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Tax Uncertainty and Business Activity*

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Abstract

We investigate the extent to which uncertainties about tax policies affect business activities. We develop a statewide tax-uncertainty measure (TU measure) and show that it captures state *corporate* tax uncertainty. By comparing adjacent counties across state borders, we show that increasing tax uncertainty by one standard deviation (a 30% increase in the TU measure) leads to a 0.17% point per-year decrease in the growth rate of establishments over two years. The result holds after conducting a variety of robustness checks and is not likely to be driven by general state-policy uncertainties.

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1 Introduction

Economists have conjectured that uncertainty about economic policies can influence the real economy. Recently, Baker et al. [2016] developed a measure of economic policy uncertainty (EPU), and subsequent studies have documented a correlation between the EPU index and economic activities. In most cases, however, establishing a causal relationship between the EPU index and an economic outcome is difficult because a nationwide EPU index provides only a time-series variation, while there might exist a time-varying unobserved component that affects both economic policies and economic outcomes.

In this paper, we extend the EPU index to a statewide index and provide a causal relationship between our extended index and a real outcome. In particular, we focus on uncertainty about state tax policies.[1] We first construct the statewide tax-uncertainty (TU) measure and show that it is positively associated with the probability of state *corporate* tax changes and is more responsive to tax changes that were not pre-announced. For example, a 10% increase in the TU measure is associated with a 1.5% point increase in the probability of a maximum state corporate tax change in the following year.

To investigate the causal relationship between our TU measure and business activity, we compare the business outcomes of the counties near a state border. The economic conditions of the counties near a state border are more likely to be similar, whereas the states to which they belong are different. Statewide tax policies are less likely to be influenced by the border counties, and, hence, the changes in tax policies are more likely to be exogenous to the economic conditions in those counties. In addition, by controlling for a location fixed effect throughout the analysis, we also account for the fact that different entrepreneurs are sorted into different border areas. As a result, the identification of our results is mainly obtained

[1] A large variation exists for tax policies across states. Moreover, of all government policies, taxes are the biggest concern for business owners (see, e.g., Yardeni et al. [2017]).

from temporal variation in cross-border economic activities.

Our results suggest that tax uncertainty is negatively associated with the growth rate of the number of establishments. The baseline estimate suggests that a 10% increase in the TU measure leads to a 0.11% point decrease in the growth rate of the number of establishments over two years. If we relate this number to the probability of a maximum state corporate tax change, a 1.5% point increase in the probability of a maximum state corporate tax change in the following year leads to a 0.11% point decrease in the growth rate of the number of establishments over two years. We provide evidence that the deterred investment due to uncertainty (the "real-option" story), rather than the relocation of establishments in border counties, is the main mechanism behind our estimates.

The result holds with several robustness checks. In particular, we check whether our results are driven by some state policy uncertainty other than state tax uncertainty. For example, we control for a state-year-specific dummy for a tight race in the gubernatorial election,[2] and our results hold. We also check whether our results are different across industries and show that they are more pronounced among industries that have relatively more incorporated firms. To the extent that general policy uncertainty affects both incorporated and non-incorporated firms equally, the aforementioned evidence suggests that our results are more likely driven by tax uncertainty.

This paper contributes to the literature on the effect of policy uncertainties on the overall economy. The study of the impact of policy uncertainties goes back to Friedman [1968]. Recently, Baker et al. [2016] developed an economic policy uncertainty (EPU) measure by using a newspaper-article count, and many papers show that the EPU measure is negatively associated with real outcomes.[3] In particular, Shoag and Veuger [2016] extend the EPU

[2]Depending on which party wins the election, either Democrats or Republicans, state policies could be very different. Therefore, the fact that people cannot predict which party will win the election means that they are uncertain about which type of policies will be implemented in the next few years.

[3]See, for example, Antonakakis et al. [2013], Colombo [2013], Jones and Olson [2013], Kang and Ratti

measure to a statewide measure and show it matches the cross-sectional distribution of unemployment rates during the Great Recession. By implementing a local identification strategy based on adjacent counties across US state borders, we control for a time-varying unobserved component that might affect both state policies and economic outcomes, and, hence, provide results with a clean identification. Overall, our results suggest that, among many policy uncertainties, tax uncertainty has a significant, negative impact on business activity in the United States.[4]

This paper is also related to the literature studying the effect of tax policies on business activities. The early studies on this subject find that taxes do not appear to have a substantial effect on economic activities in US states.[5] The more recent literature revisits the issue by focusing on improving an identification problem, with mixed results.[6] We contribute to this literature by showing that uncertainties about tax policies, even if the tax eventually

[2013], Antonakakis et al. [2014], Baker et al. [2014], Da et al. [2014], Kang et al. [2014], Karnizova and Li [2014], Nodari [2014], Wang et al. [2014], Brogaard and Detzel [2015], Fernández-Villaverde et al. [2015], Gulen and Ion [2015], Liu and Zhang [2015], Bernal et al. [2016], Bordo et al. [2016], Leduc and Liu [2016], Li et al. [2015], and Caggiano et al. [2017].

[4]Regarding tax-policy uncertainty, Hassett and Metcalf [1999] show how such uncertainties affect firm-level and aggregate investment. Aizenman and Marion [1993] and Aizenman and Marion [1999] empirically examine the impact of policy uncertainty on investment and economic growth by using cross-country variations. Edmiston [2004] examines the relationship between tax volatility and investments by using a cross-section of the 15 countries of the European Union, the United States, and Japan. To construct a tax-uncertainty measure, Edmiston [2004] generates the effective tax rates using each country's national accounts and revenue statistics, under the assumption that the data-generating process is based on a general equilibrium representative agent model. Using these inferred effective tax rates, he estimates tax-rate volatility using an ARCH specification and shows that the effect of the estimated volatility on investment per worker is negative with a time-invariant country-specific fixed effect. We augment his finding by developing a novel measure of tax-policy uncertainty based on the news-article-count information, and by controlling for a time-variant unobserved factor that might affect both tax uncertainty and an economic outcome.

[5]For a review article, refer to Wasylenko [1999].

[6]For example, using data on French plants, Rathelot and Sillard [2008] find that a higher local corporate tax deters new-firm formation. Duranton et al. [2011] also find a negative impact of local taxation on employment growth, but not on firm entry, by using establishment data in the UK. On the other hand, Chirinko and Wilson [2008] find that the impact of US state investment tax credits on manufacturing establishment counts is economically small. Rohlin et al. [2014] find that the impact of taxes on business creation around the state borders differs depending on reciprocal agreements that require workers to pay income tax to their state of residence rather than their state of employment. Using US Census micro-data on multi-state firms, Giroud and Rauh [2017] show a negative impact of state taxes on the number of establishments in the state. They also show that reallocation of productive resources to other states drives half the effect.

does not change, can negatively influence business activities.

The paper is organized as follows. In Section 2, we explain the procedure by which the statewide TU measure is constructed, and discuss its validation. Section 3 discusses the identification strategy and presents the main results. Section 4 shows robustness checks. Section 5 concludes.

2 Measuring Tax Uncertainty

In this section, we construct a measure that may capture tax uncertainty. We explain how we construct such a measure in Section 2.1. In Section 2.2, we provide some evidence that the TU measure captures state *corporate* tax uncertainty.

2.1 Constructing the Tax-Uncertainty Measure

To construct a TU measure, we extend the economic policy uncertainty (EPU) index constructed by Baker et al. [2016] to the state level. Using ten leading US nationwide newspapers, they search for articles containing the following trio of terms: "economic" or "economy"; "uncertain" or "uncertainty"; and one or more of "Congress," "deficit," "Federal Reserve," "legislation," "regulation," or "White House." They construct the EPU index by using the time variation of the relative number of articles containing the above keywords. They show that the EPU index exhibits a strong relationship with the implied stock market volatility and a policy-uncertainty measure from the Federal Reserve System's Beige Books. They also show that their newspaper-article counting method is reliable, in the sense that it has a strong correlation with the hand-collected economic policy-uncertainty measure.

To construct a TU measure, we follow the same procedure as in Baker et al. [2016], except that we use (1) ten statewide newspapers to construct a statewide measure and (2) the following trio of terms to capture uncertainty for local tax policies: "tax," "taxes," "taxed," or "taxation"; "local" or "state"; and "uncertain," "uncertainty," or "uncertainties."

To collect the newspaper-count information, we use NewsLibrary (www.newslibrary.com), an archive of news articles from major newspapers across the United States. We limit the time period to between 2001 and 2010 because the number of articles before and after 2001 changes substantially for some states in the archive. To make the time period consistent with other variables, we use information up to 2010. To collect statewide information, we first select newspapers for each state, among which we search for the articles. The selection criteria are as follows: first, we sort newspapers by their covered period; second, we select ten English-language newspapers with the longest covered periods; and third, we remove newspapers if the covered period does not span from 2001 to 2010. The selected newspapers are shown in Appendix C. For some states, the number of newspapers that satisfy the above criteria is five or fewer.[7] With a small number of newspapers, the variance of the number of newspaper articles is rather high, and the newspaper-count information may reflect one or two particular newspapers. For these reasons, we remove from our main analysis the states with five or fewer selected newspapers.

For each year, we search for articles containing the trio of keywords specified above among the ten selected newspapers for each state. For each year, we also search for all the articles from the ten selected newspapers for each state. Across years and states, we first divide the number of news articles with keywords by the number of all news articles. Then, we normalize these values so that the mean value across time and states is 100.

The selected newspapers may be different across states with respect to unobserved characteristics. To address this concern, we include a state fixed effect for all the regression analyses throughout the paper. To address any concerns about the particular set of key-

[7] Those states include Alaska, Delaware, Hawaii, Maine, Montana, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, West Virginia, Vermont, and Wyoming.

words stated above, we try a different set of keywords and discuss how it differs from the benchmark keywords. We present this analysis in Appendix B.

Figure 1 shows the histogram for the one-year percentage change in the TU measure across time and states. The mean is 0.01 and the shape of the distribution looks similar to that of a normal distribution. The standard deviation is 0.31, indicating considerable variation across time and states.

Figure 2 shows the average and the standard deviation of the one-year percentage change in the TU measure during the sample period (from 2001 to 2010) for each state. The figure shows a large heterogeneity of TU measure across states. To systematically investigate the relationship between the TU measure and tax uncertainty, we turn to regression analyses in the next section.

2.2 Does the TU Measure Capture Tax Uncertainty?

2.2.1 The TU measure and the Probability of Tax Changes

In this section, we conduct several regression analyses for the dummy variable indicating a state tax change in the following year on the log TU measure. All the analyses include state and year fixed effects, and the standard errors are clustered by state.

Most states use a progressive tax system for personal income tax, and some use it for corporate income tax. Moreover, exemption, deduction, and other tax policies, such as apportionment rules, are different across time and states. Following the literature (e.g., Rohlin et al. [2014]), we use the maximum state personal income tax, maximum state corporate income tax, and state sales tax between 2001 and 2010 for this study.[8] In doing so, we

[8]The maximum state personal income tax rate is obtained from the NBER tax simulator. (Source: http://users.nber.org/ taxsim/state-rates). We use the maximum state corporate income tax collected by Serrato and Zidar [2016]. We thank the authors for kindly sharing their data. The state sales tax is collected from the Tax Foundation. (Source: https://taxfoundation.org/data)

assume that the maximum tax rates are positively associated with the tax rate that most business owners are concerned about.

Table 1 shows the summary statistics for state tax rates, as well as the one-year difference in the state tax rates. Considerable variation exists in all tax rates across states. The variation for corporate and personal income tax rates is slightly higher than the one for the sales tax rate. The median one-year difference in the tax rate is zero for all taxes, but the standard deviations are 0.37%, 0.33%, and 0.27% for the maximum corporate tax, the maximum personal tax, and the sales tax, respectively. Indeed, many states changed one of these tax rates at least once between 2001 and 2010. For example, 11 states changed the maximum corporate income tax rates; 30 states changed the maximum personal income tax rates; and 22 states changed sales tax rates.

We first estimate linear probability models for each type of tax change. The results are shown in Table 2. A 10% increase in the TU measure leads to a 1.5% point increase in the probability of a state corporate tax change in the next year. By contrast, the coefficients for the TU measure are not significant in regressions for state personal and state sales tax changes.

Even if we do not explicitly include the term "corporate" or "business," the TU measure is more responsive to state corporate tax changes than to other types of state tax changes. This may be the case because, although statewide corporate tax changes are less frequent, they are often substantial and, therefore, attract more attention from newspapers. For the state corporate tax, the frequency of changes is the lowest, but the magnitude of a change is, on average, the largest. For example, the absolute value of a tax change is, on average, 1.01% for a state corporate tax, whereas it is 0.69% for a state sales tax and 0.28% for a state personal tax.

To further investigate why the TU measure predicts only the changes in the state corporate tax, and not in the other types of state taxes, we construct another measure by using the following quadruple of terms: "tax," "taxes," "taxed," or "taxation"; "local" or "state"; "uncertain," "uncertainty," or "uncertainties"; "corporate," business," or "businesses." Note that the only difference from the benchmark keywords are the additional terms "corporate," "business," or "businesses." We find that the correlation between the benchmark TU measure and this newly constructed measure with the additional terms is 0.9252. This finding indeed confirms our conjecture that a newspaper article that contains the benchmark trio of terms is more likely to be related to a corporate tax change.

To see whether the result for the state corporate tax change is driven mostly by either an increase or a decrease in the state corporate tax, we further divide the sample into two: one that excludes the state corporate tax decrease and another that excludes the state corporate tax increase. The results are shown in the first and second columns, respectively, of Table 3. The TU measure is positively associated with both samples, although the coefficient for the second sample is not significant.

Tables 2 and 3 include states that never instituted the state corporate tax changes. Among states for which the TU measure is available, 11 changed their state corporate tax rates between 2001 and 2010.[9] We estimate linear probability models for the states that did experience a state corporate tax change. The results are shown in Table 4. The coefficients for the log TU measure are substantially greater than those in Tables 2 and 3. For example, the first regression indicates that a 10% increase in the TU measure leads to about a 6.5% point increase in the probability of tax changes in the following year.

[9]Those states are Connecticut, Indiana, Kansas, Kentucky, Massachusetts, Michigan, Nebraska, New York, Ohio, Oregon, and Tennessee.

2.2.2 Controlling for the Expected Tax Rates

The analyses, so far, suggest that the TU measure is correlated with an *unconditional* tax change in the following year. To see whether the TU measure is related to the probability of tax changes *conditional on* the expected tax rate, we conduct two additional analyses.

First, we use the mean of other states' corporate tax rates as proxies for the expected tax rate in the following year. The literature (e.g., Goolsbee and Maydew [2000]; Serrato and Zidar [2016]) suggests that competition with other states is an important factor affecting statewide tax policies. We estimate the regression in the first columns of Table 2 and Table 4, including the mean of other states' corporate tax rates. The results are shown in Table 5. The mean of other states' corporate tax is positively correlated with the probability of tax changes in the following year. The adjusted R-squared also increases after including the mean of other states' corporate tax. More importantly, even after controlling for the mean of other states' corporate tax rates, the estimates for the TU measure are significant and exhibit a positive relationship with the probability of tax changes in the following year.

Second, we exclude states that pre-announced their state corporate tax changes to determine how the estimates for the TU measure change. Although we do not know whether a tax change was not involved in a change in the expected tax rate, in certain cases, we do know that a tax change was pre-announced and, therefore, definitely involved in a change in the expected rate. For example, Michigan legislation implemented a pre-determined elimination of its Single Business Tax (SBT) in the early 2000s. The SBT rate was successively reduced by 0.1% increments from 2000 until 2002.[10] Likewise, starting in 2005, Ohio gradually phased out the corporation franchise tax as part of implementing the commercial activity tax (CAT).[11] These tax changes were pre-announced, and, hence, they were "certain" re-

[10]Hines Jr [2002] and the Book of the States.

[11]Source: http://www.tax.ohio.gov

ductions. If the TU measure captures tax uncertainty, it must be more responsive to other relatively unexpected tax changes than to the pre-announced tax reductions in Michigan and Ohio.

We conduct the regression analysis as in Table 4, except that we remove the observations from Michigan and Ohio. The results are shown in Table 6. For comparison, we also present the results from Table 4. After removing the observations from Michigan and Ohio, the magnitude of the coefficient for the TU measure increases. More importantly, the magnitude of the coefficient for the TU measure for a state corporate tax "decrease" changes from 0.376 to 0.466, and the coefficient becomes significant. The results show that the TU measure is, in fact, more responsive to relatively unexpected tax changes.[12]

To summarize, the TU measure predicts mainly state corporate tax changes, either an increase or decrease, in the following year. The results hold even after controlling for the expected tax rate. Moreover, the TU measure is more responsive to tax changes that were not pre-announced. These findings suggest that the TU measure captures the state corporate tax uncertainty.

3 The TU Measure and Business Activity

In this section, we first explain how we establish a causal relationship between the TU measure and an output measure. After constructing the output measure and other variables, we present the main results.

[12]As a robustness check, we conducted the logit regression and found similar results.

3.1 Identification Strategy

Statewide tax policies may reflect the economic conditions in the state. For example, a state government in an economic boom period could have an incentive to raise the state tax rate to finance state spending. On the other hand, a state government in a recession period may cut the state tax rate to boost the local economy. At the same time, business activities in a state are highly influenced by the state's economic conditions. Therefore, the relationship between business activities and uncertainties about tax policies can be a mere correlation.

To investigate the causal relationship, we compare the economic outcomes in the counties near a state border. The economic conditions of the counties near a state border are more likely to be similar, while the states to which they belong are different. Statewide tax policies are less likely to be influenced by the border counties, and, hence, the changes in tax policies are more likely to be exogenous to those counties' economic conditions.

Another issue to consider is firm sorting: entrepreneurs may differ according to the border area to which they are sorted. To handle this issue, we control for a location fixed effect throughout our analyses. Therefore, the identification of our results is obtained mainly from temporal variation in cross-border economic activities.

To make our argument clearer, consider business activities of the A and B sides of a state border, given as follows:

$$g_{it}^{A} = \theta \ln(\mathrm{TU}_{it}^{A}) + \beta X_{it}^{A} + \Omega_{it} + \tau_{i}^{A} + u_{it}^{A} \tag{1}$$

$$g_{it}^{B} = \theta \ln(\mathrm{TU}_{it}^{B}) + \beta X_{it}^{B} + \Omega_{it} + \tau_{i}^{B} + u_{it}^{B}, \tag{2}$$

where i and t represent a state border and year, respectively. g_{it}^{A} and g_{it}^{B} refer to the outcome of interest on side A and side B of a state border, respectively. X_{it}^{A} and X_{it}^{B} represent other policy variables that may affect the outcome on side A and side B of a state border, respectively. τ_i^A and τ_i^B capture a time-invariant heterogeneity of each side of border i. Ω_{it} captures a border-specific unobserved economic condition at t. u_{it}^A and u_{it}^B are other unobserved components on each side of border i at t, which have zero-mean. The key assumption is that the size of border counties is small enough not to influence a statewide tax policy, and, as a result, u_{it}^A and u_{it}^B are independent of the statewide tax uncertainty.[13]

To show how comparing border counties can mitigate the endogeneity issue explained above, we subtract equation (2) from equation (1):

$$g_{it}^A - g_{it}^B = \theta\big\{\ln(\mathrm{TU}_{it}^A) - \ln(\mathrm{TU}_{it}^B)\big\} + \beta\big(X_{it}^A - X_{it}^B\big) + \xi_i + \epsilon_{it}. \tag{3}$$

By subtracting the above two equations, we can remove the unobserved time-varying border-specific economic condition Ω_{it}. Note that $\xi_i = \tau_i^A - \tau_i^B$ and $\epsilon_{it} = u_{it}^A - u_{it}^B$.

To summarize, by comparing border counties, we can control for time-varying border specific economic conditions that might also affect the outcome of interest. By additionally including the border-side fixed effects, we can control for a site-specific effect such as the firm-sorting effect.

3.2 Output Measure and Other Variables

County Business Pattern (CBP) is used to capture business activities. The CBP provides the number of establishments in each county for an establishment-size category and a detailed industry category.[14] We use a two-year growth rate, as calculated below, of the number of

[13]The literature that implements this idea goes back to Fox [1986] and David [1994]. Holmes [1998] implements this border technique to investigate the role of a right-to-work law on manufacturing activity. The following papers use a similar technique to examine the effect of statewide government policies: state investment tax credits (ITC) (Chirinko and Wilson [2008]); the minimum wage (Dube et al. [2010]); local tax policies on business location choice (Rohlin et al. [2014]); and the changes in statewide homestead exemption levels (Rohlin and Ross [2016]).

[14]A firm pays taxes based on the location of its establishments. For a detailed discussion of how a muti-state firm is taxed, see Giroud and Rauh [2017].

establishments for all industries, denoted by y, as the main outcome variable:

$$g_t = \frac{y_{t+2} - y_t}{\{0.5 \times (y_{t+2} + y_t)\}} \times 100. \quad (4)$$

Starting an actual business from the time that the owner came up with the business idea takes more than a year. Similarly, a large investment, such as a major growth decision, requires enough time to check all the necessary conditions and to implement the actual investments. Tax uncertainty at t could influence potential business owners at t, and the outcome some time later will capture this impact. We use the two-year difference as our main specification.[15]

To capture X_{it}^A and X_{it}^B, we include the maximum state personal tax, the maximum state corporate tax, and the state sales tax rates. We also include the state's minimum wage, which might affect the state's business activity. Theoretically, minimum wages can influence business owners' hiring decision by raising the hiring cost.[16]

We need to specify the counties "near" a state border. Following Holmes [1998], we choose the counties whose distance to a state border is less than 25 miles in the baseline analysis.[17] However, our results are robust to alternative definitions, such as, counties within 15, 20 or 30 miles of a state border.

Figure 3 shows the number of establishments in counties within 25 miles of a state border in 2001. Some of the adjacent counties at a border exhibit a very different number of establishments and may have a quite different economic environment. To reduce such idiosyncrasy, we choose all counties on one side of a border and all counties on the other side

[15] Rohlin et al. [2014] use a similar specification.

[16] Economists have tested this prediction and found mixed results. (e.g., Dube et al. [2010]; Neumark et al. [2014]). The minimum wage data are from Allegretto et al. [2017]. We thank the authors for making their data available on the website.

[17] We thank Thomas J. Holmes for making his data about US state borders available on his website.

as the pair for our analysis.[18]

The TU measure is not available for many Western states. Moreover, Western states tend to have geographically large counties. As a result, the economic conditions in counties near the border in Western states look quite different from those in other states. For this reason, we exclude Western states from our analysis.[19]

While the representation of equation (3) is useful for expositional purpose, we use the observations from both sides of a border and include border-pair-time fixed effects, as well as the border-side (i.e., the A or B side of a border) fixed effects. After excluding Western states and states in which the TU measure is not available, 55 border-pairs and 110 border-sides remain. In all specifications, the standard errors are clustered by border-pair and state.[20]

3.3 Main Result

Before discussing our main result, we first run a regression with only the level of taxes and minimum wages. The result is shown in the first column of Table 7. The state corporate tax and state personal tax rates are negatively associated with establishment growth rates. The coefficient for corporate tax, however, is near zero. The coefficients for the state sales tax rates and minimum wages are positive and the standard errors are relatively high. Retail customers typically pay sales tax, and, therefore, many sectors may not be directly affected by a change in sales tax rates. The minimum wage may affect the restaurant industry or other industries that hire relatively low-income workers, but the proportion of such industries might be small among all industries.

Some borders never experienced a change in state corporate tax on either side of the

[18]For counties with multiple adjunct states, we assign a state border with the shortest distance.

[19]The Western states include Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

[20]We use STATA command *reghdfe*, developed by Correia et al. [2016], which implements the clustering method of Cameron et al. [2011].

border. This may be why the coefficient for corporate tax is near zero in the first regression. In the second regression, shown in the second column of Table 7, we use only the 29 borders at which at least one side experienced a change in state corporate tax rates between 2001 and 2010. Indeed, once we condition on the borders that exhibit a variation of state corporate tax rates, the coefficient for corporate tax becomes much higher – -0.0002 vs. -0.0518 – even though the standard errors are still large.

Our main result, presented in the third column of Table 7, shows the regression result from the main specification in Section 3.1. First, the negative relationship between the outcome and the level of corporate tax becomes much more pronounced – -0.00017 vs. -0.015 – once we control for the TU measure. This finding suggests that part of the reason for the almost zero effect of the level of corporate tax is the omitted variation of tax uncertainty.

Second, the coefficient for the log TU measure, θ, is estimated at -1.073, meaning that a 10% increase in the TU measure leads to approximately a 0.11% point decrease in the growth rate of the establishments over two years. Another interpretation is that increasing tax uncertainty by one standard deviation (a 30% increase in the TU measure) leads to a 0.17% point per-year decrease in the growth rate of establishments over two years. Or moving from the 25^{th} percentile to 75^{th} percentile of the distribution of one-year percentage change of TU measures between 2001 and 2010, which corresponds to a 40% increase in the TU measure, reduces the two-year establishment growth rates by about 0.44%. If we relate this number to the probability of a maximum state corporate tax change, a 1.5% point increase in the probability of a maximum state corporate tax change in the following year leads to a 0.11% point decrease in the growth rate of the number of establishments over two years.

In the fourth column of Table 7, we include the mean of other states' corporate tax rates as proxies for the expected tax rate in the following year. When the year fixed effect is controlled for, the arithmetic mean of other states' corporate tax rates is linearly dependent on the state's corporate tax rate. For this reason, we use the geometric mean of other states' tax rates. A 1% point increase in the mean of other states' corporate tax rates leads to a 2% point decrease in the growth rate of the establishments over two years, although the standard error is rather large. More importantly, the coefficient for the log TU measure rarely changes.

Next, we exclude observations from the period of the Great Recession (from 2008 to 2010). As shown in the fifth column of Table 7, the coefficient for the log TU measure changes only slightly, from -1.073 to -1.225. This result suggests that our results are not particularly driven by the Great Recession.

3.4 Understanding the Mechanism

Our estimates are based on the information from border counties and the effect of tax uncertainty may be border-specific. For example, an establishment on Side A of a border may relocate to the other side of the border in response to tax uncertainty; this relocation may be observed mainly among establishments in border counties due to a relatively low moving cost. If this relocation is the main mechanism behind our estimates, the aggregate effect of tax uncertainty is much lower than our estimates suggest.

To test whether the effect of tax uncertainty is particularly observed among border counties, we consider the following equation:

$$g_{ct} = \theta \ln(\mathrm{TU}_{st}) + \theta_b \ln(\mathrm{TU}_{st}) \cdot \mathrm{Border}_c + \beta X_{st} + \beta_b X_{st} \cdot \mathrm{Border}_c + \tau_c + u_{ct}, \qquad (5)$$

where c and s stand for county and state, respectively. g_{ct} is the two-year establishment growth rate in county c in year t. TU_{st} is the TU measure for state s in year t, and X_{st}

includes state taxes and minimum wages in year t. τ_c refers to a time-invariant county-fixed effect, and u_{ct} is a random component of county c in year t with zero-mean. Border_c is the dummy variable, which indicates that a county c is a border county.

We are interested in whether the effect of the TU measure is particularly pronounced for border counties − in other words, whether $\hat{\theta}_b$ is statistically significant. We further control for any time-varying state-specific effect by including state-time fixed effects ψ_{ct}, and we estimate θ_b as follows:

$$g_{ct} = \theta_b \ln(\text{TU}_{st}) \cdot \text{Border}_c + \beta_b X_{st} \cdot \text{Border}_c + \tau_c + \psi_{st} + u_{ct}. \tag{6}$$

The estimation result is shown at Table 8. θ_b is estimated as near zero and insignificant, indicating that the effect of the TU measure is not particularly higher among border counties. This finding suggests that the relocation of establishments in border counties is not a main driving force behind our estimates.

4 Robustness Checks

4.1 Other Policy Uncertainty

Tax uncertainty may be correlated with other types of policy uncertainty. For example, the uncertainty about a state's budget condition may increase both tax uncertainty and other policy uncertainty. Although it is not feasible to cleanly separate tax uncertainty from other policy uncertainty, we provide two reasons that we believe our results are driven mainly by tax-policy uncertainty.

Controlling for general policy uncertainty measures

First, we estimate the main specification in equation (3) by including three measures that may capture general policy uncertainty. The first measure is a state's mid-year budget cut. A state that faces an unforeseen budget situation can adjust the state budget in mid-year. We use the amount of this mid-year budget cut, normalized by the state's population, as the first measure to capture general policy uncertainty.[21]

The second measure is a state-year specific dummy variable indicating whether a state experienced a tight race for the gubernatorial election in that year. Depending on whether a Democrat or a Republican wins the election, state policies could be very different. Therefore, the fact that people cannot predict which party will eventually win the election means that they are uncertain about the type of policies that will be implemented in the next few years. An election is defined as a tight race if the difference in voting share between the winner and the runner-up is less than 10%.[22]

We construct the third policy uncertainty measure similarly to Baker et al. [2016]. With the same set of newspapers used to generate the TU measure, we use the following trio of terms to generate a general policy uncertainty measure: "policy" or "policies"; "local" or "state"; and "uncertain," "uncertainty," or "uncertainties." Note that we replace the tax-related terms for the TU measure with "policy" or "policies" to generate a general state policy uncertainty measure.

The estimation results are reported in Table 9. In the first regression, we include the state budget cut variable. The estimate for the budget cut variable is near zero, and the

[21] Mian and Sufi [2014] use the same measure to capture policy uncertainty. The data for mid-year budget cut are from the website of the National Association of State Budget Officers (https://www.nasbo.org/reports-data/fiscal-survey-of-states). The money value is normalized by one USD in 2010 by using the consumer price index. The data for state population are from the website of the St. Louis FED (https://fred.stlouisfed.org/).

[22] The data for US gubernatorial elections are from the website of Our Campaigns (https://www.ourcampaigns.com/).

estimate for the log TU measure rarely changes. In the second regression, we include the tight-election dummies. Although the standard error is rather high, the tight-election dummy shows a negative relationship with the two-year establishment growth rates. For a state that experienced a tight gubernatorial race, about a 0.68% point of the two-year establishment growth rate decreased, on average. More importantly, the estimate for the log TU measure is almost the same. In the third regression, we include the general policy uncertainty measure (PU) generated by the newspaper article count. The effect of the PU is marginal and not significant. The estimate for the log TU measure changes marginally. In the fourth column of Table 9, we include all three general policy measures. Again, the result for the TU measure rarely changes. Overall, our result is robust to including measures that are more likely to capture general policy uncertainty.

The results in Table 9 do not necessarily mean that general policy uncertainty does not matter. The fact that the coefficients for the tight-election dummy and for the log PU measure are negative suggests that general policy uncertainty may also negatively influence business activity. The fact that the effect of tax uncertainty is pronounced even after controlling for other policy uncertainty measures suggests that, among many policy uncertainties, tax uncertainty is one of the most relevant for business activity. This finding is in line with a survey result by business owners in the United States. The *National Federation of Independent Businesses* has conducted a state-level survey for business owners for more than 30 years. One of the survey questions is: "What is the single most important problem facing your business today?" The most common choice for all survey years except for those during the Great Recession is taxes.[23] Business owners may care the most about the tax among relevant government policies, because it directly affects their future income stream.

[23]Possible choices include (1) taxes, (2) inflation, (3) poor sales, (4) finance and interest rates, (5) cost of labor, (6) government regulation and red tape, (7) competition from large businesses, (8) quality of labor, (9) cost/availability of insurance, and (10) others.

Sub-sample analysis for two types of industries

To the extent that general policy uncertainty equally affects both incorporated and non-incorporated firms, the effect of our TU measure should be more pronounced among industries with relatively more incorporated firms if the TU measure indeed captures corporate tax uncertainty. On the other hand, if our TU measure merely captures general policy uncertainty, the effect should be more or less similar across industries, regardless of the proportion of incorporated firms.

To test this prediction, we conduct sub-sample analyses: one with industries having a relatively large proportion of incorporated firms, the other with industries having a relatively small proportion of incorporated firms. To classify industries with respect to the proportion of incorporated firms, we refer to the Survey of Income and Program Participation (SIPP), a nationally representative household-based survey of the US population.[24] Using 2004 and 2008 non-overlapping panels, we calculate the proportion of business owners across different industries. "Manufacturing," "Wholesale trade," "Finance, insurance, real estate, and rental and leasing," and "Information" are the four industry categories that exhibit the largest proportion of incorporated firms, at 44%, 43%, 39%, and 37%, respectively. On the other hand, "Agriculture, Forestry, Fishing and Hunting," "Other Services (except Public Administration)," "Educational Services and Health Care and Social Assistance," and "Professional, Scientific, and Technical Services" are the four industry categories that exhibit the smallest proportion of incorporated firms, at 13%, 18%, 25%, and 28%, respectively.

Table 10 shows the estimation results. In the first column, we report the result with industries having a large proportion of incorporated firms. The coefficient for the log TU measure is estimated at -1.316, slightly larger than -1.073, the estimate for the benchmark regression. The second column shows the result with industries having a small proportion

[24]Source: https://www.census.gov/sipp

of incorporated firms. The coefficient for the log TU measure is insignificant, as opposed to that for industries with a large proportion of corporations. Overall, the effect of the TU measure is more pronounced in industries in which the proportion of incorporated firms is higher, which supports the view that the TU measure captures the state corporate tax uncertainty rather than general policy uncertainty.

4.2 Other Outcome Variables

In this section, we investigate the relationship between our TU measure and other outcome variables. First, by using the CBP, we construct a two-year growth rate of employment similar to equation (4):

$$\text{Employment growth}_t = \frac{E_{t+2} - E_t}{\{0.5 \times (E_{t+2} + E_t)\}} \times 100, \tag{7}$$

where E_t is the employment level in year t. Theoretically, if tax uncertainty is holding back investment through the wait-and-see channel, it should also deter employment growth. To test this theoretical prediction, we estimate the main specification (the specification in the third column of Table 7) with employment growth as the dependent variable. The estimation result is reported in the first column of Table 11. The coefficient for the log TU measure is estimated at -2.116, meaning that a 10% increase in the TU measure leads to approximately a 0.21% point decrease in the growth rate of employment over two years. Note that the estimate for the two-year establishment growth rate is -1.073 (the third column of Table 7), indicating that the response of employment growth is larger than that of the establishment growth rate. The key difference between establishment growth and employment growth is that the former does not take into account the intensive margin of investment, whereas the latter does. This finding suggests that tax uncertainty also affects the growth decisions of incumbent business owners.

Second, as another outcome variable, we construct the new-firm entry rate using the Quarterly Workforce Indicator (QWI) of the U.S. Census Bureau. The QWI provides employment at firms whose age is between 0 and 1, as well as the total employment in each county. With these data, we calculate the employment-weighted new-firm entry rate (job-creation rate from birth) as follows:

$$\text{Job-creation rate from birth}_t = \frac{\text{Employment at firm age 0-1 in year } t}{\text{Total employment in year } t} \times 100. \qquad (8)$$

The estimation result is reported in the second column of Table 11. The coefficient for the log TU measure is estimated at -0.112, meaning that a 10% increase in the TU measure leads to approximately a 0.01% point decrease in the employment-weighted new-firm entry rate. Note that the average job-creation rate from birth in the main sample is 4.5%. Conditional on the average job-creation rate from birth, the magnitude of the estimate for the log TU measure is very small. Moreover, the standard error for the coefficient is large. Overall, the regression result suggests that the effect of tax uncertainty is not particularly pronounced for new-firm entry. New businesses are more likely to be unincorporated. Because our tax uncertainty measure is most relevant for corporate tax uncertainty, job creation by unincorporated startups are less likely to be affected by our measure. This finding is also in line with the regression result for employment growth. Although the entry decision by potential entrepreneurs is an important, irreversible investment, the growth decision (e.g., hiring more employees) by incumbent establishments is as important as the entry decision.

4.3 Other Robustness Checks

In this section, we report several other robustness checks. We first estimate the main empirical specification without state borders, for which the economic conditions in side A and side B differ considerably. More specifically, we drop five state borders in which the difference in the number of establishments between side A and side B is greatest in 2001. The result is presented in the second column in Table 12. Compared to the baseline case, the value of the estimate for θ changes only slightly, from -1.073 to -1.012, suggesting that the borders at which adjacent counties exhibit significantly different economic conditions are not the primary driver of the main results.

The TU measure may be responsive mainly to the case in which an actual tax change occured. To check whether the states that experienced the actual tax change are the primary driver of our results, we include an interaction term for the log TU measure and the dummy indicating that a state actually experienced a corporate tax rate change. The result is presented in the third column in Table 12. The coefficient for the interaction term is estimated to be insignificant, suggesting that the negative effect of the TU measure is not driven by states in which the actual state corporate tax change was realized.

Starting in 2009, many states increased their unemployment-benefit duration by implementing either the Extended Benefit (EB) or the Emergency Unemployment Compensation (EUC) program in response to the Great Recession.[25] To capture heterogeneity in the unemployment-benefit duration, we classify states into three groups as of December 2010: (1) not eligible for the EB; (2) eligible for the EB and not eligible for the EUC tier 4;[26] and (3) eligible for the EB and for the EUC tier 4. We construct two dummy variables for 2010.[27] The first dummy variable, EB, indicates states that were eligible for the EB at the

[25] For a detailed discussion of the unemployment-benefit duration during the Great Recession, see Hagedorn et al. [2015].

[26] Note that, as of December 2010, all states in our sample were eligible for the EUC tiers 1, 2, and 3.

[27] The eligibility for the EB or EUC program between 2009 and 2010 changes several times within a

end of 2010. The second dummy variable, EUC4, indicates states that were eligible for tier 4 of the EUC, as well as for the EB at the end of 2010. In the fourth column of Table 12, we additionally control for these dummy variables. First, the coefficients for the dummy variables is negative, suggesting that states that implemented a longer unemployment-benefit duration tended to experience lower establishment growth. Second, the coefficient for the log TU measure rarely changes, indicating that our main results hold even after controlling for the increased unemployment-benefit duration during the Great Recession.

In 2005, Louisiana's and Mississippi's TU measure increased dramatically. Both states' high increase in the TU measure coincided with Hurricane Katrina, which caused severe destruction in there. The uncertainty in the states' budget condition caused by the hurricane is likely to have increased tax uncertainty. At the same time, Hurricane Katrina might also have increased other types of uncertainty. As a robustness check, we exclude the observations from Louisiana and Mississippi and re-estimate the main specification. The result is presented at the fifth column of Table 12. The main result still holds.

Next, as a placebo test, we regress the previous growth rate, calculated as

$$g_{t-1} = \frac{y_{t-1} - y_{t-2}}{\left\{0.5 \times (y_{t-1} + y_{t-2})\right\}} \times 100,$$

on the TU measure. The result is presented in the sixth column in Table 12, which clearly shows no relationship between the TU measure and the previous growth rate.

We use the two-year establishment growth rate as our main outcome variable. In Table 13, we report the results for the one-year and three-year establishment growth rates along with the two-year growth rate. First, the coefficient for the log TU measure, θ, is estimated

year, and how to link the EB or EUC program eligibility with our annual data is unclear. For this reason, we develop dummy variables only for 2010. The trigger information for the EB program is from https://ows.doleta.gov/unemploy/trigger. The trigger information for the EUC program is from https://ows.doleta.gov/unemploy/euc_trigger.

at -0.502 for the one-year growth rate. The magnitude of the estimate becomes smaller than that for the two-year growth rate. Second, θ is estimated at -1.082 for the three-year establishment growth rate, which is comparable to the estimate for the two-year growth rate. The standard error of the estimate for the three-year growth rate is higher than that for the two-year growth rate, which may reflect the fact that, over the three-year period, other incidents that affect business activity may also have happened. Overall, these results suggest that it takes some time for the effect of tax uncertainty to be realized, and the effect tends to persist.

5 Conclusion

We develop a statewide tax uncertainty measure (TU measure) and provide some evidence that it captures state corporate tax uncertainty. To identify a causal relationship between the TU measure and business activities, we compare the difference in the growth rate of the number of establishments in counties near a state border. The baseline estimates indicate that a 10% increase in tax uncertainty leads to about a 0.11% point decrease in the growth rate of the number of establishments over two years. The result holds after conducting a variety of robustness checks and is not likely to be driven by general state-policy uncertainties.

Although we show evidence that our TU measure is positively correlated with the true tax uncertainty, our TU measure may inevitably contain a measurement error. As a result, from the usual measurement error bias argument, the estimates for the TU measure may be biased toward zero. In this sense, our result may be interpreted as a lower bound of the true effect of tax policy uncertainty. Nevertheless, our result clearly shows that tax uncertainty has a significant, negative impact on business activity in the United States.

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Tables and Figures

Table 1: Summary Statistics for State Tax Rates (%)

	Mean	Median	Std. dev.
Maximum corporate income tax	6.51	6.97	2.63
Maximum personal income tax	5.23	5.82	2.70
Sales tax	5.28	5.5	1.34
ΔMaximum corporate income tax	-0.03	0	0.37
ΔMaximum personal income tax	0.02	0	0.33
ΔSales tax	0.06	0	0.27

NOTE: The number is calculated for 37 states between 2001 and 2010 for which the TU measure is available. Those states include Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin. Δ stands for one-year difference in each tax rate.

Table 2: TU Measure and State Tax Changes in the Following Year (All States)

VARIABLES	(1) Corp. tax change	(2) Personal tax change	(3) Sales tax change
ln(TU)	0.148**	-0.0893	0.110
	(0.0669)	(0.112)	(0.0804)
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	333	333	333
R-squared	0.356	0.405	0.222

NOTE: Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: TU Measure and State Corporate Tax Changes in the Following Year (All States)

VARIABLES	(1) Corp. tax increase	(2) Corp. tax decrease
ln(TU)	0.120**	0.0473
	(0.0563)	(0.0454)
Year FE	Yes	Yes
State FE	Yes	Yes
Observations	316	323
R-squared	0.273	0.300

NOTE: The first regression is based on the sample that excludes the state corporate tax decrease. As a consequence, Corp. tax increase refers to the dummy variable indicating a state corporate tax increase in the following year. The second regression is based on the sample that excludes the state corporate tax increase. As a consequence, Corp. tax decrease refers to the dummy variable indicating a state corporate tax decrease in the following year. Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: TU Measure and State Corporate Tax Changes in the Following Year (States that experienced a Corporate Tax Change)

VARIABLES	(1) Corp. tax change	(2) Corp. tax increase	(3) Corp. tax decrease
ln(TU)	0.651**	0.541**	0.376
	(0.249)	(0.225)	(0.230)
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	99	82	89
R-squared	0.405	0.436	0.378

NOTE: States that experienced a corporate tax change include Connecticut, Indiana, Kansas, Kentucky, Massachusetts, Michigan, Nebraska, New York, Ohio, Oregon, and Tennessee. The samples for the second and the third regressions are constructed as in Table 3. Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: TU Measure and State Corporate Tax Changes in the Following Year (Controlling for the Expected Tax Rate)

	All States		11 States	
VARIABLES	(1) Corp. tax change	(2) Corp. tax change	(3) Corp. tax change	(4) Corp. tax change
ln(TU)	0.148**	0.145**	0.651**	0.645**
	(0.0669)	(0.0663)	(0.249)	(0.243)
Other c.tax		3.509*		3.910*
		(1.872)		(1.834)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Observations	333	333	99	99
Adj. R-sq.	0.253	0.289	0.252	0.305

NOTE: Other c.tax refers to the average of other states' corporate tax rates. The 11 states are states that experienced a corporate tax change (Connecticut, Indiana, Kansas, Kentucky, Massachusetts, Michigan, Nebraska, New York, Ohio, Oregon, and Tennessee). Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: TU Measure and State Corporate Tax Changes in the Following Year (without Michigan and Ohio)

	11 States		w.o MI & OH	
VARIABLES	Corp. tax change	Corp. tax decrease	Corp. tax change	Corp. tax decrease
ln(TU)	0.651**	0.376	0.689**	0.466*
	(0.249)	(0.230)	(0.274)	(0.211)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Observations	99	89	81	73
R-squared	0.405	0.378	0.429	0.438

NOTE: The results with 11 states are from Table 4, and are presented here for comparison. Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Regressions for Two-year Est. Growth Rate

VARIABLES	(1) g	(2) g	(3) g	(4) g	(5) g
ln(TU)			-1.073**	-1.083**	-1.225**
			(0.476)	(0.476)	(0.542)
Corp. tax	-0.000170	-0.0518	-0.0150	-0.0805	0.456
	(0.110)	(0.120)	(0.112)	(0.105)	(0.374)
Personal tax	-0.192	-0.0621	-0.214	-0.216	0.395
	(0.257)	(0.416)	(0.219)	(0.218)	(0.573)
Sales tax	0.229	0.945	0.0858	0.0932	0.352
	(0.461)	(0.697)	(0.446)	(0.448)	(1.012)
Min. wage	0.404	1.194	0.433	0.431	0.229
	(0.570)	(0.826)	(0.537)	(0.537)	(0.534)
Other c.tax				-2.087	
				(2.173)	
Year$\leq$ 2007					Yes
Border-Year FE	Yes	Yes	Yes	Yes	Yes
Border-Side FE	Yes	Yes	Yes	Yes	Yes
Observations	1,100	580	1,100	1,100	770
R-squared	0.847	0.773	0.849	0.849	0.853

NOTE: g is the two-year establishment growth rate of each side of a state border, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. In the second regression, we use only the 29 borders at which at least one of the two sides experienced a change in state *corporate* tax rates between 2001 and 2010. Other c.tax refers to the *geometric* average of other states' corporate tax rates. Regression (5) includes observations from 2001 to 2007. Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Testing Cross-border Spillover Effect

VARIABLES	(1) g_c
ln(TU)×Border	-0.0222
	(0.310)
Corp. tax×Border	-0.0492
	(0.0779)
Personal tax×Border	-0.367
	(0.293)
Sales tax×Border	0.00519
	(0.192)
Min. wage×Border	0.135
	(0.123)
State-Year FE	Yes
County FE	Yes
Observations	24,138
R-squared	0.346

NOTE: g_c is the two-year establishment growth rates of a county, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. "Border" refers to the dummy variable indicating border counties. Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Controlling for General Policy Uncertainty Measures

VARIABLES	(1) g	(2) g	(3) g	(4) g
ln(TU)	-1.100**	-1.142**	-1.046**	-1.183**
	(0.485)	(0.497)	(0.448)	(0.459)
Budget cut	0.00261			0.00180
	(0.00282)			(0.00238)
Tight election		-0.682		-0.641
		(0.456)		(0.408)
ln(PU)			-0.0529	0.0513
			(0.719)	(0.661)
Corp. tax	-0.00840	-0.0400	-0.0149	-0.0340
	(0.112)	(0.123)	(0.111)	(0.121)
Personal tax	-0.225	-0.229	-0.213	-0.236
	(0.202)	(0.193)	(0.220)	(0.183)
Sales tax	0.0501	0.0989	0.0856	0.0737
	(0.432)	(0.447)	(0.447)	(0.436)
Min. wage	0.430	0.416	0.434	0.413
	(0.537)	(0.524)	(0.540)	(0.525)
Border-Year FE	Yes	Yes	Yes	Yes
Border-Side FE	Yes	Yes	Yes	Yes
Observations	1,100	1,100	1,100	1,100
Adj. R-sq.	0.618	0.620	0.617	0.619

NOTE: g is the two-year establishment growth rates of a border side, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. "TU" refers to the TU measure. "Budget cut" is the state mid-year budget cut, normalized by the state's population. "Tight election" is state-year specific dummy variable indicating whether a state experienced a tight gubernatorial race in that year. "PU" refers to the policy uncertainty measure generated by the following trio of keywords: : "policy" or"policies"; "local" or "state"; "uncertain," "uncertainty," or "uncertainties." Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Industry with Large vs. Small Proportion of Corporations

	Large prop. of Inc.	Small prop. of Inc.
	(1)	(2)
VARIABLES	*g*	*g*
ln(TU)	-1.316*	0.852
	(0.749)	(1.095)
Corp. tax	0.0831	-0.227
	(0.139)	(0.160)
Personal tax	-0.051	0.110
	(0.369)	(0.450)
Sales tax	-0.484	0.956
	(0.529)	(0.732)
Min. wage	-0.944	-0.304
	(0.711)	(0.540)
Border-Year FE	Yes	Yes
Border-Side FE	Yes	Yes
Observations	1,100	1,100
R-squared	0.782	0.704

NOTE: The variable definition is the same as in Table 7. Industries with a large proportion of corporations include “Manufacturing,” “Wholesale trade,” “Information,” and “Finance, insurance, real estate, and rental and leasing.” Industries with a small proportion of corporations include “Agriculture, Forestry, Fishing and Hunting,” “Other Services (except Public Administration),” “Educational Services and Health Care and Social Assistance,” and “Professional, Scientific, and Technical Services.” Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Other Outcome Variables

VARIABLES	(1) Employment growth	(2) Job-creation rate from births
ln(TU)	-2.116**	-0.112
	(1.022)	(0.240)
Corp. tax	-0.152	0.0462
	(0.225)	(0.0346)
Personal tax	-0.388	0.183
	(0.811)	(0.155)
Sales tax	-0.255	-0.189
	(0.471)	(0.292)
Min. wage	0.809	0.183
	(0.964)	(0.192)
Border-Year FE	Yes	Yes
Border-Side FE	Yes	Yes
Observations	1,100	880
R-squared	0.818	0.780

NOTE: Employment growth is the two-year employment growth rates of a border side, calculated by $\frac{E_{t+2}-E_t}{\left\{0.5\times(E_{t+2}+E_t)\right\}} \times 100$, where E_t is the employment level of a border side in year t. The employment growth is constructed by using the CBP. Job-creation rate from births of a border side in year t is calculated as $\frac{\text{Emp at firm age 0-1}}{\text{Total emp.}} \times 100$ by using the Quarterly Workforce Indicator (QWI) of the U.S. Census Bureau. Three states (Arkansas, Massachusetts, Mississippi) in QWI do not cover the sample periods $(2001 - 2010)$, and the observations from those states are dropped. Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Other Robustness Checks

VARIABLES	(1) g	(2) g	(3) g	(4) g	(5) g	(6) g_{-1}
ln(TU)	-1.073**	-1.012**	-1.135**	-1.101**	-1.121*	0.483
	(0.476)	(0.491)	(0.540)	(0.481)	(0.577)	(0.456)
Corp. tax	-0.0150	-0.0304	0.107	-0.0145	-0.0151	0.0186
	(0.112)	(0.117)	(0.147)	(0.113)	(0.113)	(0.0775)
Personal tax	-0.214	-0.0841	-0.0244	-0.209	-0.224	-0.0934
	(0.219)	(0.282)	(0.293)	(0.229)	(0.213)	(0.181)
Sales tax	0.0858	0.288	-0.163	0.00116	0.00796	-0.0945
	(0.446)	(0.489)	(0.548)	(0.447)	(0.458)	(0.197)
Min. wage	0.433	0.475	0.293	0.435	0.488	-0.291
	(0.537)	(0.606)	(0.501)	(0.532)	(0.546)	(0.243)
Realized× ln(TU)			0.101			
			(0.0661)			
No-outlier		Yes				
EB				-1.220**		
				(0.561)		
EUC4				-1.459*		
				(0.779)		
Without LA/MS					Yes	
Border-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Border-Side FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,100	1,000	990	1,100	980	1,100
R-squared	0.849	0.846	0.866	0.850	0.843	0.783

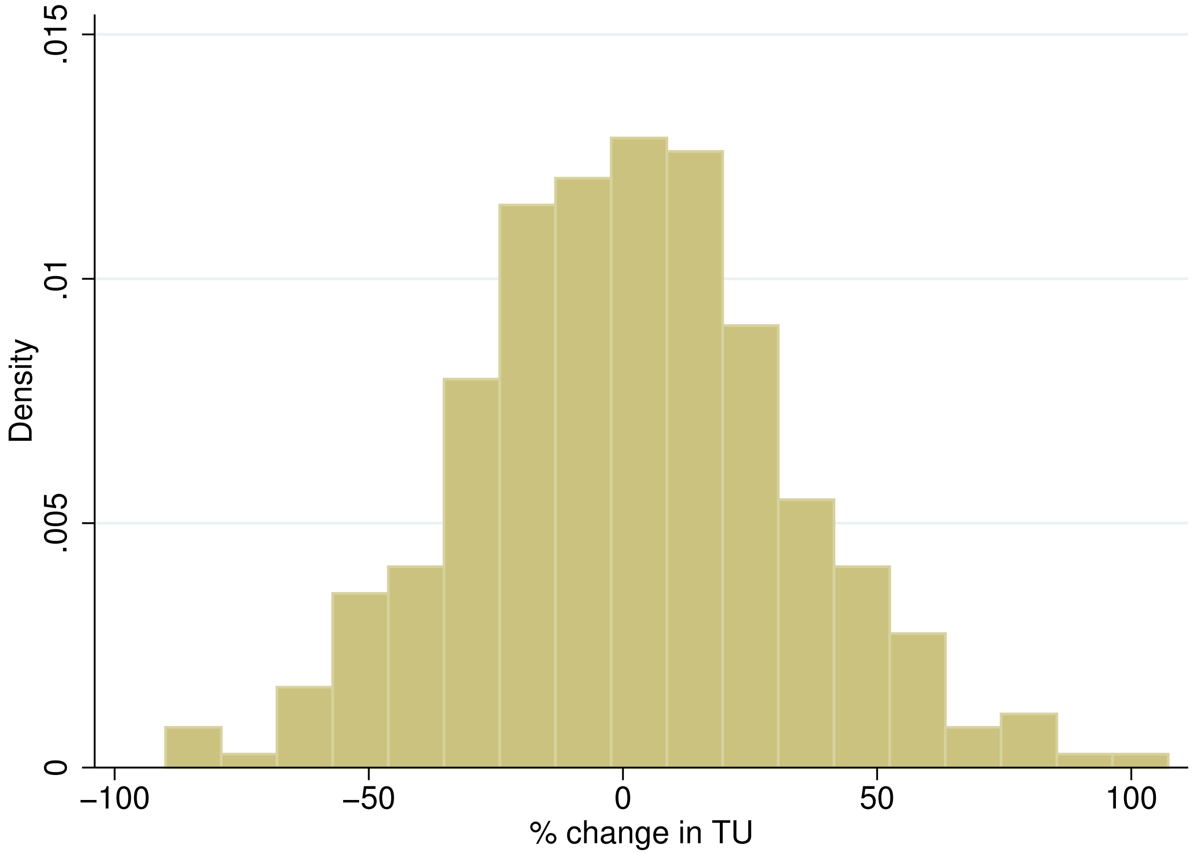
NOTE: g is the two-year establishment growth rate of each side of a state border, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. The first regression is identical to the third regression in Table 7. In the second regression, we remove five borders at which the difference in the number of establishments between sides is the largest. "Realized" is the dummy variable indicating whether the state to which a border side belongs changed the state corporate tax in the following year. EB is a dummy variable for states that were eligible for the Extended Benefits (EB) program at the end of 2010. EUC4 is a dummy variable for states that were eligible for tier 4 of the Emergency Unemployment Compensation (EUC) program, as well as for the EB at the end of 2010. In the fifth regression, we exclude the observations from Louisiana (LA) and Mississippi (MS). g_{-1} refers to the one-year growth rate in the previous year defined as $\frac{y_{t-1}-y_{t-2}}{\left\{0.5\times(y_{t-1}+y_{t-2})\right\}} \times 100$. Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Different Time Periods

VARIABLES	(1) g_{+1}	(2) g	(3) g_{+3}
ln(TU)	-0.502	-1.073**	-1.082
	(0.354)	(0.476)	(0.649)
Corp. tax	-0.0305	-0.0150	-0.0318
	(0.0694)	(0.112)	(0.141)
Personal tax	-0.0473	-0.214	-0.417
	(0.158)	(0.219)	(0.303)
Sales tax	0.187	0.0858	0.0305
	(0.292)	(0.446)	(0.532)
Min. wage	0.0791	0.433	0.730
	(0.309)	(0.537)	(0.630)
Border-Year FE	Yes	Yes	Yes
Border-Side FE	Yes	Yes	Yes
Observations	1,100	1,100	1,100
R-squared	0.800	0.849	0.883

NOTE: g_{+1} refers to one-year growth rate defined as $\frac{y_{t+1}-y_t}{\left\{0.5\times(y_{t+1}+y_t)\right\}} \times 100$. g is the two-year establishment growth rate of each side of a state border, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. The second regression is identical to the third regression in Table 7. g_{+3} refers to three-year growth rate defined as $\frac{y_{t+3}-y_t}{\left\{0.5\times(y_{t+3}+y_t)\right\}} \times 100$. Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: One-year Percentage Change of TU Measure

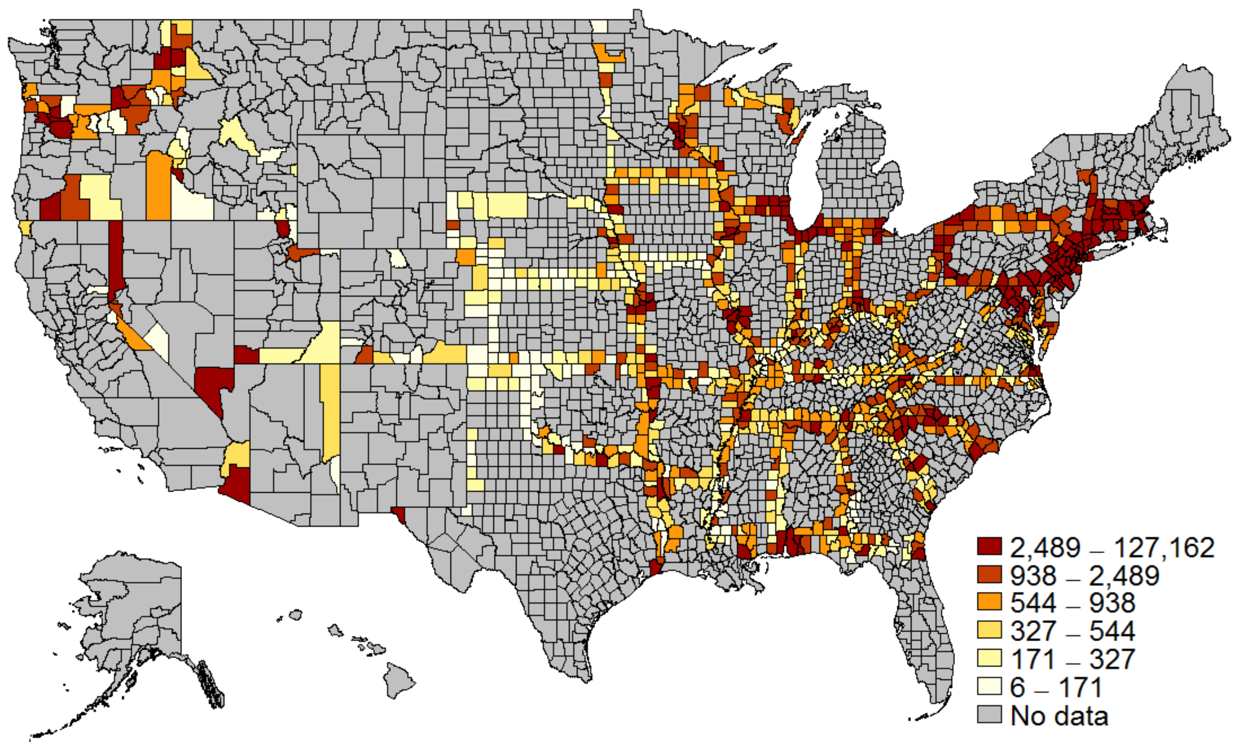


NOTE: This figure depicts the one-year percentage change of TU for all the available states and time. The mean and standard deviation are 0.01 and 0.31, respectively. States in which the TU measure is not available include Alaska, Delaware, Hawaii, Maine, Montana, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, West Virginia, Vermont, and Wyoming.

Figure 2: Ave. and Std. of One-year Percentage Change of TU Measure for Each State

NOTE: This figure depicts the average and standard deviation of the one-year percentage change of TU measure for each state. States in which the TU measure is not available include Alaska, Delaware, Hawaii, Maine, Montana, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, West Virginia, Vermont, and Wyoming.

Figure 3: Number of Establishments in Counties within 25 miles of State Borders



NOTE: This figure depicts the number of establishments in counties within 25 miles of state borders in 2001. Counties in the states in which the TU measure is not available are dropped. Those states include Alaska, Delaware, Hawaii, Maine, Montana, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, West Virginia, Vermont, and Wyoming.

Appendix

A Theoretical Framework

A.1 Environment

In this section, we present a simple model that illustrates how tax uncertainty can affect entrepreneurs' investment decisions. Consider an entrepreneur with productivity k who has an investment project. We assume that k is fixed over time. Let τ_0 be the current tax rate. The entrepreneur decides whether to invest in the project this period or wait until the next period. If the entrepreneur invests, he needs to pay a fixed cost K. Let $\pi(k)$ denote the profit per period before paying the tax.

Assumption $\pi(k)$ is continuous and differentiable with respect to k, $\pi(0) = 0$, and $\frac{d\pi(k)}{dk} > 0$ for all k.

$\hat{\pi}(k, \tau_0) = (1 - \tau_0)\pi(k)$ is the profit after paying the tax. The tax rate may change in the next period. We assume that the tax can either increase to τ_H or decrease to τ_L. Thus, $\tau_L < \tau_0 < \tau_H$. The transition matrix is assumed to be

$$M = \begin{pmatrix} m_{LL} & m_{L0} & 0 \\ m_{0L} & m_{00} & m_{0H} \\ 0 & m_{H0} & m_{HH} \end{pmatrix}.$$

The assumption imposed here is the existence of an interim state through which a high tax regime can be reached from a low tax regime, and vice versa.[28]

[28] We need three states because in the current state (state 0), tax can either increase or decrease. With three states, we can change the probability of tax changes in the next period while the expected tax rate is fixed.

A.2 Characterization

We denote the expected value of the investment as $V_e(k,\tau)$ and the value of waiting as $V_w(k,\tau)$. The value functions can be represented as below:

$$V_e(k,\tau_s) = \hat{\pi}(k,\tau_s) + \beta \sum_{s'} m_{ss'} V_e(k,\tau_{s'}) \qquad \text{for each } s \in \{L, 0, H\} \tag{9}$$

$$V_w(k,\tau_s) = \beta \sum_{s'} m_{ss'} \max[V_e(k,\tau_{s'}) - K, V_w(k,\tau_{s'})], \tag{10}$$

where $\beta \in (0,1)$ is the discount factor.

Proposition 1 For each tax level, a cutoff $\bar{k}_s$ exists such that the entrepreneur will invest only if the productivity is above the cutoff. The cutoffs should satisfy $\bar{k}_L < \bar{k}_0 < \bar{k}_H$.

Proof Using the definitions of $V_e(k,\tau_s)$and $V_w(k,\tau_s)$ in (9) and (10), we have

$$\begin{aligned} V_e(k,\tau_s) - V_w(k,\tau_s) &= \hat{\pi}(k,\tau_s) + \beta \sum_{s'} m_{ss'} V_e(k,\tau_{s'}) - \beta \sum_{s'} m_{ss'} \max[V_e(k,\tau_{s'}) - K, V_w(k,\tau_{s'})] \\ &= \hat{\pi}(k,\tau_s) + \beta \sum_{s'} m_{ss'} [V_e(k,\tau_{s'}) - V_w(k,\tau_{s'})] \\ &\quad -\beta \sum_{s'} m_{ss'} \max[V_e(k,\tau_{s'}) - V_w(k,\tau_{s'}) - K, 0]. \end{aligned}$$

The above mapping is a contraction mapping T, defining a fixed point $V_e(k,\tau_s) - V_w(k,\tau_s)$,

$$V_e(k,\tau_s) - V_w(k,\tau_s) = T[V_e(k,\tau_s) - V_w(k,\tau_s)].$$

Given that $\hat{\pi}(k,\tau_s)$ is increasing in k and decreasing in τ, we can verify that $V_e(k,\tau_s) - V_w(k,\tau_s)$ is increasing in k and decreasing in τ. Also, because $\hat{\pi}(0,\tau_s)$ is zero, $V_e(0,\tau_s) - V_w(0,\tau_s)$ is zero, as well. (Stokey and Lucas [1989])

For a given tax rate τ_s, an entrepreneur is indifferent between investing and waiting if his productivity is $\bar{k}_s$, defined as below:

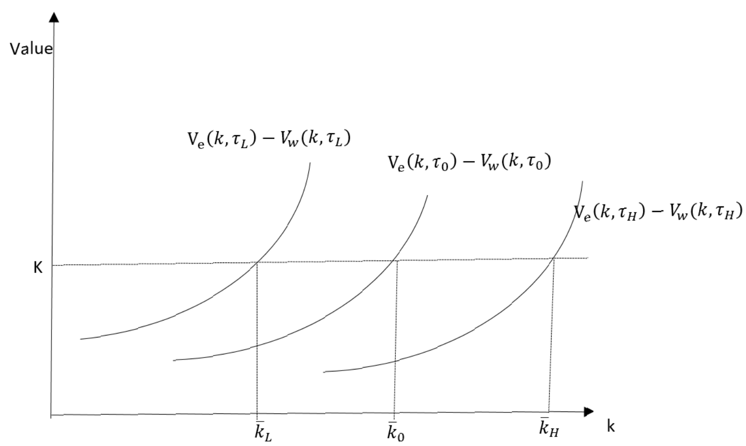
$$V_e\left(\bar{k}_s,\tau_s\right) - V_w\left(\bar{k}_s,\tau_s\right) = K. \tag{11}$$

Because $V_e(k,\tau_s) - V_w(k,\tau_s)$ is increasing in k for any τ_s, a unique cutoff $\bar{k}_s$ exists for each tax rate τ_s. An entrepreneur will invest only if the productivity is above the cutoff. Because $V_e(k,\tau_s) -$

$V_w(k,\tau_s)$ is decreasing in τ_s for any k, we get $\bar{k}_L < \bar{k}_0 < \bar{k}_H$. $\square$

We plot $V_e(k,\tau_s) - V_w(k,\tau_s)$ in Figure 4. The x-axis is productivity k and the y-axis is the value. From left to right, the curve denotes the tax rates τ_L, τ_0 and τ_H, respectively. We can see that $\bar{k}_L < \bar{k}_0 < \bar{k}_H$.

Figure 4: The productivity cutoffs



Now, suppose that the current tax rate is τ_0. If no uncertainty exists (if the tax rate never changes from τ_0), the value from the investment is $\frac{\hat{\pi}(k,\tau_0)}{1-\beta}$. The cutoffs without uncertainty will be denoted as $\bar{k}_0^D$, which satisfies

$$\frac{\hat{\pi}\left(\bar{k}_0^D, \tau_0\right)}{1-\beta} = K. \tag{12}$$

Proposition 2 Given that $\tau_H > \tau_0$ and $0 < \beta < 1$, $\bar{k}_0$ is greater than $\bar{k}_0^D$.

Proof See Section A.2.1.

To understand the above proposition, we can consider a special case $\beta = 0$. In this case, all value functions are just equal to the static profits. Therefore, $\bar{k}_0 = \bar{k}_0^D$. Proposition 2 says that if the entrepreneur cares about the future value, the productivity cutoff is higher in the uncertain environment than in the certain environment.

Proposition 3 Suppose that $\tau_H > \tau_0$ and $0 < \beta < 1$. Denote $\gamma = m_{0L} + m_{0H}$ so that $\hat{\tau} = \frac{m_{0H}}{\gamma}\tau_H + \frac{m_{0L}}{\gamma}\tau_L$ is the expected tax rate conditional on tax rate changes. If $\hat{\tau}$ is fixed,

$\frac{\partial \ln \bar{k}_0}{\partial \gamma} > 0.$

Proof See Section A.2.2.

We say that tax uncertainty becomes higher if the probability of tax changes in the next period (γ) becomes higher while the expected tax rate remains fixed. Given that the expected tax rate is fixed, the proposition says that the cutoff $\bar{k}_0$ increases as γ increases. As a result, entrepreneurs find it more difficult to invest in a more uncertain environment. This finding is in line with the "real option" literature.

A.2.1 Proof of Proposition 2

We first show that $\pi\left(\bar{k}_0\right) = \Delta_0 \pi\left(\bar{k}_0^D\right) > \pi\left(\bar{k}_0^D\right)$, where Δ_0 is a constant, and greater than 1. Because $\pi\left(k\right)$ is monotonically increasing in k, this is sufficient to show that $\bar{k}_0 > \bar{k}_0^D$.

To begin with, we can represent the value functions as below, given the structure of the transition matrix.

$$V_e\left(k, \tau_s\right) = \frac{\hat{\pi}\left(k, \tau_s\right) + \beta m_{s0} V_e\left(k, \tau_0\right)}{1 - \beta m_{ss}}, \quad s \in \{L, H\} \tag{13}$$

$$V_e\left(k, \tau_0\right) = \frac{\hat{\pi}\left(k, \tau_0\right)}{1 - \beta m_0} + \frac{\beta}{1 - \beta m_0} \sum_{s \neq 0} m_{0s} \frac{\hat{\pi}\left(k, \tau_s\right)}{1 - \beta m_{ss}}, \tag{14}$$

where $m_0 = m_{00} + \beta[m_{0L}\frac{m_{L0}}{1-\beta m_{LL}} + m_{0H}\frac{m_{H0}}{1-\beta m_{HH}}]$.

If $k > \bar{k}_H$, the firm will choose to enter the market despite the tax rate. If $k < \bar{k}_L$, the firm will never choose to enter the market. Let us consider a firm whose productivity is between $\bar{k}_L$ and $\bar{k}_0$. Assume that today's tax rate is τ_0. The firm will choose to wait this period. If the tax rate declines next period, the firm will choose to enter next period. The value of waiting at the current state can be written as

$$V_w\left(k, \tau_0\right) = \beta[m_{00} V_w\left(k, \tau_0\right) + m_{0H} V_w\left(k, \tau_H\right) + m_{0L}(V_e\left(k, \tau_L\right) - K)] \quad \text{if } k \in [\bar{k}_L, \bar{k}_0]. \tag{15}$$

With probability m_{00}, the tax rate does not change, and the firm will wait until next period. With probability m_{0H}, the tax rate will increase, and the firm will also choose to wait. With probability m_{0L}, the firm will enter the market because the tax rate goes down and the productivity is between $\bar{k}_L$ and $\bar{k}_0$.

Lemma 1 The value of waiting evaluated at $\bar{k}_0$ is

$$V_w\left(\bar{k}_0, \tau_0\right) = \frac{\beta m_{0L}}{1-\beta(m_{00}+m_{0H}\frac{\beta m_{H0}}{1-\beta m_{HH}})}[\frac{\hat{\pi}\left(\bar{k}_0, \tau_L\right)+\beta m_{L0} V_e\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{LL}} - K]. \tag{16}$$

Proof Notice that, at productivity $\bar{k}_0$, the firm will choose to wait if the tax is τ_H in the next period and will be indifferent between wait and enter if the tax is τ_0 in the next period, so we have

$$V_w\left(\bar{k}_0, \tau_H\right) = \beta[m_{HH} V_w\left(\bar{k}_0, \tau_H\right) + m_{H0} V_w\left(\bar{k}_0, \tau_0\right)] \tag{17}$$

$$V_w\left(\bar{k}_0, \tau_H\right) = \frac{\beta m_{H0} V_w\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{HH}}. \tag{18}$$

Substituting the above equation into equation (15), we have

$$V_w\left(\bar{k}_0, \tau_0\right) = \frac{\beta}{1-\beta m_{00}}\left\{m_{0H}\frac{\beta m_{H0} V_w\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{HH}} + m_{0L}(V_e\left(k, \tau_L\right) - K)\right\}.$$

Combining with equation (13), we get

$$V_w\left(\bar{k}_0, \tau_0\right) = \frac{\beta}{1-\beta m_{00}}\left\{m_{0H}\frac{\beta m_{H0} V_w\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{HH}} + m_{0L}[\frac{\hat{\pi}\left(\bar{k}_0, \tau_L\right)+\beta m_{L0} V_e\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{LL}} - K]\right\}.$$

By simplifying the above equation, we get the lemma. □

Define $\tilde{m} = m_{0L} + m_{00} + m_{0H}\frac{\beta m_{H0}}{1-\beta m_{HH}}$. Combining equation (11) with (16), we get

$$V_e\left(\bar{k}_0, \tau_0\right) - K = \frac{\beta m_{0L}}{1-\beta(\tilde{m}-m_{0L})}\left[\frac{\hat{\pi}\left(\bar{k}_0, \tau_L\right)+\beta m_{L0} V_e\left(\bar{k}_0, \tau_0\right)}{1-\beta m_{LL}} - K\right]$$

$$\Leftrightarrow \left(1-\beta\left((\tilde{m}-m_{0L})+\frac{\beta m_{0L} m_{L0}}{1-\beta m_{LL}}\right)\right) V_e(\bar{k}_0, \tau_0) = \frac{\beta m_{0L}\hat{\pi}\left(\bar{k}_0, \tau_L\right)}{1-\beta(\tilde{m}-m_{0L})} + K\left(1-\beta\tilde{m}\right). \tag{19}$$

By combining equations (14) and (19), we get

$$\hat{\pi}\left(\bar{k}_0, \tau_0\right) + \beta\sum_{s\neq 0} m_{0s}\frac{\hat{\pi}\left(k, \tau_s\right)}{1-\beta m_{ss}} = \frac{\beta m_{0L}\hat{\pi}\left(\bar{k}_0, \tau_L\right)}{1-\beta m_{LL}} + K\left(1-\beta\tilde{m}\right)$$

$$\Leftrightarrow \hat{\pi}\left(\bar{k}_0, \tau_0\right) + \frac{\beta m_{0H}}{1-\beta m_{HH}}\hat{\pi}\left(\bar{k}_0, \tau_H\right) = K\left(1-\beta\tilde{m}\right).$$

Notice that $\hat{\pi}\left(\bar{k}_0, \tau\right) = (1-\tau)\,\pi\left(\bar{k}_0\right)$. Hence,

$$(1-\tau_0)\,\pi\left(\bar{k}_0\right) + \frac{\beta m_{0H}}{1-\beta m_{HH}}\,(1-\tau_H)\,\pi\left(\bar{k}_0\right) = K\,(1-\beta\tilde{m})$$

$$\Leftrightarrow \pi\left(\bar{k}_0\right) = \frac{K\,(1-\beta\tilde{m})}{(1-\tau_0) + \frac{\beta m_{0H}}{1-\beta m_{HH}}\,(1-\tau_H)}.$$

Notice that $\hat{\pi}\left(\bar{k}_0^D, \tau_0\right) = \pi\left(\bar{k}_0^D\right)(1-\tau_0) = (1-\beta)\,K$. Hence,

$$\frac{\pi\left(\bar{k}_0^D\right)}{\pi\left(\bar{k}_0\right)} = \frac{(1-\beta)}{(1-\beta\tilde{m})}\left[1 + \frac{\beta m_{0H}}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right]$$

$$\Leftrightarrow \pi\left(\bar{k}_0\right) = \Delta_0 \pi\left(\bar{k}_0^D\right),$$

where $\Delta_0 = \frac{(1-\beta\tilde{m})}{(1-\beta)}\left[1 + \frac{\beta m_{0H}}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right]^{-1}$. The above equation says that the static profit at the uncertain environment cutoff $\bar{k}_0$ is proportional to the static profit at the certain environment cutoff $\bar{k}_0^D$.

We then show that $\Delta_0 > 1$ if and only if $\tau_H > \tau_0$ and $\beta > 0$.

$$\begin{aligned}
\Delta_0 &> 1 \Leftrightarrow \frac{(1-\beta)}{(1-\beta\tilde{m})}\left[1 + \frac{\beta m_{0H}}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right] < 1 \Leftrightarrow \\
(1-\beta)\frac{\beta m_{0H}}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)} &< (1-\beta\tilde{m}) - (1-\beta) \Leftrightarrow \\
\frac{m_{0H}}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)} &< \frac{m_{0H}}{1-\beta m_{HH}},
\end{aligned}$$

where the last step uses the definition of $\tilde{m} = m_{0L} + m_{00} + m_{0H}\frac{\beta m_{H0}}{1-\beta m_{HH}} = 1 - m_{0H} + m_{0H}\frac{\beta m_{H0}}{1-\beta m_{HH}}$ and $\beta > 0$. Therefore, we have shown that $\pi\left(\bar{k}_0\right) = \Delta_0 \pi\left(\bar{k}_0^D\right) > \pi\left(\bar{k}_0^D\right)$. $\square$

To understand the above result, let $\beta = 0$, and we can see that $\Delta_0 = 1$, which suggests that $\bar{k}_0 = \bar{k}_0^D$. So, if the entrepreneur does not care about the future value, future uncertainty has no impact on his decision. The cutoff will be the same as in the certain environment.

A.2.2 Proof of Proposition 3

Let $\gamma = m_{0L} + m_{0H}$. Denote $m_H = \frac{1}{\gamma} m_{0H}$, which is the probability that the tax rate is high, conditional on the tax rate going up or down. Then, $\tilde{m} = 1 - \gamma m_H + \gamma m_H \frac{\beta m_{H0}}{1-\beta m_{HH}}$, and Δ_0 can be represented as:

$$\Delta_0 = \frac{\left(1-\beta(1-\gamma m_H+\gamma m_H\frac{\beta m_{H0}}{1-\beta m_{HH}})\right)}{(1-\beta)}\left[1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right]^{-1}. \tag{20}$$

Notice that the expected tax rate, conditional on tax rate changes, is $\hat{\tau} = m_H\tau_H + (1-m_H)\tau_L$. Therefore, as long as m_H is fixed, $\hat{\tau}$ does not change.

We will show that the partial derivative of $\ln\Delta_0$ with respect to γ (while m_H being fixed) is positive. Given $\pi\left(\bar{k}_0\right) = \Delta_0\pi\left(\bar{k}_0^D\right)$, and the monotonicity of π on k, this is sufficient to show that $\bar{k}_0 > 0$ increases when γ increases, conditional on the expected tax rate.

Note that

$$\frac{\partial\ln\Delta_0}{\partial\gamma} = \frac{\partial\ln(1-\beta\tilde{m})}{\partial\tilde{m}}\frac{\partial\tilde{m}}{\partial\gamma} - \frac{\partial\ln\left[1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right]}{\partial\gamma}.$$

The first term of the above equation can be rewritten as

$$\frac{\partial\ln(1-\beta\tilde{m})}{\partial\tilde{m}}\frac{\partial\tilde{m}}{\partial\gamma} = \frac{\beta m_H}{1-\beta m_{HH}}\left(\frac{1-\beta}{1-\beta\tilde{m}}\right).$$

The second term can be written as

$$\frac{\partial\ln\left[1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right]}{\partial\gamma} = \frac{\beta m_H}{1-\beta m_{HH}}\frac{\frac{(1-\tau_H)}{(1-\tau_0)}}{1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}}.$$

Then, we have

$$\frac{\partial\ln\Delta_0}{\partial\gamma} = \frac{\beta m_H}{1-\beta m_{HH}}\left[\frac{1-\beta}{1-\beta\tilde{m}} - \frac{\frac{(1-\tau_H)}{(1-\tau_0)}}{1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}}\right].$$

We argue that the term $\frac{1-\beta}{1-\beta\tilde{m}} - \frac{\frac{(1-\tau_H)}{(1-\tau_0)}}{1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}}$ in the big bracket is positive, showing that

$$\frac{(1-\tau_H)}{(1-\tau_0)} < \left(\frac{1-\beta}{1-\beta\tilde{m}}\right)\left(1+\frac{\beta\gamma m_H}{1-\beta m_{HH}}\frac{(1-\tau_H)}{(1-\tau_0)}\right)$$

or that

$$\frac{(1-\tau_H)}{(1-\tau_0)}\left[1-\frac{\beta\gamma m_H}{1-\beta m_{HH}}\left(\frac{1-\beta}{1-\beta\tilde{m}}\right)\right] < \frac{1-\beta}{1-\beta\tilde{m}}.$$

Using the definition of $\tilde{m}$, we can verify that $1-\frac{\beta\gamma m_H}{1-\beta m_{HH}}\left(\frac{1-\beta}{1-\beta\tilde{m}}\right) = \frac{1-\beta}{1-\beta\tilde{m}} > 0$. Therefore, the above inequality holds if and only if $\tau_H > \tau_0$. This completes the proof. □

B The Measure without the Uncertainty Terms

To see the role of the terms related to "uncertainty," we generate another measure with the following key words: "tax," "taxes," "taxed," or "taxation" and "local" or "state." Except for removing the terms "uncertain," "uncertainty," or "uncertainties" from the benchmark keywords, the measure-generating procedure is identical, as explained in Section 2.1.

We first show the relationship between this newly-generated measure and the probability of tax changes in the following year. The result is shown in Table 14. We also present the result with the TU measure for comparison. The measure without the uncertainty terms shows a positive relationship with the probability of tax changes in the following year, but the magnitude becomes smaller and the coefficient becomes insignificant compared to the result with the benchmark TU measure.

Second, we estimate the main specification with the measure without the uncertainty terms. The result is shown in Table 15. We also present the result with the TU measure for comparison. Contrary to the TU measure, which exhibits a negative relationship with the establishment growth rate, the measure without the uncertainty terms shows no relationship with the establishment growth rates.

To summarize, the measure without the uncertainty terms does not predict the tax changes in the following year and shows no relationship with the establishment growth rates. This finding suggests that including uncertainty terms in the keywords is important to capture the tax uncertainty.

Table 14: State Corporate Tax Changes: TU Measure vs. Measure without the Uncertainty Terms

VARIABLES	(1) Corp. tax change	(2) Corp. tax change
ln(TU)	0.689**	
	(0.274)	
ln(No uncertain)		0.412
		(0.275)
Year FE	Yes	Yes
State FE	Yes	Yes
Observations	81	81
R-squared	0.429	0.348

NOTE: The first column shows the linear regression result for the TU measure with nine states, without Michigan and Ohio. The result is identical to the third column in Table 6, and is presented here for comparison. The second column shows the linear regression result for the measure without the uncertainty terms (No uncertain). Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1.

Table 15: Two-year Est. Growth Rate: TU Measure vs. Measure without the Uncertainty Terms

VARIABLES	(1) g	(2) g
ln(TU)	-1.073**	
	(0.476)	
ln(No uncertain)		-0.258
		(0.523)
Corp. tax	-0.0150	-0.00737
	(0.112)	(0.114)
Personal tax	-0.214	-0.191
	(0.219)	(0.254)
Sales tax	0.0858	0.201
	(0.446)	(0.477)
Min. wage	0.433	0.412
	(0.537)	(0.560)
Border-Year FE	Yes	Yes
Border-Side FE	Yes	Yes
Observations	1,100	1,100
R-squared	0.849	0.847

NOTE: g is the two-year establishment growth rates of a border side, calculated by $\frac{y_{t+2}-y_t}{\left\{0.5\times(y_{t+2}+y_t)\right\}} \times 100$. "No uncertain" refers to the measure generated without the uncertainty terms. The result in the first column is from the second column in Table 7, and is presented here for comparison. Robust standard errors in parentheses, clustered by border and state. *** p<0.01, ** p<0.05, * p<0.1.

C Newspapers for Each State

Table 16: State Newspaper Lists

State	Newspapers
Alabama	Anniston Star, The (AL)
	Atmore Advance, The (AL)
	Birmingham News (AL)
	Cleburne News, The (AL)
	Daily Home, The (Talladega, AL)
	Daily Mountain Eagle (Jasper, AL)
	Huntsville Times, The (AL)
	Jacksonville News, The (AL)
	Press-Register (Mobile, AL)
	Valley Times-News, The (Lanett, AL)
Arizona	Arizona City Independent (AZ)
	Arizona Daily Star, The (Tucson, AZ)
	Casa Grande Dispatch (AZ)
	Douglas Dispatch (AZ)
	Eastern Arizona Courier (Safford, AZ)
	Green Valley News & Sun (AZ)
	Inside Tucson Business (AZ)
	San Pedro Valley News-Sun (Benson, AZ)
	Tucson Weekly (AZ)
	Wickenburg Sun, The (AZ)
Arkansas	Arkansas Democrat-Gazette (Little Rock, AR)
	Daily Siftings Herald (Arkadelphia, AR)
	Daily World, The (Helena, West Helena, AR)
	Hope Star (AR)
	Newport Independent (AR)
	Pine Bluff Commercial (AR)
	Stuttgart Daily Leader, The (AR)
	Times Record (Fort Smith, AR)

Table 17: State Newspaper Lists

State	Newspapers
California	Daily Breeze (Torrance, CA)
	Daily News of Los Angeles (CA)
	Fresno Bee, The (CA)
	Long Beach Press-Telegram (CA)
	Mercury News, The (San Jose, CA)
	Modesto Bee, The (CA)
	Orange County Register, The (Santa Ana, CA)
	Sacramento Bee, The (CA)
	San Diego Union-Tribune, The (CA)
	San Francisco Chronicle (CA)
Colorado	Broomfield Enterprise (Boulder, CO)
	Colorado Springs Business Journal (CO)
	Daily Camera, The (Boulder, CO)
	Denver Post, The (CO)
	Durango Herald, The (CO)
	Gazette, The (Colorado Springs, CO)
	La Junta Tribune-Democrat (CO)
	Montrose Daily Press, The (CO)
Connecticut	Bulletin, The (Norwich, CT)
	Chronicle, The (Willimantic, CT)
	Fairfield County Weekly (Bridgeport, CT)
	Hartford Advocate (CT)
	Hartford Courant, The (CT)
	Milford Mirror (CT)
	New Haven Advocate (CT)
	New Haven Register (CT)
	News-Times, The (Danbury, CT)
	Record-Journal (Meriden, CT)
Florida	Bradenton Herald, The (FL)
	Gainesville Sun, The (FL)
	Ledger, The (Lakeland, FL)
	Miami Herald, The (FL)
	Miami New Times (FL)
	Naples Daily News (FL)
	Ocala Star-Banner (FL)
	Palm Beach Post, The (FL)
	Tampa Bay Times (FL)
	Tampa Tribune, The (FL)

Table 18: State Newspaper Lists

State	Newspapers
Georgia	Athens Banner-Herald (GA)
	Atlanta Daily World (GA)
	Atlanta Journal-Constitution, The (GA)
	Augusta Chronicle, The (GA)
	Cherokee Tribune (Canton, GA)
	Daily Tribune News, The (Cartersville, GA)
	Ledger-Enquirer (Columbus, GA)
	Macon Telegraph, The (GA)
	Marietta Daily Journal (GA)
	Savannah Morning News (GA)
Idaho	Idaho Business Review (Boise, ID)
	Idaho Statesman, The (Boise, ID)
	Lewiston Morning Tribune (ID)
	Moscow-Pullman Daily News, The (ID)
	Post Register (Idaho Falls, ID)
	Times-News, The (Twin Falls, ID)
Illinois	Barrington Courier-Review (IL)
	Buffalo Grove Countryside (IL)
	Chicago Sun-Times (IL)
	Daily Herald (Arlington Heights, IL)
	Deerfield Review (IL)
	Herald & Review (Decatur, IL)
	Pantagraph, The (Bloomington, IL)
	Peoria Journal Star, The (IL)
	Southern Illinoisan (IL)
	State Journal-Register, The (Springfield, IL)
Indiana	Boonville Standard & Newburgh-Chandler Register (IN)
	Chronicle-Tribune (Marion, IN)
	Evansville Courier & Press (IN)
	Herald-Times (Bloomington, IN)
	Journal Gazette, The (Fort Wayne, IN)
	Madison Courier, The (IN)
	News-Dispatch, The (Michigan City, IN)
	News-Sentinel, The (Fort Wayne, IN)
	Post-Tribune (IN)
	South Bend Tribune (IN)

Table 19: State Newspaper Lists

State	Newspapers
Iowa	Charles City Press (IA)
	Daily Democrat (Fort Madison, IA)
	Daily Gate City (Keokuk, IA)
	Gazette, The (Cedar Rapids-Iowa City, IA)
	Globe Gazette (Mason City, IA)
	Hawk Eye, The (Burlington, IA)
	Iowa State Daily (Ames, IA)
	Kalona News (IA)
	Sioux City Journal (IA)
	Telegraph Herald (Dubuque, IA)
Kansas	Chanute Tribune, The (KS)
	Garden City Telegram, The (KS)
	Hays Daily News, The (KS)
	Manhattan Mercury, The (KS)
	Morning Sun, The (Pittsburg, KS)
	Newton Kansan, The (KS)
	Ottawa Herald, The (KS)
	Parsons Sun (KS)
	Salina Journal, The (KS)
	Wichita Eagle, The (KS)
Kentucky	Daily News (Bowling Green, KY)
	Georgetown News-Graphic (KY)
	Grayson County News Gazette (Leitchfield, KY)
	Lexington Herald-Leader (KY)
	Messenger, The (Madisonville, KY)
	News-Democrat & Leader (Russellville, KY)
	Northerner, The: Northern Kentucky University (Highland Heights, KY)
	Owensboro Messenger-Inquirer (KY)
Louisiana	Advocate, The (Baton Rouge, LA)
	Bastrop Daily Enterprise (LA)
	Beauregard Daily News (De Ridder, LA)
	Daily News, The (Bogalusa, LA)
	Daily Star, The (Hammond, LA)
	Gonzales Weekly Citizen (Ascension, LA)
	Hawkeye, The (University of Louisiana - Monroe) (LA)
	L'Observateur (La Place, LA)
	St. Tammany News (Covington, LA)
	Times-Picayune, The (New Orleans, LA)

Table 20: State Newspaper Lists

State	Newspapers
Maryland	Arbutus Times (MD)
	Baltimore Messenger (MD)
	Capital, The (includes 6 regional titles) (Annapolis, MD)
	Carroll County Times (Westminster, MD)
	Columbia Flier (MD)
	Frederick News-Post, The (MD)
	Herald-Mail, The (Hagerstown, MD)
	Jewish Times (Baltimore, MD)
	Sun, The (Baltimore, MD)
	Towson Times (MD)
Massachusetts	Boston Herald (MA)
	Cape Cod Times (Hyannis, MA)
	Enterprise, The (Brockton, MA)
	Gatepost, The: Framingham State College (MA)
	Herald News, The (Fall River, MA)
	Patriot Ledger, The (Quincy, MA)
	Provincetown Banner (MA)
	Republican, The (Springfield, MA)
	Taunton Daily Gazette (MA)
	Worcester Telegram & Gazette (MA)
Michigan	Cheboygan Daily Tribune (MI)
	Coldwater Daily Reporter (MI)
	Detroit News, The (MI)
	Flint Journal, The (MI)
	Herald-Palladium, The (St. Joseph, MI)
	Holland Sentinel, The (MI)
	Muskegon Chronicle, The (MI)
	Record & Clarion (Gladwin, Beaverton, MI)
	Saginaw News (MI)
	Sturgis Journal (MI)
Minnesota	Chanhassen Villager (MN)
	Chaska Herald (MN)
	City Pages (Minneapolis, MN)
	Duluth News Tribune (MN)
	Eden Prairie News (MN)
	Fergus Falls Daily Journal (MN)
	Hutchinson Leader (MN)
	Jordan Independent (MN)
	St. Paul Pioneer Press (MN)
	Star Tribune: Newspaper of the Twin Cities (MN)

Table 21: State Newspaper Lists

State	Newspapers
Mississippi	Bolivar Commercial, The (Cleveland, MS)
	Clarksdale Press Register, The (MS)
	Commercial Dispatch, The (Columbus, MS)
	Daily Leader, The (Brookhaven, MS)
	Enterprise-Journal (McComb, MS)
	Greenwood Commonwealth, The (MS)
	Natchez Democrat, The (MS)
	Sun Herald (Biloxi, MS)
Missouri	Boonville Daily News (MO)
	Daily Journal (Park Hills, MO)
	Examiner, The (Independence-Blues Springs-Grain Valley, MO)
	Hannibal Courier-Post (MO)
	Jefferson City News-Tribune (MO)
	Kansas City Star, The (MO)
	Lake Sun Leader (Camdenton, MO)
	Maneater, The: University of Missouri (Columbia, MO)
	Riverfront Times (St. Louis, MO)
	St. Louis Post-Dispatch (MO)
Nebraska	Columbus Telegram, The (NE)
	Fremont Tribune (NE)
	Grand Island Independent, The (NE)
	Lincoln Journal Star (NE)
	Omaha World-Herald (NE)
	York News-Times (NE)
Nevada	Henderson View (NV)
	Las Vegas Review-Journal (NV)
	Las Vegas Sun (NV)
	North Las Vegas View (NV)
	Pahrump Valley Times (NV)
	Paradise View (Las Vegas, NV)
	Southwest View (Las Vegas, NV)
	Summerlin View (Las Vegas, NV)
	Sunrise View (Las Vegas, NV)

Table 22: State Newspaper Lists

State	Newspapers
New Jersey	Herald News (Woodland Park, NJ)
	Horse News (NJ)
	Hudson Reporter Publications (NJ)
	Hunterdon County Democrat (Flemington, NJ)
	Hunterdon Observer (Flemington, NJ)
	Jersey Journal, The (Jersey City, NJ)
	Press of Atlantic City, The (NJ)
	Record, The (Hackensack, NJ)
	Star-Ledger, The (Newark, NJ)
	Times, The (Trenton, NJ)
New York	Buffalo News, The (NY)
	City Limits (New York, NY)
	Daily Gazette, The (Schenectady, NY)
	Hicksville Illustrated News (NY)
	Newsday (Long Island, NY)
	New York Daily News (NY)
	Post-Standard, The (Syracuse, NY)
	Staten Island Advance (NY)
	Times Union, The (Albany, NY)
	Watertown Daily Times (NY)
North Carolina	Charlotte Observer (NC)
	Chronicle, The (Duke University) (Durham, NC)
	Dispatch, The (Lexington, NC)
	Fayetteville Observer, The (NC)
	Herald-Sun, The (includes Raleigh Extra and Chapel Hill Herald) (Durham, NC)
	News & Observer, The (includes Chapel Hill News) (Raleigh, NC)
	News & Record (Greensboro, NC)
	Salisbury Post (NC)
	StarNews (Wilmington, NC)
	Winston-Salem Journal (NC)

Table 23: State Newspaper Lists

State	Newspapers
Ohio	Akron Beacon Journal (OH)
	Blade, The (Toledo, OH)
	CityBeat (Cincinnati, OH)
	Columbus Dispatch, The (OH)
	Courier, The (Findlay, OH)
	Daily Reporter, The (Columbus, OH)
	Dayton Daily News (OH)
	Lantern, The: Ohio State University (Columbus, OH)
	Plain Dealer, The (Cleveland, OH)
	Review Times (Fostoria, OH)
Oklahoma	Alva Review-Courier (OK)
	Bartlesville Examiner-Enterprise (OK)
	Daily Ardmoreite, The (Ardmore, OK)
	Journal Record, The (Oklahoma City, OK)
	Lawton Constitution, The (OK)
	Miami News-Record (OK)
	Oklahoman, The (Oklahoma City, OK)
	Shawnee News-Star, The (OK)
	Tulsa World (OK)
Oregon	Albany Democrat-Herald (OR)
	Argus Observer (Ontario, OR)
	Baker City Herald, The (OR)
	Central Oregonian (Prineville, OR)
	Corvallis Gazette-Times (OR)
	Curry Coastal Pilot (Brookings, OR)
	Herald and News (Klamath Falls, OR)
	Hermiston Herald, The (OR)
	Observer, The (La Grande, OR)
	Oregonian, The (Portland, OR)

Table 24: State Newspaper Lists

State	Newspapers
Pennsylvania	Centre Daily Times (State College, PA)
	Daily Pennsylvanian, The: University of Pennsylvania (Philadelphia, PA)
	Delaware County Daily Times (Primos - Upper Darby, PA)
	Morning Call, The (Allentown, PA)
	Patriot-News, The (Harrisburg, PA)
	Philadelphia Daily News (PA)
	Philadelphia Inquirer, The (PA)
	Pittsburgh Post-Gazette (PA)
	Times Leader, The (Wilkes-Barre, PA)
	York Daily Record (PA)
South Carolina	Beaufort Gazette, The (SC)
	Bluffton Today (SC)
	Georgetown Times, The (SC)
	Herald-Journal (Spartanburg, SC)
	Island Packet (Hilton Head, SC)
	Post and Courier, The (Charleston, SC)
	State, The (Columbia, SC)
	Sun News, The (Myrtle Beach, SC)
Tennessee	Advocate and Democrat, The (Sweetwater, TN)
	Chattanooga Times Free Press (TN)
	Cleveland Daily Banner (TN)
	Commercial Appeal, The (Memphis, TN)
	Daily Post-Athenian, The (Athens, TN)
	Daily Times, The (Maryville, TN)
	Herald-Citizen (Cookeville, TN)
	Knoxville News Sentinel (TN)
	Nashville Scene (TN)
	Oak Ridger, The (TN)
Texas	Austin American-Statesman (TX)
	Austin Monitor (TX)
	Brownsville Herald, The (TX)
	Corpus Christi Caller-Times (TX)
	Dallas Morning News, The (TX)
	Dallas Observer (TX)
	Fort Worth Star-Telegram (TX)
	Houston Chronicle (TX)
	Houston Press (TX)
	San Antonio Express-News (TX)

Table 25: State Newspaper Lists

State	Newspapers
Utah	Daily Herald (Provo, UT)
	Deseret News, The (Salt Lake City, UT)
	Herald Journal, The (Logan, UT)
	Park Record (Park City, UT)
	Salt Lake Tribune, The (UT)
	Standard-Examiner (Ogden, UT)
	Sun Advocate (Price, UT)
Virginia	Arlington Catholic Herald (VA)
	Daily News-Record (Harrisonburg, VA)
	Martinsville Bulletin (VA)
	Progress-Index, The (Petersburg, VA)
	Richmond Times-Dispatch (VA)
	Roanoke Times, The (VA)
	Virginian-Pilot, The (Norfolk, VA)
Washington	Bellingham Herald, The (WA)
	Central Kitsap Reporter (Silverdale, WA)
	Columbian, The (Vancouver, WA)
	Kitsap Sun (Bremerton, WA)
	News Tribune, The (Tacoma, WA)
	Seattle Post-Intelligencer (WA)
	Seattle Times, The (WA)
	Spokesman-Review, The (Spokane, WA)
	Wenatchee World, The (WA)
	Yakima Herald-Republic (WA)
Wisconsin	Beloit Daily News (WI)
	Capital Times, The (Madison, WI)
	Chippewa Herald, The (Chippewa Falls, WI)
	Freeman, The (Waukesha, WI)
	La Crosse Tribune (WI)
	Milwaukee Journal Sentinel (WI)
	News Graphic (Cedarburg, WI)
	Northwoods River News, The (Rhinelander, WI)
	Washington County Daily News (WI)
	Wisconsin State Journal (WI)