ during our sample period, to control for potential differences in state ETR between relocating and non-relocating firms.

The results are reported in Table A5, with Column (1) tabulating the result using a firm fixed effect regression on the full sample and Column (2) tabulating the result using the matched control sample. On average, our sample firms experience a reduction in state ETR between 0.83 and 1.07 percentage points after their HQ relocation, which is an economically significant decrease given that the state ETR has a sample mean of 5%.

[31] Before we create a matched sample, we first constrain our sample to observations with non-missing state ETR observations. This data constraint results in a significant loss of observations due to missing values for Compustat items on state tax expense (TXS), U.S. domestic pre-tax income (PIDOM), and the additional variable construction requirement of having positive U.S. domestic income. To reduce sample loss, for observations with missing PIDOM, we set PIDOM equal to total pre-tax income (PI) if foreign pre-tax income (PIFO) is missing or is equal to 0.

Table A1. List of State Corporate Tax Rate Changes

State	Year	Description of changes in the top corporate income tax rate	No. of sample firms affected
CA	1997	Tax decrease: from 9.3% to 8.84%	783
CT	1997	Tax decrease: from 10.75% to 10.5%	146
NC	1997	Tax decrease: from 7.75% to 7.5%	77
AZ	1998	Tax decrease: from 9% to 8%	71
CT	1998	Tax decrease: from 10.5% to 9.5%	131
NC	1998	Tax decrease: from 7.5% to 7.25%	73
NH	1999	Tax increase: from 7% to 8%	22
CO	1999	Tax decrease: from 5% to 4.75%	154
CT	1999	Tax decrease: from 9.5% to 8.5%	124
NC	1999	Tax decrease: from 7.25% to 7%	73
NY	1999	Tax decrease: from 9% to 8.5%	481
OH	1999	Tax decrease: from 8.9% to 8.5%	169
AZ	2000	Tax decrease: from 8% to 7.968%	65
CO	2000	Tax decrease: from 4.75% to 4.63%	149
CT	2000	Tax decrease: from 8.5% to 7.5%	124
NC	2000	Tax decrease: from 7% to 6.9%	70
NY	2000	Tax decrease: from 8.5% to 8%	497
AL	2001	Tax increase: from 5% to 6.5%	28
AZ	2001	Tax decrease: from 7.968% to 6.968%	67
ID	2001	Tax decrease: from 8% to 7.6%	27
NH	2001	Tax increase: from 8% to 8.5%	22
NY	2001	Tax decrease: from 8% to 7.5%	506
CA	2002	Tax increase: suspension of state net operating loss (NOL) deduction*	—
NJ	2002	Tax increase: introduction of alternative minimum assessment tax (AMT) and suspension of NOL deduction*	—
TN	2002	Tax increase: from 6% to 6.5%	65
IN	2003	Tax increase: from 3.4% to 8.5%	44
AR	2003	Tax increase: introduction of corporate income tax surcharge of 3% on tax liability**	—
CT	2003	Tax increase: introduction of corporate income tax surcharge of 20% on tax liability**	—
CT	2004	Tax increase: of corporate income tax surcharge from 20% to 25% on tax liability**	—
ND	2004	Tax decrease: from 10.5% to 7%	3
AR	2005	Tax decrease: repeal of corporate income tax surcharge of 3% on tax liability**	—
KY	2005	Tax decrease: from 8.25% to 7%	29
OH	2005	Tax decrease: from 8.5% to 0.26% (phase out of income tax from year 2005)	144
CT	2006	Tax decrease: of corporate income tax surcharge from 25% to 20% on tax liability**	—
VT	2006	Tax decrease: from 9.75% to 8.9%	2
ND	2007	Tax decrease: from 7% to 6.5%	1
NY	2007	Tax decrease: from 7.5% to 7.1%	382
VT	2007	Tax decrease: from 8.9% to 8.5%	3
WV	2007	Tax decrease: from 9% to 8.75%	5
CT	2008	Tax decrease: repeal of corporate income tax surcharge of 20% on tax liability**	—
KS	2008	Tax decrease: from 3.35% to 3.1%	18
KY	2008	Tax decrease: from 7% to 6%	27
MD	2008	Tax increase: from 7% to 8.25%	73
MI	2008	Tax increase: introduction of business tax with a top rate of 4.95%, together with a 0.8% gross receipt tax and a 21.99% surcharge on total tax liability	66
TX	2008	Tax decrease: abolition of income tax of 4.5% , replaced with gross receipts tax without interest deductibility	386
CT	2009	Tax increase: introduction of corporate income tax surcharge of 10% on tax liability for firms with revenue over $100 million**	—
NC	2009	Tax increase: introduction of corporate income tax surcharge of 3% on tax liability**	—
ND	2009	Tax decrease: from 6.5% to 6.4%	2

OR	2009	Tax increase: from 6.6% to 7.9%	38
KS	2009	Tax decrease: in tax surcharge from 3.1% to 3.05%**	—
WV	2009	Tax decrease: from 8.75% to 8.5%	7
MA	2010	Tax decrease: from 9.5% to 8.75%	177
NJ	2010	Repeal of 4% tax surcharge**	—
NC	2011	Repeal of 3% tax surcharge**	—
IL	2011	Tax increase: from 7.3% to 9.5%	140
KS	2011	Tax decrease: from 7.05% to 7%	23
MA	2011	Tax decrease: from 8.75% to 8.25%	166
ND	2011	Tax decrease: from 6.4% to 5.4%	4
OR	2011	Tax decrease: from 7.9% to 7.6%	33
MI	2012	Replacing the Michigan business tax of 4.95% and the surcharge of 21.00% with a flat corporate income tax rate of 6%***	—
MA	2012	Tax decrease: from 8.25% to 8%	171
IN	2013	Tax decrease: from 8.5% to 8%	50
AZ	2014	Tax decrease: from 6.97% to 6.5%	61
IN	2014	Tax decrease: from 8% to 7.5%	54
NC	2014	Tax decrease: from 6.9% to 6%	70
AZ	2015	Tax decrease: from 6.5% to 6%	53
CT	2015	Tax increase: from 7.5% to 9%	73
IN	2015	Tax decrease: from 7.5% to 7%	46
NC	2015	Tax decrease: from 6% to 5%	63
AZ	2016	Tax decrease: from 6% to 5.5%	50
IN	2016	Tax decrease: from 7% to 6.5%	44
NC	2016	Tax decrease: from 5% to 4%	55
NY	2016	Tax decrease: from 7.1% to 6.5%	316
AZ	2017	Tax decrease: from 5.5% to 4.9%	47
DC	2017	Tax decrease: from 9.2% to 9%	7
IN	2017	Tax decrease: from 6.25% to 6%	37
NC	2017	Tax decrease: from 4% to 3%	54
NM	2017	Tax decrease: from 6.6% to 6.2%	1

* We exclude from our main analysis two tax events—the suspension of the NOL deduction and the introduction of an AMT—that are treated as tax increase events in Heider and Ljungqvist (2015) because they cannot be quantifiable to a rate increase that applies to all firms.

**We exclude changes in the state tax surcharge rate from the analysis because such changes are usually temporary. In robustness checks, we find that our results are not affected by considering state tax surcharge rate changes. As a state tax surcharge is levied on tax liability, we estimate the effect on the state corporate income tax rate by multiplying the change in the tax surcharge rate by the state's top corporate income tax rate.

***This tax regime change has a minimal change in tax rates because the former Michigan business tax of 4.95% and the surcharge of 21.00% are equivalent to a tax rate of 6% [4.95% × (1 + 21%)].

Table A2. Adjacent County Analysis

Dependent variable: *HQ Relocation*

	(1)	(2)	(3)	(4)
Δ*HQ Corporate Tax Rate*	0.0209**		0.0205**	
	(2.15)		(2.08)	
Δ*HQ Corporate Tax Rate* $^{(+)}$		0.0046**		0.0046**
		(2.68)		(2.66)
Δ*HQ Corporate Tax Rate* $^{(-)}$		−0.0105*		−0.0099*
		(−1.86)		(−1.72)
Control variables	Included	Included	Included	Included
Fixed effects	Industry + Year	Industry + Year	Industry×Year	Industry×Year
Observations	7,894	7,894	7,894	7,894
R^2	0.02	0.02	0.03	0.03

Notes: This panel reports the coefficient estimates for the tests of hypothesis using a sample of firms with an HQ located within 10 miles of a state border. The sample size is reduced to 7,894 firm years with 792 unique firms and 196 cross-state HQ relocations. We estimate the regression using a linear probability model. Δ indicates lag changes (from year *t*−2 to year *t*−1). Δ*HQ Corporate Tax Rate* $^{(+)}$ is the tax increase in percentage points and Δ*HQ Corporate Tax Rate* $^{(-)}$ is the absolute value of the tax decrease in percentage points. We include the set of control variables used in Table 3. For brevity, we do not report the control variables and fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table A3. Additional Robustness Tests

Dependent variable: *HQ Relocation*

	(1) Excluding California and New York HQs	(2) Excluding states with few HQs	(3) Additional controls	(4) Logit (marginal effects)	(5) Conditional logit (marginal effects)	(6) Clustering at firm level	(7) Clustering at firm and year
ΔHQ Corporate Tax Rate	0.0022***	0.0023***	0.0024***	0.0032***	0.0191**	0.0024***	0.0024***
	(3.31)	(4.23)	(4.55)	(3.86)	(2.17)	(3.15)	(3.12)
Control variables	Included	Included	Included	Included	Included	Included	Included
Fixed effects	Industry ×Year	Industry ×Year	Industry ×Year	Industry + State + Year	Firm + State + Year	Industry ×Year	Industry ×Year
Clustering	State	State	State	Firm	Firm	Firm	Firm + Year
Observations	65,792	79,295	87,881	87,881	10,884	87,881	87,881
R^2	0.03	0.03	0.03	0.04	0.03	0.03	0.03

Notes: This table reports the results of robustness tests of hypothesis. We estimate the regression using a linear probability model. Δ indicates lag changes (from year *t*−2 to year *t*−1). The set of control variables used in Table 3 are included here but not reported, for brevity. Similarly, we do not report fixed effects. All variables are defined in Appendix A. *t*-statistics are reported. Pseudo R^2 and *z*-statistics are reported for the logit and conditional logit models in Columns (4) and (5). For the results in Column (2), we exclude the following states, where only a small number of headquarters are located: Alabama, Arkansas, South Carolina, North Dakota, South Dakota, Delaware, Maine, Montana, Mississippi, Idaho, Iowa, Kansas, Kentucky, Louisiana, Nebraska, Nevada, New Hampshire, New Mexico, Oklahoma, Rhode Island, Vermont, West Virginia, and Wyoming. Standard errors are corrected for heteroskedasticity and are clustered at the state-of-headquarters level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table A4. Inbound Analysis: Determinants of the HQ Destination State for Relocating Firms

Dependent variable: *Destination State*

	(1)	(2)
Destination State Tax Increase t–1	−0.0099**	−0.0069*
	(−2.61)	(−1.85)
Destination State Tax Decrease t–1	−0.0076	−0.0087
	(−1.52)	(−1.65)
Destination State Tax Increase t–2	0.0042	0.0087
	(0.68)	(1.45)
Destination State Tax Decrease t–2	0.0377***	0.0313***
	(3.23)	(3.04)
Destination State Corporate Tax Rate	−0.0044***	
	(−4.93)	
Origin minus Destination State Tax Rate		0.0028***
		(4.33)
Destination Property & Payroll Weights	−0.0494***	−0.0165***
	(−6.90)	(−3.75)
Origin minus Destination State Tax Rate × *Destination State Corporate Tax Rate*	0.0054***	
	(5.79)	
Origin minus Destination State Tax Rate × *Destination Property & Payroll Weights*		−0.0031***
		(−3.95)

Other Destination State Characteristics:		
Real GSP Growth	0.0064***	0.0040*
	(2.74)	(1.84)
Bordering States Tax Diff	0.0004**	−0.0003*
	(−2.00)	(−1.94)
Industry Cluster	0.0321***	0.0322***
	(21.77)	(21.85)
Democratic Governor	−0.0029***	−0.0030***
	(−3.03)	(−3.10)
Business Friendliness	−0.0001	−0.0001
	(−0.94)	(−0.90)
Gross Receipt Tax	−0.0007	0.0005
	(−0.30)	(0.22)
Carryforward	0.0002**	0.0001*
	(2.61)	(1.70)
Carryback	−0.0018**	−0.0010
	(−2.38)	(−1.20)
Both Combined & Addback	0.0004	0.0003
	(0.18)	(0.11)
Throwback-throwout	−0.0108***	−0.0092***
	(−4.82)	(−4.33)
Job Creation Tax Credits	0.0126**	0.0123**
	(2.30)	(2.26)
Job Training Subsidies	0.0108***	0.0096***
	(3.52)	(3.30)
R&D Tax Credit	−0.0015	−0.0028
	(−0.53)	(−0.93)
Investment Tax Credit	0.0229	−0.0058
	(0.50)	(−1.48)
Property Tax Abatement	−0.0058	0.0273
	(−1.49)	(0.59)
Personal Tax Rate	−0.0010	−0.0005
	(−1.44)	(−0.80)
LT Capital Gain Tax Rate	−0.0001	−0.0001
	(−0.08)	(−0.08)
Business Friendliness Missing	0.0020	0.0000
	(0.28)	(0.01)
Control Variables Missing	0.0015	−0.0001
	(0.38)	(−0.02)
Fixed effects	Origin State + Year	Origin State + Year
Observations	92,500	92,500
R^2	0.03	0.03

Notes: This table reports the results on the determinants of the HQ destination state for relocating firms. We estimate the regression using a linear probability model. For brevity, we do not report fixed effects. *Origin minus Destination State Tax Rate* is the corporate income tax rate of the origin state minus that of the destination state. *Destination Property & Payroll Weights* is the combined weight on the property and payroll factors of the firm's HQ state's tax apportionment formula. All variables are defined in Appendix A. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the relocating firm level. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.

Table A5. Effects of Headquarters Relocation on Firms' State Effective Tax Rate

Dependent variable: State ETR

	(1)	(2)
	Firm Fixed Effects	Propensity Score Matching
Post Relocation	−0.0061**	−0.0052**
	(−2.40)	(−2.34)
Relocation Firms	—	0.0003
		(0.19)
Sales Factor Weight	−0.1072***	−0.0130***
	(−3.77)	(−3.72)
Combined Reporting	0.0051***	0.0082***
	(3.10)	(4.01)
Addback Rule	−0.0043	0.0180***
	(−1.16)	(3.59)
Firm Size	0.0080***	−0.0026***
	(11.04)	(−5.60)
Market-to-Book	0.0001	0.0002
	(0.61)	(0.32)
Leverage	0.0044**	−0.0162***
	(2.02)	(−5.70)
R&D	0.0019**	−0.0033**
	(2.08)	(−1.99)
Capital Intensity	−0.0081***	−0.0062*
	(−2.74)	(−1.82)
Intangibles	0.0033	0.0153*
	(1.12)	(5.78)
ΔSales	−0.0005	0.0031
	(−0.57)	(1.02)
Domestic ROA	−0.0039***	−0.0554***
	(−4.43)	(−6.72)
NOL	−0.0029**	−0.0033**
	(−2.63)	(−2.60)
ΔNOL	−0.0004	−0.0093**
	(−0.29)	(−1.98)
Multi-State Operations	0.0001	0.0004
	(0.30)	(0.99)
Multinational Indicator	0.0063***	−0.0003
	(−4.56)	(−0.23)
Fixed effects	Firm + HQ State + Year	Industry + HQ State + Year
Adjusted R^2	0.24	0.29
Observations	74,547	5,215
Number of relating firms	595	359

Notes. This table reports the results of the effect of headquarters relocation on firms' subsequent state effective tax rates. Control variables and fixed effects are included but not reported for brevity. *StateETR* is defined as the firm's total state tax expense (TXS) divided by its pre-tax domestic income (PIDOM). We set pre-tax domestic income (PIDOM) equals to pre-tax total income (PI) when PIDOM is missing and when pre-tax foreign income (PIFO) is missing or equals 0. *StateETR* is set to missing if the denominator is negative and is winsorized at 0 and 1. *Post Relocation* is an indicator variable coded as 1 for the firm-years after the firm relocates its HQ to another state, 0 otherwise. *Relocation Firms* is an indicator variable coded as 1 for the firms that relocated their HQ during the sample period, 0 otherwise. *Leverage* is total leverage over total assets; *R&D* is research and development expenditures over total assets; *Intangibles* is intangible asset over total assets; *Domestic ROA* is domestic pre-tax income over total

assets; *NOL* is an indicator for firm-year with a positive tax loss carried forward; *ΔNOL* is the change in tax loss carried forward over total assets; and *Multinational Indicator* is an indicator for firm-years with positive foreign pre-tax income. The remaining variables are defined in Appendix A. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered by firm and year. ***, **, and * represent statistical significance (two-sided) at 1%, 5%, and 10%, respectively.