Uncertainty and the Geography of the Great Recession

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Abstract

We document the link between increased levels of economic and policy uncertainty and unemployment at the state-level during the 2007-2009 recession. The cross-sectional variation in uncertainty robustly matches the distribution of employment outcomes during this period. When we instrument for this cross-sectional variation using preexisting institutions, we find evidence for a causal role for uncertainty in increasing unemployment. A simple model of hiring and firing under uncertainty rationalizes these results, and the within-state distribution of effects across industries, occupations, and individuals is consistent with this model's predictions. Together, these results suggest that increased uncertainty contributed to the severity of the Great Recession.

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Mr. FITZPATRICK: What is the gentleman's plan to take care of the unemployment in this country?
Mr. KNUTSON: What is my plan?
Mr. FITZPATRICK: Yes.
Mr. KNUTSON: Reassure industry.
Mr. FITZPATRICK: How?
Mr. KNUTSON: By removing all the uncertainty that you folks have created. Let us assure industry and we will end unemployment in a short time.

United States House of Representatives, April 12, 1935

I Uncertainty and the Great Recession

Did high levels of economic and policy uncertainty contribute to the large and persistent increase in unemployment from 2007 to 2009? This paper presents a broad range of evidence showing that increased levels of uncertainty were an important factor explaining the cross-sectional distribution of employment patterns during the Great Recession. To do so, we develop an indicator-based state-level uncertainty index. Using this index we find that the uncertainty-unemployment relationship is highly robust, and that higher levels of uncertainty created by pre-existing institutions lead to increased unemployment. We then develop a simple model of hiring under uncertainty and show that the employment losses associated with the index were distributed according to the predictions of the model across industries, occupations, and individuals within states.

Macroeconomists have advanced a number of hypotheses to explain the severity of the 2007-2009 decline in employment. These explanations, which are not mutually exclusive, include insufficient demand due to household deleveraging, slow recalculation or adjustment to sector-specific shocks, credit constraints due to problems in the financial sector, and the aforementioned increases in policy and general economic uncertainty. Unfortunately, as is often the case in macroeconomics, distinguishing the differential impact of these amplification channels has not been straightforward.

One aspect of the "Great Recession" that might shed light on the mechanism is the substantial geographic variation in employment losses. The five states most deeply affected by the recession experienced increases in their unemployment rates of 6 percentage points or more from 2006 to 2009 (with the largest increase, in Nevada, exceeding 7.5 percentage points). Conversely, the five states least affected by the downturn saw their unemployment rates increase by less than 2.1 percentage points. Given the importance of this geographic variation, it is desirable that theories of the recession are consistent with this cross-sectional pattern.

The differential effect of the recession across places was not random. In line with a explanation centered around structural sectoral shifts, states with larger housing price run-ups and declines suffered the largest employment losses. More directly on point, overall employment losses across states and counties are highly correlated with employment losses in the construction sector.

A number of important papers have demonstrated that geographic variation in household deleveraging and weaker demand are also correlated with employment losses. Mian and Sufi (2011), in a framework that is underpinned theoretically by Philippon and Midrigan (2011), show that employment losses are most severe in areas with initially high and subsequently falling household debt-to-income ratios. They analyze data from counties with large household balance sheet shocks and claim that lessened aggregate demand was responsible for the majority of the job losses between 2007 and 2009.

Another theory, that credit constraints caused by financial sector problems lengthened the recovery (e.g. Guerrieri and Lorenzoni (2011) and Chodorow-Reich (2013)), does not necessarily predict such wide variety in regional outcomes. However, work by Gozzi and Goetz (2010) and Greenstone and Mas (2012) find that local credit crunches for small businesses did indeed lead to employment and wage losses between 2007 and 2009.

A recently popular explanation for the significant duration of the 2007-2009 reces-

sion's recovery is an increase in policy and economic uncertainty. Widely discussed in the popular news amidst analyses of the impact of Federal Reserve policy, health care reform, the rise of the Tea Party movement (see Madestam et al., 2013), debt ceiling disputes and state and federal spending levels, policy and economic uncertainty have also received attention from researchers looking into their possible effects on the U.S. economy during the aftermath of the recession. In a leading paper in this literature, Baker, Bloom, and Davis (2013) create an indicator-based measure of policy uncertainty using newspaper mentions, tax code provision expirations and forecaster disagreement. They show that higher indicator uncertainty from 2008 on was associated with a deeper and longer recession.

In their analysis of news and government documents, Dominguez and Shapiro (2013) look to see how the slow recovery was anticipated, and find that the political "stalemate" in the US contributed to the length of the recession, as did shocks from Europe. Similarly, Bachmann and Sims (2012) establish that consumer and firm "confidence" is of the utmost importance during downturns. Schaal (2011) is able to reproduce many of the dynamics of the Great Recession by introducing uncertainty shocks into a dynamic search model of heterogeneous firms, while Stock and Watson (2012) use a dynamic factor model to establish that heightened uncertainty worsened the recession significantly. That said, in its simplest exposition, the uncertainty channel does not predict a wide spatial distribution of outcomes. This has led some to argue that the policy uncertainty channel is not consistent with a central feature of the recession. For example, Mian and Sufi (2012) claim that "an increase in business uncertainty at the aggregate level does not explain the stark cross-sectional patterns in employment losses we observe," and Bachmann and Bayer (forthcoming) argue that idiosyncratic firm-level risk shocks that are consistent with the procyclicality of the dispersion of investment rates cannot explain output variations over the business cycle.

This paper serves to counter such claims, and to present cross-sectional evidence in

support of the uncertainty channel. We create local measures of Baker-Bloom-Davis type indicator uncertainty from 2006 through 2009. We find that increases in local uncertainty over this period are strongly correlated with the effects of the recession, and that the correlation between uncertainty at the state level and employment losses is highly robust across alternate measures. While there is certainly a feedback loop between economic outcomes and uncertainty, we show that increases in local uncertainty are partially driven by pre-existing state institutions, and that these pre-determined uncertainty amplifications cause unemployment increases. The uncertainty channel also remains strongly correlated with unemployment increases in our data in regressions that control for other mechanisms.

Moreover, we show that even when controlling for the aggregate local outcome, uncertainty affects the cross-section of industries, workers, and occupations within states in the manner predicted by a standard model. Our baseline results suggest that if uncertainty levels in all states had been at those of the five states facing the lowest levels of uncertainty in 2009, that would have been associated with a national unemployment rate that was about 1.4 percentage points lower.

The key lessen from these findings taken together is that, like the structural and demand-driven channels, the uncertainty explanation is consistent with the geographic pattern of the recession. While it is hard to quantify the exact causal effect of this amplification mechanism, and to separate the impact of uncertainty from that of first-order shocks to the economy, these findings are important in cautioning researchers not to dismiss the uncertainty channel in contributing to the length and depth of the Great Recession. It also suggests that more research on the interaction of multiple channels would prove beneficial.

The remainder of this paper is structured as follows. In Section II, we develop regional measures of uncertainty, document their association with employment outcomes, and use them to construct a regional uncertainty index. We then proceed to show, in Section III, that predetermined state government institutions affect regional uncertainty. By

using these institutions to instrument for uncertainty, we show that higher levels of uncertainty cause higher levels of unemployment. After that, in Section IV, we examine the relationship between regional uncertainty and unemployment levels after controlling for competing explanations for high post-2006 levels of unemployment. In Section V, we present a simple model of hiring and firing by firms that face varying levels of uncertainty to derive predictions for the cross-section of employment levels. We confirm these predictions in Section VI at the industry, individual, and occupation level, and present survey-based evidence that provides direct support for the uncertainty mechanism. In Section VII we discuss our results and conclude.

II State-Level Measures of Uncertainty

In this section, we present a variety of uncertainty indicators at the state level and construct an aggregate index that captures uncertainty as measured along these different dimensions. We also show that these measures of uncertainty were strongly associated with increases in unemployment during the 2007-2009 recession.

Our presentation here builds upon a long-standing yet rapidly evolving body of literature on measuring policy uncertainty. Past theoretical research has shown that policy uncertainty can affect consumption, investment (Rodrik, 1991; Hassett and Metcalf, 1999) as well as broader economic activity (Bloom, 2009; Fernandez-Villaverde et al., 2011; Bloom et al., 2012). While the foundations for believing that policy uncertainty can have effects on the broader economy have existed in the economics literature for some time (Friedman, 1968; Bernanke, 1983), recent research has introduced new ways to measure indicators of uncertainty, opening the door for empirical work. For example, Bertola et al. (2005) find that increased income uncertainty makes consumers postpone durable good purchases, while Julio and Yook (2012) examine corporate investment around national elections and find evidence that firms reduce investment when election outcomes are less

certain. Baker, Bloom, and Davis (2013) have developed a method for measuring policy uncertainty based upon newspaper coverage, expiring tax provisions, and economic forecaster disagreement, which has been used to examine past trends in policy uncertainty in the U.S. Gulen and Ion (2012) use this index to show that policy-related uncertainty is negatively related to investment, both at the firm and industry levels, and that this uncertainty has had a substantial impact on corporate investment since the 2007 financial crisis. Meanwhile, Bachmann et al. (2013) use survey data to confirm that increases in uncertainty have a large and protracted impact on aggregate manufacturing production. All of these studies focus, in principle, on nationwide uncertainty. To see whether this body of literature can contribute to our understanding of the cross-section of macroeconomic outcomes, we need measures of uncertainty at the state level.

II.a Media-Based Measures

Following Baker, Bloom and Davis (2013), we first measure uncertainty using media mentions of the word "uncertainty." We rely on an archive of local newspapers (NewsLibrary.com), which covers more than 4000 news sources and contains state identifiers. We count articles from 1/1/2006 through 12/31/2010 containing the word "uncertainty." We then aggregate the article counts by state and year, and construct a measure of the increase of uncertainty during the recession equal to the ratio between the sum of the numbers of articles published in 2007, 2008 and 2009 and the number of articles published in 2006.[1] We use the 2006 measures as a conservative baseline, since the downturn began at different times in different states. The results are not changed significantly by altering the starting date. The unit for the dependent measure is effectively the ratio of article counts in the next three years relative to 2006. The mean is at 3.34, indicating that there was a 34% total increase in the number of articles containing "uncertainty" in this period, or a

[1] Summary statistics for this variable and others used here and in the next section can be found in Appendix Table A1. Details on data sources and processing are in the Data Appendix.

little over 10% more articles per year. The measure ranges from a high of 5.4 for Rhode Island and 4.8 for Nevada and Arizona to lows of 1.9 for Louisiana and 2.2 for Alaska and Maine. This means that there was a 60% annual increase in the number of articles containing the word uncertainty in Nevada and a 27% decrease in Maine. These measures are obviously noisy, but this range of variation appears reasonable relative to the within-state year-to-year variation in this period.

In Figure 1a, we plot this relationship against the change in unemployment rates across states from 2009 to 2006. As is evident in the graph, the relationship is quite strong. The R^2 is 0.20. The relationship holds when looking at article word counts ($R^2 = 0.24$), when including 2010 ($R^2 = 0.18$), and when using the change in unemployment rates from 2007 to 2009 ($R^2 = 0.22$). To contextualize these numbers, note that the R^2 between employment growth and debt-to-income across county reported in Mian and Sufi (2010) is 0.10, and the R^2 when regressing state unemployment rate changes on housing price changes from 2006-2009 is 0.48.

A similar approach can be carried out using not the supply of, but the demand for, information. To construct a proxy for local uncertainty, and because a lot of the variation in that measure presumably stems from uncertainty about local policy measures, decisions and priorities, we look at the increase in Google searches that include the terms "state" and "budget" or "state" and "tax." We use Google Trends relative search frequency numbers for these terms in all states in 2009, normalize them using the 2006 numbers, and study the association between these ratios and state-level unemployment rate changes. As Figure 1b shows, the correlation between the two is strong ($R^2 = 0.14$). Similar uncertainty-related search terms produce equivalent results.

II.b Budget-Based Measures

While the media and search results show that there is a considerable cross-sectional relationship between uncertainty and employment outcomes, there are more direct measures of policy uncertainty. In this section, we test the relationship between uncertainty about state spending and taxation and economic outcomes and similarly find a strong and robust relationship.

When exploring the relationship between policy uncertainty and economic outcomes, it is important not to rely upon policy measures that could be deterministically related to the outcomes in question. For example, income taxes receipts will be strongly correlated with employment rates in the absence of any changes to tax rates. It would be mistaken, though, to attribute this relationship to any notion of policy uncertainty.

Therefore, instead of relying upon Census data for realized receipts and spending, we use measures coded from National Association of State Budget Officers (NASBO) reports that record legislated tax and spending changes. The NASBO estimates are also useful in that they are recorded in dollars, making it easy to compare disparate policy changes.

The first measure of uncertainty we use is mid-year budget cuts. State budgets are generally passed annually or biennially, but can be amended in mid-cycle to satisfy state budget balance requirements or for other reasons. The NASBO records these mid-year budget cuts in its *Fall Fiscal Survey of the States*. These cuts are a good measure of uncertainty associated with state spending, as they could not be incorporated in the standard budget cycle.

In Figure 1c, we aggregate the spending cuts in FY 2008 and FY 2009 (most states' fiscal years end in June, meaning FY 2007 did not overlap with the recession), and express them in per capita terms. We then plot these mid-year or "surprise" cuts against the change in unemployment rate across states from 2006 through 2009.

As is evident from Figure 1c, there is a strong positive relationship between surprise budget cuts and employment losses in the recession. The R^2 for the relationship shown is 0.24, with each percentage point of unemployment associated with an extra $30 per capita of surprise cuts. This relationship is virtually unchanged when using the change in unemployment from 2007 to 2009 ($R^2 = 0.25$) or when scaling by total spending.

The NASBO also records legislated tax increases and decreases. Again, unlike tax receipts, this measure reflects policy changes which presumably respond to unexpected developments and introduce uncertainty into the economy.

The R^2 in the relationship displayed in Figure 1d is 0.17. Excluding North Dakota, the R^2 is still 0.10. The relationship holds when scaling the tax changes by total state-spending in the period ($R^2 = 0.12$) and when using the change in unemployment from 2007 through 2009 ($R^2 = 0.14$). These results document that states that suffered disproportionately in the recession saw larger legislated tax increases.

II.c Forecast-Based Measures

It is also possible to compare realized state government revenue to the projections used at the start of the budget cycle. In Figure 1e, we show that the absolute value of these deviations is correlated with the severity of the recession. The R^2 is a somewhat low 0.07 with North Dakota, and 0.10 when excluding it. Note that, by using the absolute value, this relationship indicates that projections were farther from the truth in hard-hit states, rather than merely demonstrating that revenue undershot projections there.

A similar measure of uncertainty, in the sense that it is based on deviations from forecasts, can be constructed from the Federal Reserve Bank of Philadelphia's (FRBP) leading indicators of trends in labor markets in each of the 50 states. These leading indicators are meant to predict, six months in advance, how the coincident employment indices that the FRBP publishes on a monthly basis will change. "The coincident indices combine

four state-level indicators to summarize current economic conditions in a single statistic. The four state-level variables in each coincident index are non-farm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index (U.S. city average). The trend for each state's index is set to the trend of its gross domestic product (GDP), so long-term growth in the state's index matches long-term growth in its GDP" (Federal Reserve Bank of Philadelphia, 2012). In Figure 1f, we show that the sum of leadings indicators' absolute deviations from realized changes from 2006 through 2009 show a strong association with changes in unemployment over the crisis period; the R^2 for this relationship is 0.16.

A different way of looking at the condition of each state's economy is one that focuses on changes in the perception of the long-term solvency of each state government. We use changes in the credit ratings provided by Standard & Poor's as our measure of uncertainty here,[2] where the direct notion of uncertainty here is, of course, how predictable it was whether or not states will live up to their financial obligations. As Figure 1g shows, a one-notch change in credit rating is associated with almost a full percentage point change in the unemployment rate ($R^2 = 0.21$).

II.d A State-Level Uncertainty Index

A concise way of summarizing the uncertainty measures above is to combine them into an index, in the spirit of Baker, Bloom, and Davis. We show an example constructed by normalizing them to have a zero mean and unit variance and then taking the principal component factor.[3] As Figure 1h shows, this combination of uncertainty measures is, predictably, also highly correlated with greater employment losses ($R^2 = 0.49$). We see this index as a useful form of shorthand for our full set of uncertainty measures, and it shows,

[2]Similar results hold for the credit ratings given by Moody's and Fitch, though both of these credit agencies rate the debt issued by fewer states than S&P does.

[3]See Appendix Table A2 for a ranking of states based on this index of uncertainty, and Table A3 for details on the principal component analysis.

once more, that uncertainty is strongly correlated with relatively high unemployment rates. To shed some light on what this means in real-world terms, let us think of a counterfactual world in which all states arrived in 2009 with uncertainty levels that were the average of the five states in our sample with the lowest uncertainty indices (Texas, Maine, Nebraska, Alaska and Louisiana). If unemployment levels comoved correspondingly, the national unemployment rate (as a population-weighted average of state-level rates of unemployment) would have been 1.4 percentage points lower than it was.

One concern when using this index is that it might also reflect variation in first moment shocks that affect economic performance. In Table 1, we demonstrate not just the strong correlation between our uncertainty index and unemployment growth (Panel A), but also the lack of a strong relationship between our measure and initial unemployment, predicted unemployment, measured productivity growth, and and a Bartik-style industry-share-shift instrument (Panel B). Furthermore, to test whether this relationship is unique to this recession, or merely selects for an unobserved cyclical pattern across states, we run a series of placebo regressions. For each three year period between 1976-2006, we regress the change in unemployment rates against the change in uncertainty from 2006-2009. We plot the R^2 of the true regression (vertical bar) and the R^2s from these placebo regressions (dots) in Figure 2. As is evident from the figure, the change in local uncertainty in 2006-2009 is clearly associated with changes in unemployment in that same period in a way that goes beyond coincidental correlation: it has significantly more explanatory power for the 2006-2009 change in unemployment than for any of the other three-year periods

Although they demonstrate a tight link between proxies for uncertainty and unemployment in the data, the results presented thus far do not imply a *causal* role for uncertainty shocks. In the next section we show that both relative uncertainty levels and unemployment increases are correlated with certain predetermined features of state government, suggesting that institutions that mediate levels of uncertainty also lead to lower levels of

unemployment.

III State Institutions Affect Both Uncertainty and Unemployment

The changes in state-level uncertainty studied in the previous section, which mirror the national increase measured by Baker, Bloom, and Davis (2013), may have been moderated or exacerbated by predetermined state-level institutions. Previous research has identified a variety of institutions that contribute to or mitigate policy-related uncertainty. Ozler and Rodrik (1993) found that some political systems were able to absorb external shocks more effectively. Poterba (1995) and Clemens and Miran (2012) found that states' budgetary rules have a large impact on the cyclicality of state spending. Andersen, Lassen, and Nielsen (2012) found that economic and political uncertainty were correlated with late budgets at the state level, and Besley and Case (1995) note the large impact that gubernatorial term limits have on state policy. In this section we investigate whether the impact of the aggregate, nation-wide increase in uncertainty, once filtered through features of state-level institutions as they existed at the onset of the recession, partially caused and explains the cross-section of unemployment outcomes.

Many institutions vary across states. We have experimented with a large number of these institutional features, and in nearly every case, institutions expected to heighten uncertainty are associated with increases in our index from 2006 to 2009.[4] Here, we focus on state-level institutional features that intuitively drive uncertainty and where the effects can be measured relatively precisely. The measures we use include the normal fraction of state revenue derived from taxes (as opposed to less-cyclical sources, see Clemens (2012)), the states' structural surplus before the recession, the quality of the states' forecasting offices, as well as indicator variables indicating whether states have a formal budget deadline, have recently failed to pass a budget on time, or were governed by a lame-duck governor upon

[4]See Appendix Figure A1 for a full overview.

entering the recession.

We measure the normal tax fraction of revenue as the state's total tax revenue divided by total revenue over the twenty years leading up to the recession. The structural surplus leading up to the recession is the ratio of total revenue to total expenditure, after subtracting out revenue from insurance trusts (which is mostly investment returns earned by public employee pensions). Data on forecasting gaps for state income taxes are taken from NASBO reports since 2000. For precision, we use the largest absolute value forecasting gap in percentage terms over that period, though the average gap gives extremely similar results. Data on state budget deadlines, whether or not a state has failed to pass a budget on time since 1990, and the lame duck status of the governor in 2006 are from Andersen et al. (2012).

As expected, Panel A of Table 2 shows that the level of our uncertainty index is highly correlated with these predetermined features of state government. Column 1 displays the results of a regression of the state uncertainty index on the tax fraction of state revenue. The regression indicates that a 1 standard deviation increase in the tax fraction (an increase of 6.5%) raised uncertainty by 0.28 standard deviation. Similarly, Column 2 demonstrates that higher levels of structural surplus are correlated with lower uncertainty. The magnitude of the coefficient is similar to the result in Column 1: a 1 standard deviation larger surplus (7.2%) is associated with a 0.27 standard-deviation reduction. Columns 4-6 display the results of similar regressions on the late-budget, forecast gap, and lame-duck variables. Late budgets and lame duck status are similarly correlated with higher uncertainty, raising the level by 0.46 and 0.56 standard deviations respectively. A one standard deviation increase in the forecast gap was associated with a statistically significant 0.39 standard deviation increase in our uncertainty measure. In summary, this panel paints a consistent picture of correlations between these features of state government and uncertainty levels, with more competent, politically and financially stable state governments

showing lower levels of uncertainty.

Importantly, these predetermined institutions do not just mediate state-level uncertainty. The impact they have on uncertainty levels also drives employment outcomes at the state level in the recession. In Panel B, we instrument for our uncertainty measure using the government features from Panel A, and show instrumental-variable estimates of the impact of uncertainty on the change in unemployment between 2006 and 2009. Some of the first-stage F-tests suggest that the instruments used are weak, but even so the estimates will be "median-unbiased" (Angrist and Pischke, 2009). We find that higher levels of uncertainty caused higher levels of state-wide unemployment. In particular, the sign of the coefficient is always positive, as one would expect. For five out of the six pre-determined institutions we use as instruments for uncertainty, the coefficient is statistically significant; for four out of six it is statistically significant at the 1% level.

Now, to test whether the uncertainty these institutions generate truly drives unemployment changes during an aggregate uncertainty shock or whether it merely proxies for unobserved correlation across states in business cycles, we again turn to placebo regressions. Panels C and D of Table 2 show that the institutions we explored were not correlated with industry-share predicted employment changes (as in Bartik, 1991) from 2006 to 2009, nor were they correlated with the distribution of unemployment levels in 2006. Figure A2 further demonstrates the unique importance of these institutions during the recession. As above for Figure 2, we regress the change in unemployment rates against each institution for each three-year period between 1976 and 2006. The vertical bars in Figure A3 show the R^2s from the "true" regression, while dots indicate the distribution of R^2s for placebo periods. As is evident from the figure, the institutions that mediate local uncertainty are much better predictors of unemployment rates during an aggregate uncertainty shock than they are in normal times.

The results in this section demonstrate that increased uncertainty driven by predeter-

mined features of state government increased the levels of unemployment the states suffered through during the Great Recession. Uncertainty is thus not merely a by-product of economic conditions, but independently drives outcomes.

IV Robustness Tests

Another way to assess whether the uncertainty hypothesis helps rationalize the distribution of unemployment changes is to attempt to control for other amplification channels. This type of test requires strong assumptions to isolate causality, and these assumptions clearly do not hold in this situation. Nevertheless, and recognizing these limitations, it is informative to see whether the variation in employment outcomes correlates with our uncertainty index above and beyond the variation explained by other channels. In order to do so, in Table 3 we replicate the main specification regressing unemployment rate changes from 2006 to 2009 on our uncertainty index while including controls for structural shocks, changes in aggregate demand, and local credit conditions.

Panel A includes controls for structural shocks. Column 1 replicates our main specification adding the share of state employment in the construction industry in 2006 as a control. In Column 2, we replace the construction share with a Bartik, industry-share-shift instrument to identify the impact of local labor demand changes. In both columns, the estimated effect of uncertainty is unchanged. Column 3 includes a variable for the percentage change in the FHFA housing price index. This control diminishes the magnitude of the impact of uncertainty by over 30%, though it remains highly economically and statistically significant. Column 4 includes Census division fixed effects to account for overall regional patterns, which again leaves the coefficient on uncertainty nearly unchanged. Including construction share, the Bartik variable, and the FHFA housing price index along with Census division fixed effects, still results in a statistically significant ($p < 0.05$) and large coefficient on uncertainty. The results in this panel suggest that the

relationship between uncertainty and regional unemployment increases is not accounted for by its correlation with measures of structural shifts.

Panel B explores the effect of adding controls for consumer demand. Column 1 includes state-level housing supply elasticities (as in Saiz (2010)), to proxy for debt-to-income (DTI) levels as in Mian and Sufi (2012). This control has little effect on the estimated impact of the uncertainty index. Column 2 regresses unemployment changes on uncertainty and the percentage change in car sales (based on data from the National Automobile Dealers Association). The effect of uncertainty falls by 25%, but again remains significant. Column 3 regresses the unemployment change on our uncertainty index and a measure of the percentage change in employment in arts, entertainment, recreation, and food service (NAICS sectors 71 and 72). These industries are used by Mian and Sufi (2012) as a measure of local demand for non-tradable goods. This variable only slightly decreases the magnitude of the effect of uncertainty. Finally, Column 4 includes all of these demand variables and the uncertainty index, yet also shows a significant coefficient on uncertainty that is similar in size. The ability of uncertainty to explain the geography of unemployment changes is thus robust to controls for the aggregate demand channel.

Panel C examines the competing explanation of credit availability. Column 1 controls for the share of employees who work for small businesses (from the Quarterly Census of Employment and Wages), which supposedly have more problems gaining access to credit. Columns 2 and 3 include indicators for credit limits and unused credit from Experian (2010). Column 4 includes bank failures (from FFIEC call reports). Finally, Column 5 includes all of our credit variables and the uncertainty index. The effect of uncertainty remains highly significant and comparable in magnitude across all of these specifications.

What if we combine the structural, demand, and credit variables described above into aggregated indexes (see Section 2 for a description of the creation of the uncertainty index; we follow the same approach for the other indices) and include all of them? In Panel

D, we regress unemployment changes on the uncertainty, credit, demand, and structural indices to see whether the combined effect of alternate channels breaks the association between uncertainty and unemployment. Despite this battery of controls, the relationship between uncertainty and unemployment persists and is largely unchanged. These results demonstrate the robustness of our finding and suggest that accounting for uncertainty adds to our full understanding of the aftermath of the financial crisis: a back-of-the-envelope calculation similar to the one in section 2 suggests that the increase in the unemployment rate associated with the rise of levels of uncertainty above the average of the five lowest-uncertainty states, even after removing variation in unemployment rates correlated with demand shortfalls, structural shifts, and dried-up credit is just below one percentage point.

Table 3 shows that the coefficient on our uncertainty index remains stable despite various controls for structural, demand, and credit based shocks. It is still possible, of course, that our estimates are biased due to differences along other, unobservable dimensions. Recent work by Oster (2014), building off work by Altonji et al. (2008) has developed a method of benchmarking this bias using information about the change in the coefficient of interest when controls are added. Given the assumption that the observed set of controls vary proportionately to the potentially biasing unobserved controls, the Oster methodology computes an identified bounding set. It is possible to assess whether this set precludes a zero uncertainty effect.

Using the Oster methodology[5], we compute a bounded range for the final, most-controlled regression in panels A-D. Using the structural shift controls in panel A, we find an interval of (0.65-0.72), and using the demand controls in panel B we find an interval of (0.12-0.85). Using the credit channel controls in panel C produces a range of (0.33-1.04), whereas including the index constructed from all of these channels, as in panel D, yields a range of (0.41-0.89).

[5]See Oster (2014) for details. We set $\delta = 1$ and $R^2_{max} = 0.8$.

Again, while these intervals are fairly broad, they suggest that the relationship between uncertainty and poor employment outcomes is not driven purely by omitted variable bias. A natural experiment in this context is unlikely, but that should not prevent econometric work on such an important topic. The cross-sectional measure we've developed repeatedly shows, in a variety of robustness tests, that economic and political uncertainty played a causal amplification role during the Great Recession.

To help elucidate the mechanisms through which this channel operates, we now turn to a model of firm-level hiring and firing under uncertainty, and to micro-level evidence that supports its implications.

V A Simple Model of the Cross Sectional Effects of Uncertainty

The previous sections demonstrated that state-level increases in uncertainty are strongly associated with state-level increases in unemployment, and that this relationship is unlikely to be fully accounted for by reverse causality. To sharpen this point, we explore the effects of uncertainty on the *within-state* cross-section of industries, individuals, sectors, and occupations. To do this, we first solve a simple model of hiring under uncertainty and derive comparative statics on the impact of an uncertainty shocks. We then take these predictions to the data in Section VI.

The theoretical mechanisms through which uncertainty affects employment have been studied extensively.[6] Therefore, and because the main contribution of this paper is empirical, we build a simplified version of these models where the link between model structure and conclusions is easier to follow.

[6]For a sample of this literature, see Arellano, Bai, and Kehoe (2012), Basu and Bundick (2012), Bertola, Guiso, and Pistaferri (2005), Bloom (2009), Berger and Vavra (2012), Caballero, Engel and Haltiwanger (1997), Fajgelbaum, Schaal, and Taschereau-Dumouchel (2013), and Fernandez-Villaverde, Guerron-Quintana, Kuester, and Rubio-Ramirez (2011).

V.a Steady State

We begin by characterizing the economy with a constant level of uncertainty before analyzing the impact of an uncertainty shock. We assume an economy with multiple industries indexed by i, each populated with a continuum of firms. Firms receive a stochastic productivity draw each period of life that takes a value of either $\{\phi_h, \phi_l\}$. This draw determines whether their optimal production requires high or low employment $\{\epsilon_h, \epsilon_l\}$, respectively. When a firm's employment matches its productivity draw, it earns a profit equal to π; it receives zero otherwise. The firms' stochastic productivity draws ϕ are persistent, so that the probability of receiving the same draw $Pr[\phi_{t+1} = \phi_t] = p > 0.5$. In this setup, a larger value of p reflects less uncertainty. Firms must pay a fixed cost proportional to profits $C_i\pi$ to adjust their employment state and discount the future at rate β. We assume that C is sufficiently low that, absent the uncertainty shock, all firms find it profitable to adjust to their desired level of employment.[7] Firms hire from a large number of available workers. Each period there is a probability $(1 - \delta_i)$ that a given worker dies. An equal number of unmatched young workers is born each period to maintain a constant population.

Timing in the model works as follows. At the start of each period t old workers die, new workers are born, and firms receive their productivity realizations. After the shocks are realized, firms have access to the labor markets and can hire or fire workers. Production takes place at the end of the period, after labor markets have closed. A graphical representation of this timing structure is in Figure A3; we refer to the moment after workers die as t^{early} and the the moment after workers are hired or fired as t^{late}.

Given our setup, firms solve:

$v_t(\phi_t, \epsilon_t) = max\, E[\pi(1_{\epsilon_t = \phi_t} - C_i(1_{\epsilon_{t,late} \neq \epsilon_{t,early}})) + \beta v_{t+1}(\phi_{t+1}, \epsilon_{t+1})]$

We define the population density within an industry across states as $\mu_t =$

[7] Specifically, we assume $C < \bar{C}$, where a full expression for $\bar{C}$ is in the Model Appendix.

$\left[\begin{array}{cccc} \mu_{\phi_h \epsilon_h} & \mu_{\phi_h \epsilon_l} & \mu_{\phi_l \epsilon_h} & \mu_{\phi_l \epsilon_l} \end{array} \right]_t'$, and consider the transition matrix Ξ such that $\mu_{t+1} = \Xi \mu_t$. Given that $C < \bar{C}$, this transition matrix is given by:

$$\Xi = \left[\begin{array}{cccc} p\delta & p\delta & 0 & 0 \\ p(1-\delta) & p(1-\delta) & 1-p & 1-p \\ (1-p)\delta & (1-p)\delta & 0 & 0 \\ (1-p)(1-\delta) & (1-p)(1-\delta) & p & p \end{array} \right]$$

Taking eigenvalues and eigenvectors, we solve for the ergodic distribution of firm population across these states

$$\mu = \left[\begin{array}{c} \frac{p\delta}{2} \\ \frac{1-p\delta}{2} \\ \frac{(1-p)\delta}{2} \\ \frac{1-\delta+p\delta}{2} \end{array} \right]$$

As expected, this distribution is asymmetric. Natural attrition ensures that more firms are poised to hire than fire in the steady state. Given our solution for the ergodic distribution, we can calculate the endogenous net hiring occurring within an adjusting industry each period by subtracting the mass at the two adjusting states:

$$net\, hiring = \frac{1}{2}(1-\delta)$$

Net hiring exactly offsets the employment lost to the exogenous death process.

V.b An Uncertainty Shock

Now, we consider the effect of a temporary (1 period) uncertainty shock ($\tilde{p} < p$). This shock is unpredictable, reflecting the type of "unforecastable" uncertainty we study here. Because the shock is temporary, the continuation value functions do not change, only the odds of reaching them is altered. Firms thus decide to adjust despite the temporary shock

if the induced uncertainty is low relative to the costs.

Proposition 1: After a temporary uncertainty shock:

- The adjustment rule for hiring and firing firms is symmetric
- Firms in an industry i continue to adjust if

$$\tilde{p} > \frac{1}{2}\left(1 + \frac{C_i - 1}{\beta C_i \delta_i}\right)$$

- Firms in an industry that does not continue to adjust fail to hire young workers. Employment in these industries shrink at a rate of $(1 - \delta_i)$.

Proof: See Appendix.

Having characterized the behavior and distribution of firms, we can now identify three cross-sectional implications of an uncertainty shock. Uncertainty shocks are more likely to reduce employment:

1. In industries with larger baseline turnover $1 - \delta_i$;
2. In occupations with larger adjustment costs;
3. Among younger workers.

The intuition behind the first two claims in the proposition is straightforward. Industries or occupations with larger adjustment costs or natural attrition rates are impacted more easily by uncertainty increases. The intuition behind the last prediction stems from the fact that, by symmetrically stalling hiring and firing, uncertainty has conflicting effects on the employment of incumbents. New young workers can not benefit from the decrease in firing, and so see a larger relative decline in employment.

From this simple model, it is apparent that the uncertainty hypothesis predicts a unique impact pattern *within-state,* allowing us to test for this channel while holding aggregate effects like regional credit or demand shocks constant. We turn to these tests in the next section, where we will also use survey data to demonstrate that uncertainty does indeed make firms less eager to hire.

VI Disaggregated Evidence on Uncertainty and Unemployment

In this section we take the predictions that flow from our model to the data, to ensure that the mechanism implied by the model corresponds to features of the empirical reality surrounding us. We do this by carrying out tests at more disaggregated levels than the state-level relationships we have studied so far. We focus on the predictions our model provided regarding the impact of uncertainty within a given state on different industries, on occupations with different on-the-job training requirements and on workers of different ages. We also provide direct survey-based evidence on the way in which uncertainty affect firm demand for workers.

VI.a Uncertainty and Industry-Level Employment

The model predicts that an uncertainty shock will have a larger negative effect on employment in industries with higher (exogenous) separation rates $1 - \delta$. This prediction is intuitive: a pause in the hiring decision will have a larger effect on industries with more baseline turnover. The cross-sectional uncertainty measure we have introduced here allows us to test this prediction using variation in state-industry-level employment changes. These tests allow us to hold constant differences in the aggregate economy of each state, as well as national changes at the industry level, and test for the uncertainty channel by exploring only the within-state, within-industry cross-section.

We measure baseline separation rates as the average national, industry-level rate in the JOLTS data from 2000-2006. Our primary specification is:

$$\Delta ln\left(Employment\right)_{i,s} = \alpha_i + \alpha_s + Uncertainty_s \times Separation\,Rate_i \times \beta + \varepsilon_{i,s},$$

where the standard errors are clustered by state. The coefficient on the interaction term is reported in the first column of Table 4. It indicates that the difference in employment losses between industries with 5% and 15% annual separation rates is 0.6% higher for a unit increase in the uncertainty measure. For example, it implies that a high turnover industry like "Accommodation and Food Service" and a low turnover industry like "Durable Goods Manufacturing" experienced similar employment trends in a median uncertainty states like Connecticut. In a high uncertainty state like California, the decline in "Accommodation and Food Service" should have been 4.5% larger. The second column repeats this exercise excluding government employment, with little change in the results.

One concern with this analysis is that industry-level separation rates are not randomly assigned, and differential effects along these dimensions could instead represent differential sensitivity to business cycles. To address this possibility, we introduce two sets of controls. First, in Column 3, we interact separation rates with the change in the statewide unemployment rate from 2006-2009 and add this as a control. The coefficient of interest now represents the differential impact of uncertainty across industries, over and above any cyclical differences between high and low turnover industries. Adding this control has only a modest effect on the coefficient and its precision, and the data still show uncertainty impacting the cross-section as predicted by the model.

Finally, to address the issue more directly, we construct a measure of industry level cyclicality. Specifically, we measure industry-level cyclicality as the average decline in employment during each NBER dated recession since 1970. [8] Interestingly, this measure does not correlate strongly with the separation rate, as indicated in Figure A4. Some highly cyclical industries like manufacturing have low turnover rates, yet others like construction

[8] To ensure comparability across recessions, we first de-meaned these declines by recession and then took the industry level average.

have very high ones.

We then interact this cyclicality measure with the total change in unemployment and the uncertainty index and add both variables as controls in Column 4. Unsurprisingly, the table shows that more cyclical industries experienced larger employment losses in states with larger increases in unemployment (row 4). Holding this effect constant, though, these industries were not much affected in states with more uncertainty relative to those with less (row 3). On the other hand, an industry's baseline separation rate did not interact strongly with the overall change in unemployment in this specification either (row 2), but the significant difference by turnover when comparing high- and low-uncertainty states remains, just as predicted by the model (row 1).

The previous section demonstrated that the uncertainty hypothesis predicted not only aggregate outcomes, but had cross-sectional implications as well. The first of these predictions, that uncertainty should have a larger impact on high turnover industries, is strongly supported by the data.

VI.b Uncertainty and On-The-Job Training

The second prediction we test is whether higher adjustment costs lead to less hiring under increased uncertainty, and, hence, to less employment. We use individual-level data from the American Community Survey for 2006-2009 (Ruggles et al., 2010), combined with typical on-the-job training requirements by occupation from the Bureau of Labor Statistics. We drop individuals who are institutionalized or not in the labor force, and keep only workers in occupations that can be matched using the Census Bureau's occupation crosswalk and are characterized by no, short-term, moderate-term and long-term on-the-job training. We then estimate the following equation:

$$Unemployed_{i,y} = \alpha + Training \times Uncertainty \times I(2009)_{i,y}\theta' + Controls_{i,y}\gamma' + \varepsilon_{i,y},$$

where *Unemployed* is an indicator variable that expresses whether a worker i is unem-

ployed or not in year y; *Training*Uncertainty*I(2009)* is the explanatory variable of interest, an interaction between the amount of on-the-job training the worker's occupation typically requires, the value of our uncertainty index in the worker's state of residence, and an indicator that equals 1 for 2009, 0 for all other years; and *Controls* are fixed effects for year and state as well as for the amount of on-the-job training typically required. In a second regression we also include controls for the individual's educational attainment and work experience. Standard errors are clustered by state.

Column 1 in Table 5 shows that our model's prediction holds true: workers in occupations that require higher levels of on-the-job training are more likely to become unemployed when uncertainty in their state increases. Column 2 shows that this result stands even when controlling for the individual's educational attainment and work experience. In practical terms, what these regressions show is that for occupations with long-term on-the-job training, a one standard-deviation increase in uncertainty makes unemployment 2 percentage points more likely. What this means in the context of the model presented in the previous section is that the second cross-sectional prediction derived there holds as well.

VI.c Uncertainty and Young Workers

The third prediction from our model is that young workers are more likely to be the victims of high levels of uncertainty than old workers. We follow a very similar approach to that followed in the previous subsection, and estimate the following equation:

$$Unemployed_{i,y} = \alpha + Youth \times Uncertainty \times I(2009)_{i,y}\theta' + Controls_{i,y}\gamma' + \varepsilon_{i,y},$$

where *Youth*uncertainty*I(2009)*, the new explanatory variable of interest, now represents an interaction between an indicator that equals 1 for young workers (under the age of 31; results are strikingly similar for workers under 26), and 0 for older workers, the level of our uncertainty index in the worker's state of residence, and an indicator that equals 1

for 2009, 0 for all other years; and *Controls* now include a youth dummy instead of the amount of on-the-job training. Once again, in a second regression we also include controls for the individual's educational attainment and work experience, and standard errors are clustered by state. We implicitly assume here that younger workers' labor supply is not differentially affected by increased levels of uncertainty.

Column 3 in Table 5 shows that our model's third prediction holds true: young workers are more likely to become unemployed when uncertainty in their state increases. Column 2 shows that this result stands even when controlling for the individual's educational attainment and work experience, implying that a young worker's probability of unemployment in California in 2009 was almost two percentage points higher than to Texas due to these two states' levels of uncertainty.

VI.d Survey Evidence

The final feature of last section's model that we test is the mechanism underlying our predictions: that uncertainty levels impact firm-level demand for labor. We use data from the Panel Study of Entrepreneurial Dynamics to test this prediction. More specifically, we test whether owners/managers of start-up firms who express more concern about regulatory uncertainty (in response to the question: "Considering the economic and community context for the new firm, how certain are you that the new business will be able to accomplish the following? Comply with local, state, and federal regulations") in the first wave of the survey are more or less likely to claim that they will be hiring employees in the future, by estimating the following equation:

$$Hiring_i = \alpha + Uncertainty_i\theta' + Controls_i\gamma' + \varepsilon_i.$$

Our model describes a world in which they are less likely to do so, i.e. in which θ is negative, and Table 6 confirms this prediction. In Column 1, we control for county, state and year fixed effects, and find a significant and sizable negative impact of regula-

tory uncertainty (coded as a dummy variable: 1 indicates at least high uncertainty, while 0 indicates at most neither high, nor low uncertainty) on the decision to hire. Column 2 also controls for the entrepreneur's educational attainment and race, while Column 3, in addition to those variables, controls for industry; the effect of regulatory uncertainty continues to be highly significant and economically important. When we also control for labor market uncertainty ("Considering the economic and community context for the new firm, how certain are you that the new business will be able to accomplish the following? Attract employees"), the coefficient on regulatory uncertainty decreases somewhat, but remains highly significant: an entrepreneur faced with "high" levels of uncertainty was more than 10 percentage points less likely to hire new employees than one facing lower levels of uncertainty. The demand-side effects emphasized in our model remain important even when control for labor supply dynamics.

To summarize, these four disaggregate tests of the uncertainty channel show empirical support for its importance in deepening the impact of the financial crisis, emphasizing its importance in coming to a comprehensive understanding of the depth and length of the Great Recession.

VII Discussion and Conclusion

The high levels of persistent unemployment caused by the 2008 financial crisis have been explained in a variety of ways. What we have shown here is, first, that an explanation grounded in increased levels of policy and general economic uncertainty channel is plausibly of significant importance. We have built on the work of Baker, Bloom and Davis (2013) to demonstrate that it is not just the time series, but also the cross-section of uncertainty levels that is consistent with the observed unemployment increases. As further support for the uncertainty mechanism's role in driving jumps in unemployment we show that high levels of uncertainty driven by predetermined state-level institutions cause high

levels of unemployment. We also provide evidence that all of this is not a mere statistical fluke: when compared to competing hypotheses, the uncertainty explanation for the length and depth of the Great Recession shows the potential to add to our understanding in and of itself.

We then proceeded to explore how these macroeconomic dynamics can be explained from the ground up. A simple model of hiring and firing under uncertainty that rationalizes firm-level employment losses under increased levels of uncertainty provided us with specific predictions regarding the behavior of firms and industries as well as the labor market outcomes facing certain groups of occupations and individual workers. Overall, the empirical evidence supports these predictions, suggesting that the macro-level evidence for the uncertainty hypothesis is not a mere product of dire economic straits, but that it reflects underlying microeconomic mechanisms that generate adverse employment outcomes. In 1788, James Madison wrote that "[g]reat injury results from an unstable government. The want of confidence in the public councils damps every useful undertaking, the success and profit of which may depend on a continuance of existing arrangements. What prudent merchant will hazard his fortunes in any new branch of commerce when he knows not but that his plans may be rendered unlawful before they can be executed? What farmer or manufacturer will lay himself out for the encouragement given to any particular cultivation or establishment, when he can have no assurance that his preparatory labors and advances will not render him a victim to an inconstant government?" The evidence presented here shows that these fears were certainly not absurd, and that policy and economic uncertainty exacerbated the Great Recession.

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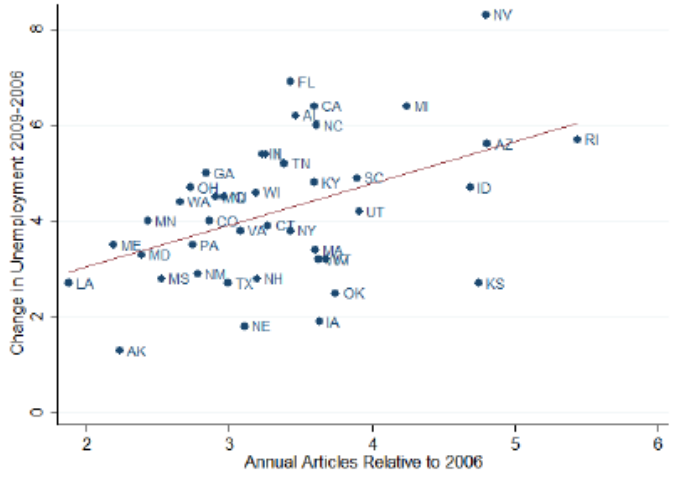
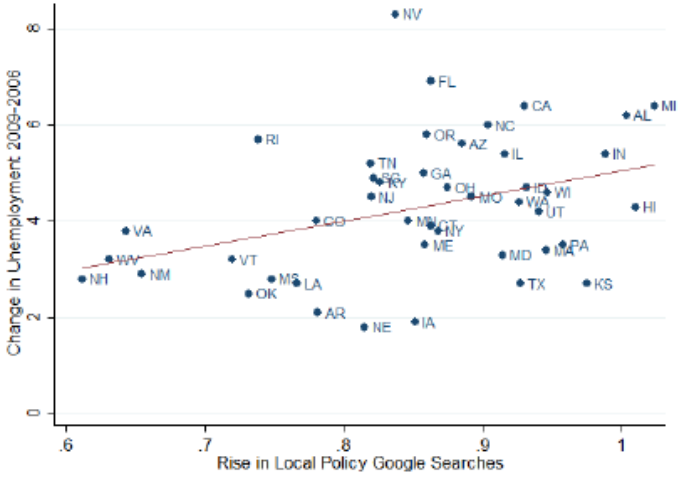
Figure 1. Uncertainty and Unemployment

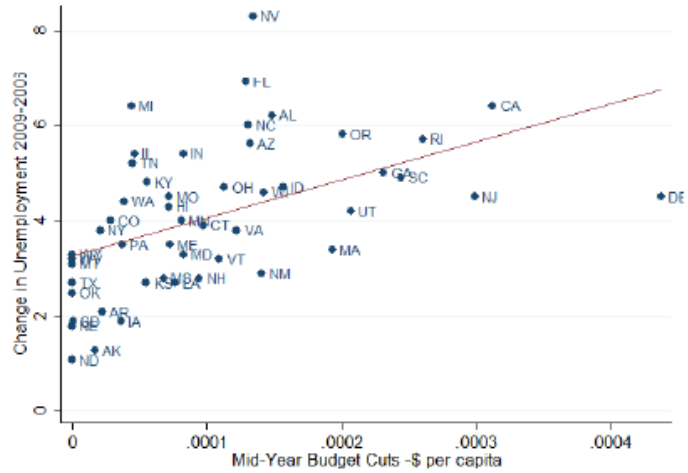
1a. Uncertainty in the News and Unemployment



1b. Google Searches and Unemployment



1c. Budget Cuts and Unemployment



1d. Tax Policy and Unemployment

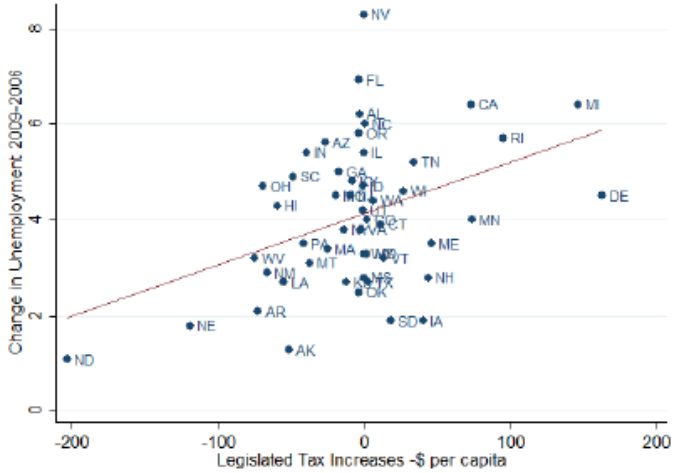
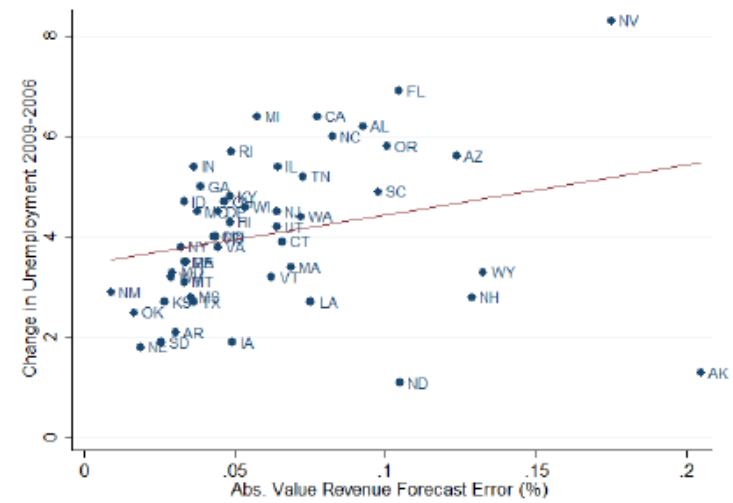


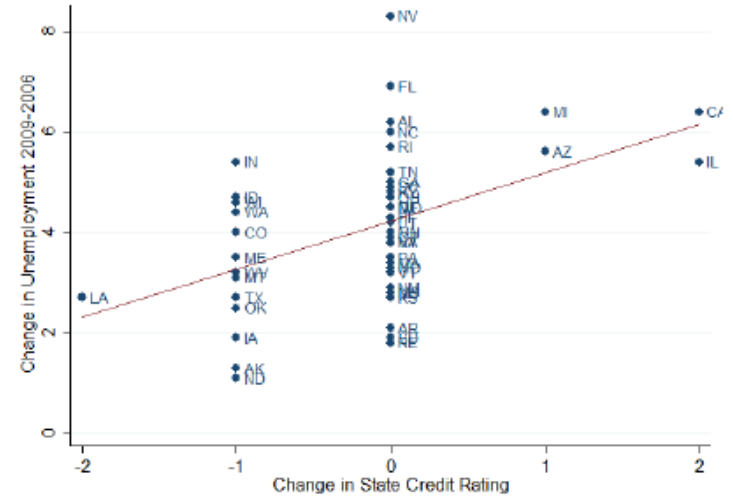
Figure 1. Uncertainty and Unemployment (Continued)

1e. Revenue Deviations and Unemployment

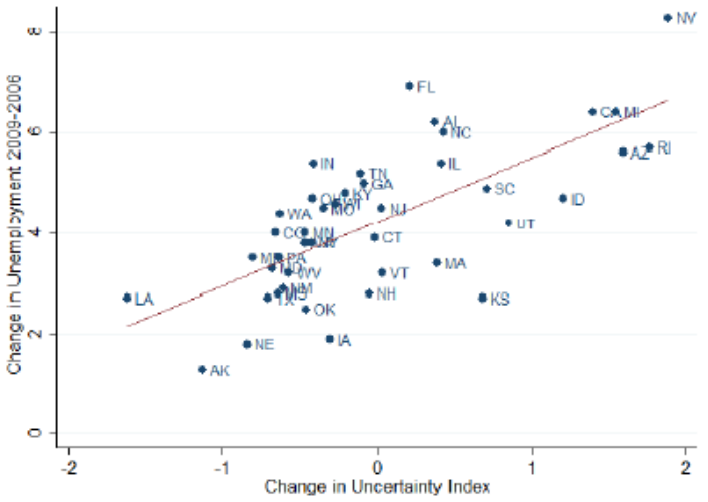


1f. Coincident Index Deviations and Unemployment

1g. State Credit Ratings and Unemployment



1h. Uncertainty Index and Unemployment



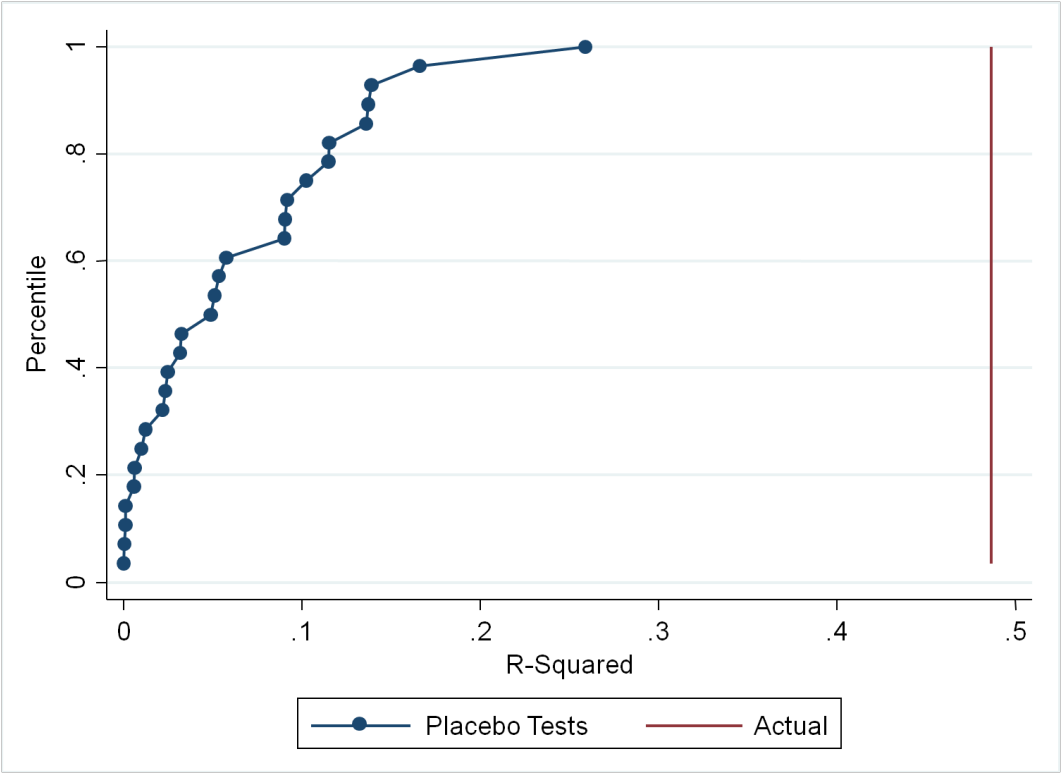


Figure 2. Placebo Regressions - Uncertainty Index and Unemployment: This figure plots the distribution of R_2s from regressing all three-year unemployment rate changes from 1976 to 2006 against the uncertainty index measured from 2007 to 2009. The red line plots the R_2 from regressing the change in unemployment from 2009 to 2006 against that measure. The large increase in predictive power indicates that the uncertainty measure is not correlated with the cross-sectional correlation pattern in business cycles across states.

Table 1. Correlation of Uncertainty and Changes in Unemployment Rates

Baseline

	Δ Unemployment (2006-2009)			
	(1)	(2)	(3)	(4)
Uncertainty Index	1.269***	1.102***	1.266***	1.159***
	(0.194)	(0.222)	(0.201)	(0.230)
Controls				
Initial Unemployment			X	X
AR Model Forecast				X
		Drop Foreclosure Katrina		
Sample	Full	States	Full	Full
R^2	0.49	0.29	0.49	0.51
N	42.00	37.00	42	42.00
Dependent Variable	4.1	3.9	4.1	4.1

Placebo Tests

	Unemployment 2006		Δ GDP Per Worker (2006-2009)		Industry-Share (Bartik) Shock		AR Unemployment Forecast	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Uncertainty Index	0.0259	0.0576	0.863	0.322	-0.343	-0.270	0.136	0.082
	(0.217)	(0.351)	(0.765)	(0.753)	(0.292)	(0.413)	(0.147)	(0.212)
		Drop Foreclosure Katrina		Drop Foreclosure Katrina		Drop Foreclosure Katrina		Drop Foreclosure Katrina
Sample	Full	States	Full	States	Full	States	Full	States
R^2	0.00	0.000	0.07	0.01	0.05	0.01	0.03	0.01
N	42	37	42	37	42	37	42	37
Dependent Variable	4.5	4.4	8.5	9.3	-6.2	-6.2	4.5	4.5

Notes: Details on the construction of the regional uncertainty index are in the text. We drop AZ, CA, FL, LA, and NV in Baseline test (2), and Placebo Tests (2), (4), (6) and (8). For Baseline Test (4) and Placebo Tests (7) and (8) we run a regression of state-level unemployment rates on U_{t-3} through U_{t-7} from 1976-2006. We then use this model to predict unemployment in 2009, and this prediction is included as a control.$***p<0.01, **p<0.05, *p<0.1$

Table 2. The Impact of Institutions on Uncertainty and Unemployment

Panel A: Effect of Institutions on Uncertainty

	Uncertainty Index					
Institution	3.746**	-3.032*	-0.643**	0.465*	5.732**	0.563
	(1.725)	(1.665)	(0.248)	(0.250)	(2.462)	(0.417)
	Tax Revenue	Structural	Budget	Late	Forecast	Lame
Measure	Fraction	Surplus	Deadline	Budget	Gap	Duck
R^2	0.074	0.049	0.154	0.082	0.177	0.062

Panel B. IV Results

	Δ Unemployment 2006-2009 (pp)					
Uncertainty Index	2.382***	2.357**	0.612	2.623***	1.585***	3.370*
	(0.879)	(1.173)	(0.547)	(1.016)	(0.449)	(1.791)
First Stage						
F-Statistic	4.7	3.3	6.7	3.5	5.4	1.8
	Tax Revenue	Structural Surplus	No Budget	Late	Forecast	Lame
Instrument	Fraction	(-)	Deadline	Budget	Gap	Duck

Panel C. Placebo Test: Effect of Institutions on Industry Share Shock

	Industry Share Predicted Employment Change					
Institution	2.385	1.412	0.624*	-0.555	2.104	0.681
	(3.419)	(1.814)	(0.354)	(0.344)	(2.625)	(0.408)
	Tax	Structural	Budget	Late	Forecast	Lame
Measure	Revenue	Surplus	Deadline	Budget	Gap	Duck
R^2	0.016	0.007	0.073	0.054	0.011	0.051

Panel D. Placebo Test: Effect of Institutions on Initial Unemployment Levels

	Unemployment 2006 (pp)					
Institution	-1.803	-4.112	-0.163	0.227	3.849	-0.035
	(3.026)	(2.891)	(0.287)	(0.283)	(2.925)	(0.307)
	Tax	Structural	Budget	Late	Forecast	Lame
Measure	Revenue	Surplus	Deadline	Budget	Gap	Duck
R^2	0.012	0.053	0.007	0.013	0.047	0.000
N	42	42	41	42	36	41

Notes: Details on the construction of the institutional variables are in the text. Panel A demonstrates the effect of each institution on the uncertainty measure. Panel B demonstrates the effect of each institution on unemployment from 2006-2009. Panels C and D report placebo tests demonstrating that these institutions are uncorrelated with industry-based employment shock and initial unemployment levels respectively. Sample sizes for all regressions in each column reported in the last row. $***p<0.01, **p<0.05, *p<0.1$

Table 3. Alternative Hypotheses Compared

Panel A. Structural Shift Controls	Δ Unemployment 2006-2009				
Uncertainty Index	1.224***	1.213***	0.888***	1.273***	0.716**
	(0.164)	(0.176)	(0.266)	(0.208)	(0.292)
Controls	Construction Employment	Industry Share Instrument	FHFA Housing Price	Census Division	All Structural
Panel B. Aggregate Demand Controls	Δ Unemployment 2006-2009				
Uncertainty Index	1.141***	0.946***	1.214***		0.845***
	(0.186)	(0.195)	(0.157)		(0.205)
Controls	DTI Instrument	Percentage Change in Car Sales	Change in Food and Entertainment Employment		All Demand Controls
Panel C. Credit Supply Controls	Δ Unemployment 2006-2009				
Uncertainty Index	1.146***	1.215***	1.217***	1.187***	1.041***
	(0.195)	(0.196)	(0.194)	(0.185)	(0.217)
Controls	Small Business Share	Average Credit Limit	Average Unused Credit Limit	Bank Failures	All Credit Controls
Panel D: Multiple Channels	Δ Unemployment 2006-2009				
Uncertainty Index			0.882***		
			(0.210)		
Structural Shift Index			X		
Aggregate Demand Index			X		
Credit Supply Index			X		

Notes: Details on the construction of the control variables are in the text. Panel A, B, and C add control variables related to the structural shift, aggregate demand, and credit supply hypotheses respectively. In panel D, we first construct an index for each alternate hypotheses by standardizing the individual controls and taking the principal component factor. *** p <0.01, ** p <0.05, * p <0.1

Table 4. Uncertainty and the Within-State Cross Section of Industries

	Change in State-Industry Employment			
	(1)	(2)	(3)	(4)
Separation Rate *	-6.584***	-6.608**	-4.824*	-4.931*
Regional Uncertainty Index	(2.191)	(2.623)	(2.673)	(2.760)
Separation Rate *			-0.0146	-0.0174
Change in Unemployment 06-09			(0.0134)	(0.0133)
Cylicality Measure *				-0.202
Regional Uncertainty Index				(0.145)
Cylicality Measure *				-0.253***
Change in Unemployment 06-09				(0.0658)
Industry Fixed Effect	X	X	X	X
State Fixed Effect	X	X	X	X
Sample	All Industries	Exclude Gov't Employment	Exclude Gov't Employment	Exclude Gov't Employment
R^2	0.693	0.685	0.685	0.713
N	722	640	640	601

Notes: Standard errors clustered by state. The separation rate is average separation rate for each industry in JOLTS for 2001-2006. The cylicality measure is the average percentage decline in industry employment during NBER recessions, 1970-2010, relative to the average downturn in those recessions. Additional details are in the text.

Table 5. Uncertainty and Individual Unemployment

	Change in Probability of Unemployment (Percentage Points)				
	(1)	(2)		(3)	(4)
On-the-job Training * Uncertainty	0.538***	0.536***	Youth * Uncertainty	0.810***	0.811***
	(0.056)	(0.056)		(0.168)	(0.170)
Educational Attainment		X	Educational Attainment		X
Experience		X	Education		X
State Fixed Effects	X	X	State Fixed Effects	X	X
Year Dummies	X	X	Year Dummies	X	X
R^2	0.02	0.02		0.02	0.02
N	8,680,657	8,680,657		8,680,657	8,680,657

Notes: Standard errors clustered by state. Data on employment status, age, education, experience, and location for 2006-2009 come from the U.S. census and the American Community Survey. Individuals under the ago of 30 are considered to be "Youth." Institutionalized individuals are excluded. Data on on-the-job training by occupational category comes from the Bureau of Labor Statistics.

Table 6. Uncertainty and Firm-Level Hiring

	Decision to Hire			
	(1)	(2)	(3)	(4)
Regulatory Uncertainty	-0.146***	-0.146***	-0.160***	-0.118***
	(0.048)	(0.047)	(0.044)	(0.40)
Labor Market Uncertainty				-0.185**
				(0.073)
Industry Controls			X	X
Demographic Controls		X	X	X
County and State Fixed Effects	X	X	X	X
Year Dummies	X	X	X	X
R^2	0.04	0.06	0.07	0.09
N	557	554	542	542

Notes: Robust standard errors clustered by state. Data from the Panel Study of Entrepreneurial Dynamics. Demographic controls include indicators for race and educational attainment; industry controls are GICS sectors.

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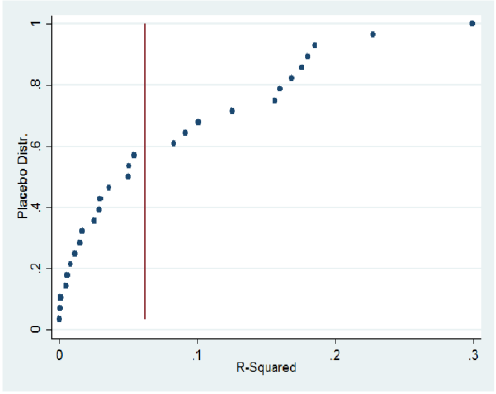
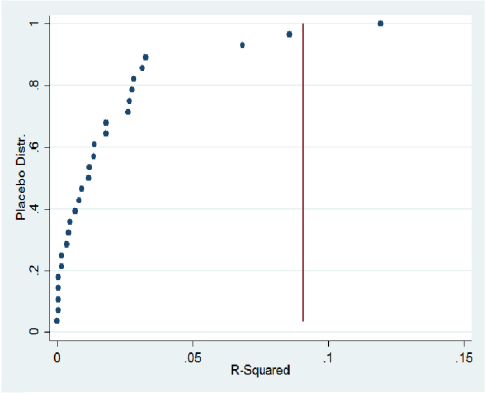
Figure A.1. Institutions, Uncertainty, and Unemployment

	Negatively Correlated with Unemployment	Positively Correlated with Unemployment
Positively Correlated with Uncertainty	*Debt to GDP('06)	*Legislative Activity* Legislative Days in Session ('04-'06) Full Time Legislature No. of Bills Enacted ('04-'06) Annual Legislature *Political Divide* Divided Government Supermajority Requirement History of Late Budgets Lame Duck Governor ('06) *Revenue Instability* Fraction of Revenue from Taxes Large Budget Forecast Deviations History of Late Budgets *Money in Politics* State Political Donations (per cap) Governor Salary
Negatively Correlated With Uncertainty	*Revenue Stability* State Rainy Day Funds (per cap) Strong Balanced Budget Law State Structural Surplus ('06) *Budget Procedures* Budget Deadline Provision for Dealing with Gov't Shutdown	

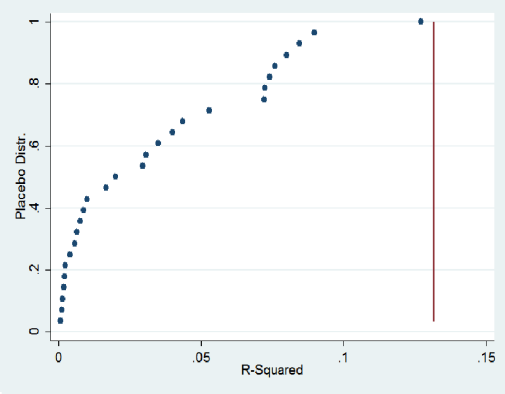
Figure A.2. Placebo Regressions - Institutions and Unemployment



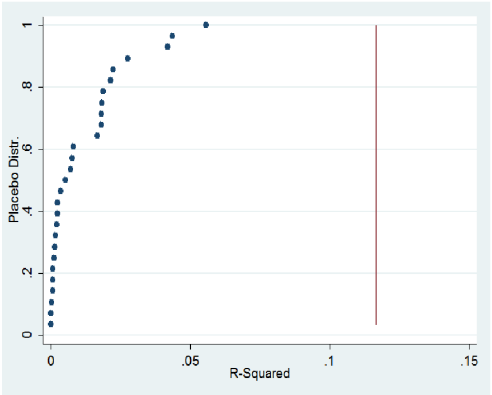
A. Budget Forecast Gap



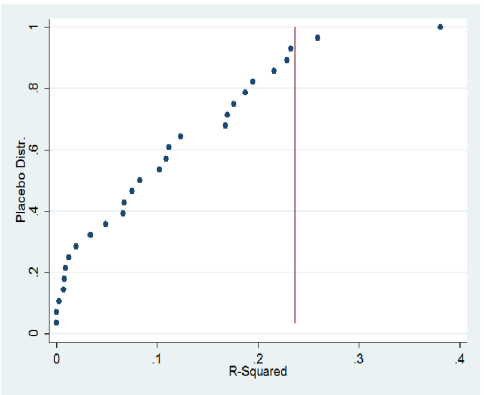
B. Budget Deadline



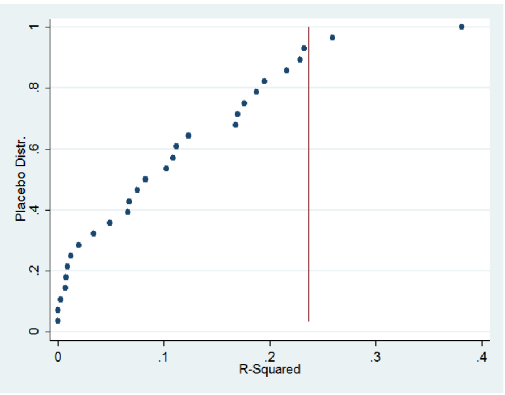
C. Tax Fraction of Revenue



D. Lame-Duck Governor



E. Late Budget



F. Structural Surplus

Figure A.3. Model Timeline

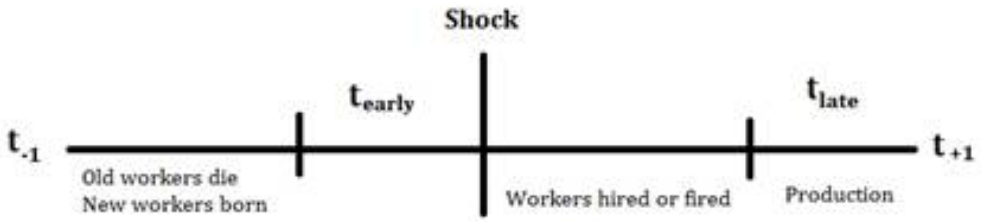


Figure A.4. Cyclicality and Separation Rate

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Table A.1. Summary Statistics

	Mean	SD	Min	Median	Max
Employment Outcomes					
Δ Unemployment rate (2006-2009)	4.07	1.53	1.10	4.00	8.30
Percentage Points					
Δ GDP per worker (2006-2009)	8.97	2.87	-2.62	8.84	17.15
Percentage Points					
Uncertainty Measures					
Newspaper Coverage Ratio	3.349	0.772	1.874	3.262	5.435
Ratio of # of Articles in 2007-2009 to 2006					
Search Ratio	0.852	0.103	0.612	0.861	1.024
Ratio of Google searches in 2009 to 2006					
Off-Cycle Budget Cuts	102.0	94.9	0.0	78.7	438.0
Dollars per Capita, 2008 and 2009					
Legislated Tax Changes	-5.74	58.62	-202.95	-2.50	162.82
Dolalrs per Capita, 2008 and 2009					
Revenue Forecast Deviations	0.062	0.040	0.009	0.049	0.205
Ratio of Deviation to Initial Estimates, 2008 and 2009					
Federal Reserve Forecast Deviations	1.713	0.793	0.668	1.575	4.559
Differences between Indicator and Realization, 2006 to 2009					
Credit Rating Changes	-0.188	0.734	-2.000	0.000	2.000
Changes from 2006 to 2009					
Institutions					
Tax Fraction of Revenue	0.433	0.065	0.213	0.447	0.547
Percentage of Total Revenue					
Structural Surplus	0.984	0.031	0.939	0.981	1.081
Non-insurance Trust Revenues as a Percentage of Total Revenues					

Notes: See Data Appendix and text for sources.

Table A.2. Ranking of States by Uncertainty Index

Rank	State	Index
1	Nevada	1.889
2	Rhode Island	1.766
3	Arizona	1.593
4	Michigan	1.550
5	California	1.397
6	Idaho	1.208
7	Utah	0.854
8	South Carolina	0.712
9	Kansas	0.682
10	North Carolina	0.429
11	Illinois	0.417
12	Massachusetts	0.391
13	Alabama	0.377
14	Florida	0.212
15	Vermont	0.032
16	New Jersey	0.031
17	Connecticut	-0.015
18	New Hampshire	-0.052
19	Georgia	-0.083
20	Tennessee	-0.106
21	Kentucky	-0.208
22	Wisconsin	-0.267
23	Iowa	-0.302
24	Missouri	-0.346
25	Indiana	-0.411
26	Ohio	-0.419
27	New York	-0.422
28	Oklahoma	-0.460
29	Virginia	-0.463
30	Minnesota	-0.464
31	West Virginia	-0.569
32	New Mexico	-0.605
33	Washington	-0.632
34	Pennsylvania	-0.635
35	Mississippi	-0.647
36	Colorado	-0.656
37	Maryland	-0.678
38	Texas	-0.706
39	Maine	-0.804
40	Nebraska	-0.841
41	Alaska	-1.129
42	Louisiana	-1.621

Unranked: Delaware, Oregon, North Dakota, Arkansas, Hawaii, Montana, South Dakota, Wyoming.

Table A.3. Factor Analysis and Loadings

Factor analysis/correlation				
Factor	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
Factor 1	1.55573	0.95760	0.8973	0.8973
Factor 2	0.59813	0.43743	0.3450	1.2423
Factor 3	0.16070	0.20383	0.0927	1.3350
Factor 4	-0.04312	0.01406	-0.0249	1.3101
Factor 5	-0.05719	0.09884	-0.0330	1.2771
Factor 6	-0.15603	0.16843	-0.0900	1.1871
Factor 7	-0.32446	.	-0.1871	1.0000

Factor loadings (pattern matrix) and unique variances		
Variable	**Factor 1**	**Uniqueness**
Newspaper Coverate Ratio	0.6727	0.5475
Off-cycle Budget Cuts	0.4495	0.7979
Credit Rating Changes	0.4445	0.8024
Search ratio	0.2074	0.9570
Legislated Tax Changes	0.3303	0.8909
Revenue Forecast Deviations	0.5596	0.6868
Federal Reserve Forecast Deviations	0.4882	0.7617

LR test: independent vs saturated: χ^2 (21) = 41.68. Prob $>\chi^2$ = 0.0046.

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Model Appendix

Steady State Restrictions on the Cost of Adjustment, C

We assume that C is smaller than the minimum of the following two expressions:

$$C^1 = -\frac{-\beta^3 p^2\delta+\beta^3 p^2\delta^2-\beta^2 p-\beta^2 p\delta^2+2\beta p+\beta^2-\beta+\beta\delta-1}{(\beta-\beta^2 p\delta-2\beta p\delta+\beta^2 p\delta^2+1)(1-2\beta p-\beta^2+2\beta^2 p)}$$

and

$$\frac{\begin{array}{c}(-1-2\beta^2 p-\beta^3\delta-\beta^2\delta+\beta^3\delta^2-6\beta^2 p^2-8\beta^3 p+11\beta^3 p^2+7\beta^4 p+2\beta^4\delta-6\beta^4 p^2-\beta+5\beta p+\beta^3-\\ 2\beta^2 p^2\delta+2\beta^2+6\beta^3 p\delta+3\beta^2 p\delta-3\beta^3 p\delta^2-9\beta^3 p^2\delta+2\beta^3 p^2\delta^2+8\beta^4 p^2\delta-\beta^4 p^2\delta^2-3\beta^4 p^3\delta+\\ 4\beta^3 p^3\delta+\beta^4 p^3\delta^2+\beta^5 p\delta-7\beta^4 p\delta-\beta^5 p\delta^2-3\beta^5 p^2\delta+2\beta^5 p^2\delta^2+\beta^5\delta^3 p^2+2\beta^5 p^3\delta+\beta^5 p^3\delta^2-\\ 3\beta^5 p^3\delta^3-2\beta^5 p^4\delta^2+2\beta^5 p^4\delta^3-2\beta^4-2\beta^4 p^3\delta^3-\beta^4 p\delta^3+3\beta^4 p^2\delta^3)\end{array}}{(1-2\beta p-\beta^2+2\beta^2 p)(-\beta\delta+2\beta p\delta-1)(1-3\beta p-\beta^2+\beta^2\delta+2\beta^2 p-3\beta^2 p\delta+2\beta^2 p^2\delta+\beta)}$$

Proof of Proposition 1

It is trivial to show that firms in states (ϕ_h, ϵ_h) and (ϕ_l, ϵ_l) do not adjust. We now show that the adjustment decisions in states (ϕ_h, ϵ_l) and (ϕ_l, ϵ_h), namely whether to hire or fire, are affected by uncertainty symetrically. We begin by expanding the value function for the high-productivity, low-employment adjusting state:

$$v(\phi_h, \epsilon_l) = Max\{\pi(1-C) + \beta(p\delta v_{hh} + (1-p)\delta v_{lh} + (1-\delta)pv_{hl} + (1-p)(1-\delta)v_{ll}), \beta(pv_{hl} + (1-p)v_{ll})\}$$

The benefit to adjusting is then the difference between these values, or:

$$b(\phi_h, \epsilon_l) = \pi(1-C) + \beta\delta\left(p\left(v_{hh} - v_{hl}\right) - (1-p)\left(v_{ll} - v_{lh}\right)\right)$$

The value function and benefit to adjusting for the other mismatched state can be written as:

$$v(\phi_l, \epsilon_h) = Max\{\pi(1-C) + \beta(pv_{ll} + (1-p)v_{hl}), \beta(p\delta v_{lh} + p(1-\delta)v_{ll} + (1-p)\delta v_{hh} + (1-p)(1-\delta)v_{hl})\}$$

which means that:

$$b(\phi_l, \epsilon_h) = \pi(1-C) + \beta\delta\left(p(v_{ll} - v_{lh}) + (1-p)\left(v_{hl} - v_{hh}\right)\right)$$

Finally, we know that $v_{hh} - v_{hl} = \pi C = v_{ll} - v_{lh}$ in the adjustment region. Ergo, the gain to adjusting in either state is identical, $b(\phi_l, \epsilon_h) = b(\phi_h, \epsilon_l)$, as the lemma claims. Because the shock is temporary, continuation value functions do not change, only the odds of reaching them are altered. Firms thus decide to adjust despite the temporary shock if:

$$\begin{aligned} b(\phi_h, \epsilon_l) = b(\phi_l, \epsilon_h) &= \\ \pi(1-C) + \beta[\delta(1-\tilde{p})(v_{hl} - v_{hh}) + \tilde{p}\delta(v_{ll} - v_{lh})] &= \\ 1 - C - \beta C\delta + 2\beta C\tilde{p}\delta &> 0 \end{aligned}$$

which implies that firms in industry i will adjust if

$$\tilde{p} > \frac{1}{2}\left(1 + \frac{C_i - 1}{\beta C_i \delta_i}\right)$$

Firms in industries with adjustment costs C_i or attrition rates $1 - \delta_i$ such that above equation fails to hold have no hiring or firing. It is not worth paying the cost C_i to adjust to the desired state given the reduced odds of continuing in the same state. Though the hiring and firing decision is symmetric, the assymetric distribution of firms means that there is a greater reduction in hiring. As a consequence, the existing stock of employment in these industries (if positive) shrinks at rate of $(1 - \delta)$.□

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Data Appendix

I: Uncertainty and the Great Recession

State-Level Unemployment Rates: Bureau of Labor Statistics, unemployment rates for states (seasonally adjusted).

II: Uncertainty and Unemployment

Newspaper Mentions of Uncertainty: Newslibrary.com (`http://www.newslibrary.com`), articles between 1/1/2006 and 12/31/2010. These results were filtered to remove any papers that began after this period or with spotty on-line coverage (by restricting ourselves to papers with at least 25 articles a year from 2006 through 2010 with the word "uncertainty"), and to remove television transcripts, non-English language papers, and national papers such as USA Today. In the end, we are left with 116,120 articles from 42 states from 226 newspapers.

Google Searches: Google Trends (`http://www.google.com/trends/`), searches for "state" and "budget" or "state" and "tax." We use Google Trends relative search frequency numbers for these terms in all states in 2009, then normalize them using the 2006 numbers.

Mid-Year Budget Cuts, Tax Changes: National Association of State Budget Officers (NASBO), Fall Fiscal Survey of the States, 2008 and 2009.

State Populations: U.S. Census Bureau, State and County QuickFacts.

Coincident and Leading Indicators: Federal Reserve Bank of Philadelphia, 2006-2009.

Credit Ratings: Standard and Poor's, 2006-2009.

III: State Institutions Affect Both Uncertainty and Unemployment

Legislative Days in Session: LexisNexis State Net Session Statistics.

Full Time Legislature: LexisNexis State Net Session Statistics.

Number of Bills Enacted: LexisNexis State Net Session Statistics.

Annual Legislature: Snell (2011).

Divided Government: Andersen et al. (2012).

Supermajority Requirement: Leachman et al. (2012).

History of Late Budgets: Andersen et. al (2012).

Debt to GDP: U.S. Census Bureau, State Government Finances.

Fraction of Revenue from Taxes: U.S. Census Bureau, State Government Finances.

Budget Forecast Deviations: National Association of State Budget Officers (NASBO) Fiscal Survey of the States.

Lame-Duck Governor: Andersen et al. (2012).

State Political Donations: National Institute on Money in State Politics.

Governor Salary: Alaska Department of Administration (2008), `http://doa.alaska.gov/dop/fileadmin/socc/pdf/bkgrnd_socc23.pdf`.

State Rainy Day Funds: National Association of State Budget Officers (NASBO), Fiscal Survey of the States.

Strong Balanced Budget Law: Clemens and Miran (2012), Advisory Commission on Intergovernmental Relations.

State Structural Surplus: U.S. Census Bureau, State Government Finances.

Budget Deadline:Andersen et al. (2012).

Provision for Dealing with Government Shutdown: Andersen et al. (2012).

IV: Uncertainty is Robust to Alternative Channels

Construction Employment: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2006-2009.

Bartik Instrument: Constructed from the Quarterly Census of Employment and Wages, at the 2-digit level.

FHFA Housing Price Index: Federal Housing Finance Agency, House Price Index, 2006-2009.

Housing Supply Elasticities: Raw data from Saiz (2010), weighted by population to the state level as in Ganong and Shoag (2013).

Car Sales: National Automobile Dealers Association, 2006-2009.

Food and Entertainment Employment: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2006-2009

Small Business Share: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2006

Credit Limit Data: Experian, The State of Credit, 2010.

Bank Failures: Federal Financial Institutions Examination Council, Reports of Condition and Income, 2007-2009.

VI: Disaggregated Evidence on Uncertainty and Unemployment

Industry Separation Rates: Bureau of Labor Statistics, Job Openings and Labor Turnover Survey, 2000-2006.

Employment by Industry: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 1970-2009.

Individual Employment, Occupation, and Demographics: Minnesota Population Center, Integrated Public Use Microdata Series: Version 5.0.

On-the-job Training Requirements: Bureau of Labor Statistics, Education and training assignments.

Survey Data on Entrepreneurs: University of Michigan, Panel Study of Entrepreneurial Dynamics, http://www.psed.isr.umich.edu/psed/home.