Some Unpleasant Stabilization Arithmetic

Joe Peek, Eric Rosengren, and Geoffrey M.B. Tootell[1]

Abstract

Before the Great Recession, traditional countercyclical monetary policy, lowering short-term interest rates as the economy weakens, was viewed as the primary tool for addressing economic downturns. However, the experience of hitting the effective lower bound (ELB) for an extended period of time increased the awareness of the possible limitations of relying too heavily on traditional countercyclical monetary policy. The challenges to effective countercyclical monetary policy presented by the possibility, in fact the probability, of returning to the ELB in future recessions have highlighted the potential importance of nonmonetary policy tools, such as federal fiscal policy, state and local fiscal policy, and even bank regulatory policy, as necessary sources of countercyclical stabilization policy. However, to implement such policies effectively, policymakers must be both willing and able to use them, which requires both the desire to use the available countercyclical tools and policy buffers of a size sufficient for them to be useful. Thus, a current concern is the extent to which the United States has sufficient policy buffers to offset a large adverse shock.

This paper highlights that limitations in using short-term interest rates to combat economic downturns is likely to be a recurring problem, given the increased likelihood of the federal funds rate hitting the ELB. We explicitly consider monetary and nonmonetary policy buffers to gauge how resilient the economy is likely to be in the next recession. We focus on individual US states which allows us to evaluate how critical the various policy buffers are at the individual state level while recognizing differences in the extent to which states will be impacted, both by countercyclical policies and by limitations imposed by insufficient policy buffers, given the differences in such factors as states' sensitivities to countercyclical monetary and federal fiscal policies.

From a policy perspective, more attention should be given to establishing appropriate policy buffers to mitigate future shocks. For both state and federal governments, we highlight the potential downside of using up financial capacity during this recovery. For bank regulation, we highlight the importance of maintaining a well-capitalized and resilient banking system. For monetary policy, considering how best to respond to the increased likelihood of hitting the ELB in the future, and either building a larger monetary policy buffer or being more willing to aggressively use nontraditional tools, will be essential.

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Before the Great Recession, traditional countercyclical monetary policy, lowering short-term interest rates as the economy weakens, was viewed as the primary tool for addressing economic downturns. However, the experience of hitting the effective lower bound (ELB) for an extended period of time increased the awareness of the possible limitations of relying too heavily on traditional countercyclical monetary policy.[2] As a consequence, the Federal Reserve turned to less traditional, and some would argue less effective, policy tools, such as quantitative easing and forward guidance. The challenges to effective countercyclical monetary policy presented by the possibility, in fact the probability, of returning to the ELB in future recessions have highlighted the potential importance of nonmonetary policy tools, such as federal fiscal policy, state and local fiscal policy, and even bank regulatory policy, as necessary sources of countercyclical stabilization policy. Still, monetary policy is often seen as the first and last resort, serving as the ultimate backstop when adverse shocks hit the real economy. Yet after spending seven years at the effective lower bound, perhaps the optimal approach would be to use these four policy categories in a coordinated manner. However, to implement such policies effectively, policymakers must be both willing and able to use them, which requires both the desire to use the available countercyclical tools and policy buffers of a size sufficient for them to be useful.

A current concern is the extent to which the United States has sufficient policy buffers to offset a large adverse shock. In particular, in a low interest rate environment, the possibility of offsetting adverse economic shocks with traditional monetary policy tools may be constrained by the policy rate, the federal funds rate, hitting the effective lower bound. While there are other, nontraditional tools available to the central bank, such as expanding the balance sheet and forward guidance, central banks' limited experience using these tools makes the impact less certain. Moreover, these tools have proven to be politically controversial, making their aggressive deployment, or even their deployment at all, less certain in response to a future economic downturn.

If these nontraditional monetary policy tools were needed to be deployed only in an extreme circumstance that was very unlikely to be repeated, one might not be particularly concerned. However, if instead, the current economic environment limits the use of

[2] While some other central banks, such as the European Central Bank and the Bank of Japan, have reduced their policy rates below zero, the Federal Reserve has not (yet) done so. Thus, at this point, we can think of the effective lower bound and the zero lower bound (ZLB) as being interchangeable for the United States.

countercyclical monetary policy during economic downturns, then alternative policy solutions must be used. Either larger monetary policy buffers must be created or larger nonmonetary public policy buffers (and the willingness to use them) will become much more essential for enabling an effective countercyclical policy response. This paper highlights that limitations in using short-term interest rates to combat economic downturns is likely to be a recurring problem. With low productivity, slow population growth, and low target inflation and interest rates in the United States, as well as in many developed countries, it is quite likely that economic downturns will result in the policy interest rate hitting the effective lower bound in the future. The Federal Open Market Committee (FOMC) provides an estimate of the longer-run value of the federal funds rate, currently estimated to be 2.875 percent. Since the monetary policy response to most recessions has been to lower the policy interest rate by much more than 300 basis points, short-term interest rates hitting the effective lower bound in response to an economic downturn is likely to be a recurring problem.

As a result, fiscal policy, at both the state and federal level, and bank regulatory policy may be needed to provide alternative policy tools that could be utilized. To do so, however, these tools, too, need to have large policy buffers available which policymakers can draw upon to cushion the impact of economic downturns. This paper explicitly considers monetary and nonmonetary policy buffers to gauge how resilient the economy is likely to be in the next recession. The paper expands upon the work of Romer and Romer (2017, 2018) which examined how well a set of national economies respond to adverse economic shocks. They find that having limited monetary and fiscal policy buffers when a financial crisis occurs adversely affects economic performance following the financial crisis.

While this paper is in a similar spirit to the Romer and Romer papers, it differs in two significant ways. We focus on a wider set of policy buffers that includes state and local government fiscal policy and bank regulatory policy in addition to federal fiscal policy and monetary policy. We also focus on individual US states rather than on nations, which allows for more similarity in institutional characteristics (one central bank; a fixed exchange rate among states; and common language, customs and federal laws) and allows us to focus more on how a variety of policy buffers impacts the resilience of individual state economies. Note that the states still have very different demographic and industrial mixes, and their ability to use state and local spending to mitigate the effects of an economic shock will depend on both the severity of the

shock, given their industrial mix, and how factors such as states' sensitivities to countercyclical monetary and federal fiscal policies can cushion the blow. This allows us to evaluate how critical the various policy buffers are at the individual state level, focusing on the extent to which states will be differentially impacted should the policy responses to an adverse shock be limited by these buffers becoming depleted.

For example, a state with a young population, highly dependent on the tourist trade, with a highly cyclical banking sector may be poorly prepared if an insufficient monetary policy buffer limits the ability of the Fed to lower interest rates in response to an economic slowdown. A poorly capitalized banking sector may constrain credit when it is most needed, a young population tends to be more sensitive to credit availability, and a tourist economy can slow dramatically given that it is more dependent on discretionary spending. Alternatively, a state with a very large rainy day fund, a dependence on oil, and an older population may be less impacted if there is an economic downturn while oil prices remain stable. The rainy day fund can cushion the downturn, while stable oil prices and an older population that relies on steady social security payments and is less subject to unemployment spells may allow the state to avoid some of the problems faced by more cyclical states, making the need for countercyclical monetary policy to insulate the economy less important. This highlights several key factors affecting how well individual states weather an adverse shock. First, states differ substantially in the magnitude of the effect of adverse shocks on the cyclical variation in their economic activity. Second, states differ in the capacity for their own countercyclical fiscal policy response. Finally, states differ in the degree to which their economies respond to national countercyclical policy actions.

This paper begins by briefly considering the risks of monetary policy hitting the effective lower bound in the future. The paper then examines how policy buffers have changed and the factors that have impacted the ability to insulate the economy from adverse shocks at the state level. We begin by describing factors impacting the policy buffers that can be generated from monetary policy, bank regulatory policy, federal fiscal policy, and state and local government fiscal policy. The conclusion from an analysis of these four sectors is that these policy buffers may not be sufficient to offset future shocks, reducing the capacity available to policymakers to insulate the economy from future adverse shocks. We then explore how the depletion of policy buffers is likely to impact real per capita personal income growth at the state level. The results

show significant differences across states and highlight the need to consider how we can better insulate the economy from future adverse shocks.

Variations across States

Figure 1 shows that states were impacted very differently during the Great Recession. The 10 states shown in red had the largest increases in their unemployment rate over the period 2005-2010. The 10 states shown in green had the smallest increases in their unemployment rate. The peak unemployment rate for each state during that period is shown within each state. While the national unemployment rate during this period went from a low of 4.4 percent to a high of 10 percent, there were significant differences across regions of the country. States that were least impacted tended to be Midwestern states that were less urban and more dependent on agriculture. For these states, the maximum unemployment rate remained well below 10 percent. States that were severely impacted tended to be states that had experienced rapid increases in real estate prices or were cyclically dependent states, such as Michigan with its auto industry, and all had peak unemployment rates well above 10 percent. A compounding problem was that many banks with a high concentration of real estate loans in their asset portfolio failed during this period, potentially impacting credit availability in those states that experienced particularly depressed real estate values. Since real estate price declines correlated well with states experiencing significant unemployment, the inability to lower short-term rates as much as in previous recessions may have contributed to the depth of their problems.

Figure 2 provides a map showing some differences in industry mix by state. The five states shown in green have the highest percentage of payroll employment in motor vehicle manufacturing, those in blue are the five states with the highest percentage of payroll employment in oil and gas extraction, and the three states in red, along with Wyoming and West Virginia, represent the five states with the highest percentage of government employees. States with a high concentration in motor vehicle manufacturing, a cyclical industry impacted by shorter-term interest rates, would be relatively more susceptible to the adverse effects associated with a shortfall in the size of a monetary policy buffer. Oil dependent states may be more sensitive to world events and relatively less sensitive to local or national business cycles, and thus oil and gas activity may be able to provide a less cyclical stream of severance tax revenues and royalty income to state governments that could help mitigate any cyclical effects on the

revenues of those state governments. States with a large number of government workers are likely to be impacted if low policy buffers for the federal government or state government cause employment cutbacks due to greater fiscal austerity, although in the absence of such austerity moves one might expect that having a high share of government employment might mitigate cyclical fluctuations in personal income.

Figure 3 is a map showing demographic and educational attainment differences. The five states in blue have the highest percentage of their population over age 65, the green states, along with Vermont, are the five with the highest percentage of population aged 16-24, and the five states shown in red are those with the highest percentage of their population with at least a college education. States with large retiree populations are more likely to be impacted by cutbacks in Medicare and social security payments should fiscal issues cause cuts in these programs, although a heavy reliance on such payments might mitigate the cyclical component in state personal income. The unemployment rate for the youngest working cohorts tends to be higher, and more variable, until those workers obtain job skills and attachments to firms, so that states with a very young population may face more unemployment in economic downturns, accentuating any cyclical component in a state's personal income. Individuals with a higher educational attainment tend to experience much lower unemployment rates than those with less, which should make those states with higher educational attainment less susceptible to economic downturns.

These maps illustrate differences across states in specific industry mixes and demographic features. Such differences in characteristics are reflected both in how well a state economy performs on average and in its cyclical variation. That is, some states have a magnified business cycle relative to the nation and to other states, while the business cycle of other states is more moderated. This suggests that not only do the reactions of a state's economy to countercyclical policies differ across states, but the need for countercyclical stabilization policies varies across states. **Table 1** provides an indicator of the sensitivity of state economies to cyclical variations in the national economy. The indicated measure is based on "betas" which reflect the response of each individual state measure to fluctuations in the national measure, in this instance estimating a set of regressions, one for each state, with the growth rate of state real per capita personal income as the dependent variable and the national growth rate of real per capita personal income as the explanatory variable. A value of one indicates that the state's movements mirror that of the

national average, while a value above (below) one indicates the state's movements are magnified (moderated) relative to the size of the fluctuations in the national average. The underlying individual state-level regressions for real per capita personal income growth rates are based on quarterly data. The indicated range of sensitivities is quite large, suggesting that the need for countercyclical stabilization policies varies substantially across states, with the most sensitivity state, Washington, having a "beta" of 1.176, and the lest sensitive state, Hawaii, having a "beta" of only 0.495. This range suggests that we do not have a one-size-fits-all situation for national countercyclical policies.

In summary, different regions of the country have characteristics that differ sufficiently so that their need for stabilization policies can be quite different, as well as the effects on their state economy of a given stabilization policy. This also suggests that the impact of inadequate policy buffers that limit policy responses will be distributed unevenly across states. For example, if monetary policy buffers are limited, states with economies that are relatively more interest sensitive may not recover as quickly. If federal fiscal policy buffers are limited, states more dependent on federal expenditures and transfer payments may be differentially impacted if fiscal austerity occurs simultaneously with a future recession. The following sections will investigate in more detail the nature of, and the reliance on, the policy buffers in each of the four policy areas.

Monetary Policy Buffers

To play its traditional role as the key countercyclical policy tool, monetary policy must have a buffer of sufficient size to engage in meaningful policy stimulus. As a first approximation, the buffer for traditional monetary policy can be summarized by the extent to which the federal funds rate exceeds the effective lower bound. Once a downturn occurs, the funds rate needs to fall significantly in order to help offset the downturn. However, this traditional policy tool can be short-circuited if the funds rate hits the effective lower bound during the response to a downturn. Unfortunately, in the current environment, the risks of the funds rate hitting the effective lower bound have been enhanced by the combination of low inflation rates and changes in the economy, such as slow productivity growth and reduced labor force participation rates, which have reduced the equilibrium real interest rate.

The two panels of **Table 2** reveal historically how much that rate has usually declined as the Fed pursued countercyclical stabilization policy. Whether the change is measured from the peak of the funds rate or the peak of the business cycle, the funds rate needs to decline significantly to help offset the recession. The average is in the range of about 5 to 6 percentage points, but that is somewhat underestimated given that the effective lower bound certainly restricted a larger movement in the 2007 recession and probably also did so in the 2001 recession insofar as one considers the ELB at that time being 1 percent. The question is, do we have a sufficient cushion to allow monetary policy to play its traditional role in countercyclical policy.

Figure 4 illustrates the effect of the lower rate of inflation and the slower growth rate of potential GDP on the magnitude of the monetary policy buffer. As can be seen in the figure, the nominal funds rate has declined significantly since the financial crisis began. This decline is primarily due to a reduction in the funds rate meant to offset the deep recession. From late 2008 until late 2015, the funds rate was stuck at near zero. The lower line shows the funds rate level consistent with a 600 basis point decline as a response to an average recession should it hit the economy at any time during that sample. At times, just after recessions end, when the Fed has used up much of its buffer, if the economy were to be hit with a double dip, it would not have a sufficient buffer to fight off the second dip. This can be seen in the early 1990s and the early 2000s. As the economy rebounds, however, the rate rises, increasing the monetary policy buffer and decreasing the chances of the funds rate needing to fall below zero if a recession occurs.

What is important is that the needed reduction in the funds rate if a recession hits would now almost always push the federal funds rate below zero. This is due in part to a decline in the equilibrium real rate and in part to a decline in the inflation target to 2 percentage points. Because productivity growth and trend labor force growth have declined noticeably, the monetary policy cushion will probably remain much smaller than during most of the post-1950s sample. As can be seen, if a downturn hits the economy right now, the funds rate would be able to decline by less than 2 percentage points before reaching zero, much less than the usual reduction of about 6 percentage points. Even if the funds rate were at its long-run equilibrium nominal rate, now estimated by the FOMC's Survey of Economic Projections to be just below 3 percentage points, the funds rate would have much less scope to decline than the amount typically employed.

A better perspective on the thrust of monetary policy is provided by a comparison of the effective real federal funds rate with the equilibrium real federal funds rate. **Figure 5** shows the real effective federal funds rate, the updated Laubach and Williams (2003) real equilibrium interest rate, and their difference, the federal funds rate gap. This gap better reflects the degree to which the stance of traditional monetary policy is stimulative or contractionary. That is, it is not enough for the funds rate to be lowered for monetary policy to be characterized as being stimulative; it must be lowered enough to be below the equilibrium rate. Moreover, even with a constant funds rate, as the equilibrium rate varies, so too would the stance of monetary policy.

The experience since 1961 is that the federal funds rate gap has gone negative in response to a recession, although following the double dip recessions at the beginning of the 1980s, the real funds rate gap dipped only slightly below zero. Another important characteristic shown in the figure is the steady downward trend in the real equilibrium rate. In combination with the downward drift of the inflation rate since the end of the 1970s and the ELB on the nominal funds rate, this makes it increasingly difficult to reduce the real funds rate below the real equilibrium rate. In fact, this can be seen in the figure by the federal funds gap falling below zero by a smaller amount after the Great Recession than after the prior, much less severe recession. Of course, the ability of the federal funds rate to fall sufficiently to create a sizeable negative value for the federal funds rate gap was limited by the ELB constraint on the nominal federal funds rate in an environment of low inflation rates, and this relatively weak response of the federal funds gap likely contributed to the slowness of the economic recovery. Moreover, given the falloff of the real equilibrium rate since the turn of the century and the recent low inflation rates, we can expect that it will be difficult for the Fed to provide adequate monetary policy stimulus through its traditional policy tool in future downturns because of the diminished monetary policy buffer.

Another consideration is that, even though we think of monetary policy as being a national policy, insofar as the federal funds rate applies to the entire country, its effects can differ across geographic regions. For example, states differ in their industrial mix and demographic characteristics, which affects their sensitivity to changes in the interest rate. In turn, states will also be differentially affected should the monetary policy response to an economic downturn be short-circuited by the funds rate hitting the ELB. In our empirical analysis, we include a measure

of state-level interest sensitivity based on a state's employment share in the most interest sensitive industries.

In summary, the declining equilibrium real rate, combined with a low inflation target, has significantly reduced the size of the monetary policy buffer available for countercyclical policy responses. At this point in time at a late stage in the business cycle, an average-sized downturn would likely cause the funds rate to hit the effective lower bound, meaning that other tools would be required to provide the countercyclical policy traditionally provided in the United States by monetary policy. These could include nontraditional monetary policy tools, such as quantitative easing and forward guidance, as were implemented in response to the Great Recession when we did hit the ELB, as well as the alternative, nonmonetary policy tools discussed below.

Bank Regulatory Policy Buffers

A key feature of both the 1990-1991 and 2007-2009 recessions is the important role played by the disruption in financial intermediation that contributed significantly to the severity of the economic downturns. There is now a substantial literature on how problems at financial intermediaries can result in difficulties for borrowers to obtain credit on the same terms, or sometimes at all (Peek and Rosengren 1995; Peek, Rosengren and Tootell 2003; Reinhart and Rogoff 2009a). In the United States, these periods of diminished credit availability have significant regional patterns. As **Figure 6** shows, there are two periods of significant bank failures since 1960.[3] First was a buildup of bank failures associated with a series of rolling regional problems, beginning with large numbers of failures of Savings and Loans, followed by banks heavily dependent on farm loans and the oil industry having elevated failures associated with the farm crisis and the collapse in oil prices in the mid-1980s, and finally culminating in the decline in real estate prices associated with the 1990-1991 recession. Note that while the numbers of failures are quite high, many of these banks were relatively small. **Figure 7** shows the states with the highest bank failure rates and also states with a failure rate above 10 percent associated with the 1990-1991 recession.[4]

[3] The sample of banks considered includes commercial banks, savings banks, and (beginning in 1980) savings and loan associations.

[4] For Figures 7 and 8, banks that failed within two years of the peak and trough of each recession were attributed to that recession. Thus, for the 1990-1991 recession, the period covered ranged from 1988:Q3 to 1993:Q1, and for the 2007-2009 recession, bank failures are included from 2005:Q4 to 2011:Q2.

The second episode of elevated bank failures was associated with the Great Recession, when the effects of a fall in housing prices was amplified by banks' high leverage and reliance on runnable short-term wholesale funding. While the number of failures was lower than for the 1990-1991 recession, it included much larger banks. **Figure 8** shows the states with the highest bank failure rates associated with the Great Recession. While the largest banks received significant attention, many states also had a large number of failures of smaller banks. As the figure shows, the Western states experienced the highest failure rates, with states such as Florida, Arizona, and California that tend to exhibit large real estate price fluctuations once again appearing with elevated bank failure rates.

Although bank failures played a notable role in these two recessions, banks have now become better capitalized. As **Figure 9** shows, the Tier 1 risk-based capital ratio for both large and small banks has improved since the Great Recession.[5] While smaller banks tend to have higher capital ratios compared with the largest banks, more recently that gap has closed substantially, likely influenced by the post-financial-crisis tightening of financial regulations that primarily focused on the largest banks.

As **Figure 10** shows, some of the improvement in risk-based capital ratios has been generated by a reduction in risk-weighted assets. The figure shows that for the banks with over $50 billion in assets, there has been a fairly substantial decline in risk assets relative to total assets from the late 1990s. For the smaller commercial and savings banks, the reduction in risk-weighted assets during that same period is not nearly as pronounced. That is particularly true over the past five years when smaller commercial and savings banks have been increasing their ratio of risk-weighted assets to total assets, reflecting in part that some of these institutions have significantly increased their exposure to commercial real estate.

Figure 11 shows banks' leverage ratios and equity capital ratios. These more narrow capital ratios tend to receive more attention when financial institutions are under duress. The figure shows that for large banks both measures of capital improved notably after the financial crisis. However, for smaller banks, while there has been an increase, it is not nearly as substantial, in large part reflecting that the post-crisis tightening of regulation of banks focused

[5] Figures 9, 10, 11, and 12 include commercial and savings banks throughout the period and OTS-regulated savings institutions as soon as they file call reports. Some OTS institutions began filing the call report in 2011. All filed the call reports by 2012:Q1.

primarily on the largest banks. For example, the largest banks are now subject to stress tests that make it costly for them to hold assets that are subject to dramatic price declines under adverse stress scenarios. As a consequence, some of these riskier assets, such as commercial real estate loans, have tended to migrate to smaller institutions. **Figure 12** illustrates the rising share of commercial real estate loans at small banks, while the share at large banks remains below its peak near the end of the recession. This raises the possibility that small and mid-sized institutions rather than the largest institutions could be the source of credit constraints in future episodes of a deterioration in bank health.

In this section, we have used bank failures as a proxy to show regions of the country disproportionately impacted by banking problems in the past rather than the supervisory ratings data that we use later in the paper because of the confidential nature of the supervisory data. Problems in the banking environment can make it more difficult for businesses to continue operating at a high rate during economic downturns, as the problems of the banks become transmitted to their borrowers through constrained credit availability. In the regression analysis presented later, we use the percent of bank deposits held by banks operating in a state that have low ratings from bank supervisors that are as a proxy for the absence of a sufficient bank regulatory buffer that can mitigate credit problems for firms and households when bank health deteriorates during an economic downturn. Peek, Rosengren, and Tootell (2003) have found that the share of banks receiving the lowest bank supervisory ratings is a reasonable proxy for loan supply shocks.

The idea is that if banks have a sufficient capital buffer and risk management controls in place then when an economic downturn occurs the banks will be of sufficient health that there will not be a widespread downgrading of supervisory ratings. One way to add to the regulatory buffer is to raise the countercyclical capital buffer during the good times so that it will be available when bad times arrive. However, to date, U.S. bank regulators have chosen to leave that buffer at zero, even though some other countries, such as the United Kingdom, Ireland, France, Sweden and Norway, have taken the opportunity to act to implement a positive countercyclical capital buffer for their banks.

While bank health has improved substantially since the financial crisis, that improvement reflects in large part the tightening of bank regulation which was focused on the largest banks. As the financial crisis fades in the memories of banks, the public and regulators, there is a

potential risk that many of the regulations that encouraged better capital positions will be relaxed. If regulations are eased too much, there is a greater risk that bank health will make a procyclical contribution to the downturn as banks limit credit availability as a consequence of a deterioration in their own health.

Federal Fiscal Policy Buffers

Romer and Romer (2017, 2018) argue that the ability to use fiscal policy to respond to a financial crisis becomes limited when a country's debt-to-GDP ratio becomes too large. They estimate that the distance of the debt-to-GDP ratio below 130 percent is one measure of a fiscal buffer. They also examine violating the European Union's Stability and Growth Pact limits. However, those limits of a deficit of 3 percent of GDP and a debt-to-GDP ratio of 60 percent have already been exceeded in the United States. Alternatively, we focus on two periods of fiscal restraint in the United States which reflect political decisions to steadily reduce the deficit relative to potential GDP. This reflects a political constraint of willingness rather than a financial constraint whereby the country was financially unable to continue to grow its deficit.

Figure 13 shows the full employment surplus, both with and without automatic stabilizers, as a percentage of potential GDP since 1980, based on federal fiscal years that end on September 30th. Two episodes stand out when the full employment federal budget surplus with and without automatic stabilizers increased significantly and persistently. The first is the period from federal fiscal years 1990 to 2000 when the United States went from running a deficit to running a surplus. This reflects the adoption of the Budget Enforcement Act of 1990, which created spending caps for discretionary spending items and pay-as-you-go requirements that required spending increases and tax cuts be offset elsewhere in the budget. A second period of steady deficit reduction began in federal fiscal year 2009 when there was heightened interest in controlling spending to prevent further increases in the deficit. The dating of these two episodes is reinforced by the pattern of nominal federal government consumption and gross investment expenditures shown in **Figure 14**. Here, the austerity periods, which line up quite nicely with those identified as being characterized as having a persistent decline in the federal budget deficit as a percentage of potential GDP in the prior figure, are identified as the two periods when federal nominal government consumption and gross investment expenditures fell below their previous peak.

These two episodes of self-imposed fiscal austerity reflected concerns at the time of the growing fiscal deficit. It should be emphasized that this shows an unwillingness rather than an inability to increase deficits and/or the debt level. However, if the US debt continues to grow, the United States may see a greater political unwillingness to continue growing the debt in the future, even though the dollar's current primary role in world foreign currency reserves, the invoicing of international trade and cross-border lending suggests an absence of an externally imposed financial constraint.

To understand how federal fiscal austerity impacts states, we examine how federal spending is apportioned across the states. From 1981 through 1997 the Census Bureau's Federal Expenditure by State Report (FES) presented data on federal expenditures by state broken into several categories. From 1993 to 2010, the Consolidated Federal Funds Report (CFFR) produced similar data. With some reallocation among spending categories, we were able to splice the CFFR series to the FES series in 1998 to produce a set of consistent series for each state for four federal spending categories: Grants, Procurement, Wages and Salaries, and Direct Payments.[6] Unfortunately, the CFFR series were discontinued after 2010 as a result of budget cuts. The Pew Charitable Trusts attempted to recreate and then extend these data from 2004 to 2014. They then passed their methodology to the Council of State Governments (CSG) to further extend the data into 2015. However, the Pew and the CSG did not have access to the same internal government documents, so their series differ somewhat in both level and movement from the CFFR series, making them difficult to splice for the four individual subcategories with any confidence.

Figure 15 is based on the most recent CSG federal spending data for 2015, presented as a percent of state personal income. In federal government fiscal year 2015, the states receiving the highest federal spending relative to state personal income included New Mexico, West Virginia, Alabama, Virginia, and Mississippi. The figure also shows distinct differences across states in the composition of federal spending received. While West Virginia, Mississippi and Alabama

[6] Because the two reports categorize direct federal expenditures and grants differently, we combined the CFFR's Retirement and Disability and Other Direct Payments categories and the FES' Direct Payments for Individuals and Other Programs categories to create a Direct Payments category for both. We also move Grants to Nongovernmental Recipients from the FES' Other Programs category to its Grants category. Finally, the CFFR and FES Direct Payments category includes Unemployment Insurance (UI) payments by state governments to their own citizens from 1989 onwards. This category is not reported separately so we use data from the Department of Labor (DOL) to remove state UI payments from the series so that it reflects only federal expenditures. We also use the DOL data to add in advances (loans) the federal government provides to states to help cover their UI revenue shortfalls during periods of high unemployment, given that such payments represent a federal stabilization policy.

received the highest direct payments relative to personal income, Virginia received the highest in procurements. New Mexico ranks first in grants relative to personal income and second in procurements relative to personal income.

Using the annual FES/CFFR federal spending series by components, we can identify which states appear to be relatively more or less sensitive to episodes of fiscal austerity, using changes in the full employment federal budget surplus without automatic stabilizers as a percent of potential GDP as our proxy. We estimate individual state-level regressions for federal fiscal years from 1983 to 2010 for each of the four components of the form:

(1) $EXP_i = a_0 + a_1*SURP + a_2*UR + a_3*SURP*UR + e,$

where EXP_i represents the percentage growth rate of real per capita federal expenditures of category i, SURP is the change in the federal surplus without automatic stabilizers measured as a percent of potential GDP, and UR is the change in the state unemployment rate. Thus, the total response of expenditures to a change in the federal surplus is a function of the unemployment rate ($a_1 + a_3*UR$). **Table 3** indicates the five most and least sensitive states to an increase in the cyclically adjusted surplus, based on the estimated coefficients. The table shows the total effect, calculated as a weighted average of the estimated effects for the four separate spending components, using the component's share of the sum of the four components in that state as the weights.

Panel A shows the estimated sensitivities assuming no change in the unemployment rate; that is, the value of a_1. The most sensitive state, Kentucky, experiences a federal spending decline of just over 3 percent for a 1 percentage point increase in the federal surplus ratio. The remainder of the top five states each experience a federal spending decline in their state of between 2 and 3 percent, with the change in federal spending in the median state being about a 1.2 percent decline when the federal surplus ratio rises by 1 percentage point. Each of the five least restrictive states experience an increase in federal spending, based on the estimated coefficient. Note that the final column indicates the spending category that is the primary contributor to the size of the effect shown. It should not be surprising that the primary contributor for the least restrictive states is Direct Payments since this category includes countercyclical transfer payments.

Panel B shows the total spending sensitivities to a 1 percentage point increase in the surplus ratio when the state unemployment rate also rises by 1 percentage point. As might be

expected, the state rankings are not identical because here the total effect depends on the point estimates of both a_1 and a_3, and there is no reason to expect the pattern of relative values across states for a_3 to be the same as for a_1. Still, there is some overlap, with both Hawaii and Kansas being among the top five in both Panels A and B and Georgia, Pennsylvania and Ohio being in the bottom five in both panels. The estimates indicate that the size of the reductions in federal spending in the most restrictive states tends to be much larger when the unemployment rate is rising, which would tend to weaken the state economy even more. In fact, the median effect is negative, at 1.230, indicating that for many states any countercyclical federal spending response, at least associated with only a 1 percentage point increase in the unemployment rate, is not sufficient to offset a decline in the federal spending contribution to the state.

Much of the federal fiscal actions discussion has focused on cutting expenditures. Of course, it is possible that increasing fiscal buffers could be done by raising federal taxes to provide greater fiscal buffers rather than by cutting expenditures. However, recent history has shown that major tax increases to address the depletion of the fiscal buffer would be quite difficult politically and are probably less likely than restraining expenditures. Still, there are a variety of tax increases that could be contemplated (e.g., business taxes, estate taxes, excise taxes, or broadening the tax base), each resulting in differential effects across the tax bases in the individual states. To obtain an idea of the sensitivity of tax payments by the citizens of a state to changes in total tax revenues, we estimate individual state-level regressions from 1984 (when the individual state tax data begin) to 2015 to obtain the "beta" relating state real per capita federal personal income tax payments by a state's citizens to national real per capita personal income tax revenues using data from the Statistics of Income. The estimated sensitivities for the five most and least sensitive states are shown in Panel A of **Table 4**. The state with the greatest sensitivity is Connecticut, followed by Massachusetts, Wyoming, New York and New Jersey. At the other extreme, are Hawaii, Arkansas, West Virginia, New Mexico and Mississippi. The table shows that the range in sensitivities is quite broad. Panel B shows the value of the state per capita federal personal income tax revenue for the five highest and five lowest states in 2015. Again, there is quite a large range of values across the states. Interestingly, there is quite a bit of overlap between the two tables, with the states with the most (least) sensitivity also being among those with the highest (lowest) per capita federal personal income tax burdens. While there certainly are a variety of other state differences that could impact the incidence of tax by state, the federal

income tax differences across states provide one illustration of how large the difference could be if establishing greater fiscal buffers focused on taxes rather than expenditures.

State Fiscal Policy Buffers

State and local expenditures and revenues vary considerably across states in their level as well as their variability. Thus, both the need for stabilization policy and the ability of a state to provide countercyclical policy vary across states, both of which have implications for differences across states in the degree of variability of personal income and the need for buffers such as state rainy day funds. For example, based on data from the Pew Center on the States, the state pension funding ratio (assets/liabilities) in state fiscal year 2016 ranged from a minimum of 31 percent (New Jersey) to 99 percent (Wisconsin), with a median of 70 percent. Five states had a funding ratio of less than 50 percent, while 12 had a ratio above 80 percent.

On the other side of the ledger, most states had a rainy day fund. Based on rainy day fund data from the National Association of State Budget Officers' Fiscal Survey of the States, most of the funds tend to be a small share of the state and local governments' total annual expenditures. For state fiscal year 2015, Alaska stood out with a funding ratio of 86.6 percent, enabled by their oil and gas revenues. Wyoming, with its energy-related revenues was next at 14.4 percent. The next two states, again with significant energy-related revenues, were West Virginia (8.18 percent) and North Dakota (7.83 percent). The percentages fall off from there. Thirty-three states had rainy day funds with less than 3 percent of their annual expenditures and another six states had no balance in their rainy day funds or did not have a rainy day fund. Thus, rainy day funds are unlikely to provide much of a buffer for most states when a large adverse shock hits.

What about the variability of state and local expenditures and revenues themselves? Our measures are taken from the Census Bureau's Annual Survey of State and Local Government Finances, supplemented with the unemployment insurance data from the Department of Labor due to some inconsistencies in the Census unemployment insurance data. These data are annual based on a state's fiscal year, most of which end on June 30th. The most recent year of data is for fiscal year 2015 with the exception of Alabama, Michigan, and Texas which have fiscal years that end after June 30th. For these three states, the most recent year is fiscal year 2014. Our measure of state and local expenditures is general expenditures minus intergovernmental revenue from the federal government plus state unemployment insurance expenditures. State and local

revenues are defined as general revenue minus intergovernmental revenue from the federal government plus state unemployment insurance revenues. General expenditures (revenues) are all expenditures (revenues) except those associated with liquor stores, insurance trust, and utilities. We remove intergovernmental revenue from the federal government to eliminate federal funding that passes through the state and local budgets to better isolate state and local fiscal policies from federal fiscal policies.

State and local revenues and expenditures experience different levels and variability across states for a number of reasons. For example, the variability of revenues is affected by the composition of the sources of revenues. For state fiscal year 2015, the ratio of personal and corporate income taxes to total revenues ranged from zero to 30 percent, and the range for the ratio of income plus sales taxes to total revenue ranged from 10 percent to 53 percent. Thus, we should expect to see wide differences in the sensitivity of state revenue to the business cycle.

The same is true for the variability of state and local expenditures, which can vary substantially depending on which and how well programs are funded. For example, doing the same beta analysis of state and local real per capita expenditure growth rates on the total for all 50 states for state fiscal years from 1983 to 2015 provides a wide range of estimated betas, ranging from 0.0133 (North Dakota) to 1.546 (Georgia). Similarly, the estimated betas for real per capita revenue growth rates relative to the total aggregate for all 50 states range from a low of 0.13 (North Dakota) to 1.52 (California). Perhaps even more important for the ability of a state to weather business cycle fluctuations, as well as various adverse shocks, is the extent to which expenditures and revenues move together. Over the 1983-2015 state fiscal year period, the correlation of state and local real per capita revenue and expenditure growth rates ranged from -0.218 (Illinois) to 0.684 (Florida).

The correlation between state and local expenditure and revenue growth rates is affected by a number of factors. It could happen naturally due to the structure of the sources of revenues and the composition of expenditure programs. Alternatively, it could be imposed on the state due to balanced budget amendments, which most states have in some form that would constrain state expenditures when state revenues decline. **Figure 16** shows the number of states for which state and local expenditures decreased for each state fiscal year from 1983-2015, with recession shading to provide perspective for the timing. The top panel shows the count of states experiencing nominal expenditure decreases, since state governments set budgets in nominal

dollar terms. The pattern clearly shows that the number of states experiencing declines in expenditures spikes soon after a recession as revenues might be expected to decline. This is consistent with state budgets being constrained by cyclical declines in revenues, forcing austerity onto state spending, with the length of the delay being related to the extent to which the state budget had a buffer available, such as a rainy day fund. The lower panel shows the corresponding figure for real per capita state and local expenditures. As one would expect, the number of states experiencing declines follows the same pattern, but with higher numbers of states.[7]

In summary, state economic performance and state personal income patterns differ substantially in their susceptibility to adverse shocks and the business cycle. In part, this is due to differences across states in the demographic and industrial composition of the states. It also depends in part on the willingness and ability of state governments to prepare for fluctuations in economic activity, revenues and expenditures through their choices in the composition of the sources of their revenues, and expenditures and the fiscal policy buffers they choose to establish. However, a state's economic activity also depends in part on federal fiscal policy, whose impact differs substantially across states, and on the state's sensitivity to changes in monetary policy.

Empirical Analysis

The previous sections have highlighted that policy buffers in a number of dimensions have diminished. The projected rise in the federal debt-to-GDP ratio will likely provide less room, or possibly less willingness, for an expansionary federal fiscal policy in the next economic downturn. State financing has become more stretched, as many states have not replenished rainy day funds drained during the last recession and many states face increasing pressures from their unfunded pension guarantees. While large banks have built larger capital buffers over time, smaller banks are likely to still be susceptible if collateral values, particularly for real estate, were to fall. Finally, traditional monetary policy, typically the primary tool employed for countercyclical policy, is likely to be limited by the funds rate hitting the effective lower bound, requiring monetary stimulus to turn to less traditional tools. Given these diminished buffers, how will states likely fare should the economy experience a downturn? While the previous sections

[7] Keep in mind that the decline in 2015 is related in part to the reduced number of states with available data in 2015.

highlight that states have very different exposures to potential shocks, as well as being disproportionately impacted by countercyclical policies that are enacted in response to the shocks, this section will try to quantify three potential scenarios. The first is a recession that occurs with the typical policy responses; that is, where policy buffers are sufficient so that the average countercyclical policies can be implemented. The second scenario restricts the monetary policy response; that is, the simulation assumes that the funds rate declines from a level of 2 percent and then is limited by hitting the ELB at zero. The third scenario limits all four policy responses; that is, federal fiscal policy, state and local fiscal policy, and bank regulatory policy are each assumed to have depleted policy buffers, while monetary policy is limited by the ELB as in the prior simulation.

Policy Constraints

To set up the simulations, we first must specify measures that can serve as a proxy for limitations on each policy response. We then estimate the regression using state-level real per capita personal income growth. The analysis is based on a panel regression using annual data based on federal fiscal years for the period 1983-2015.

Real Per Capita Personal Income Growth

The base panel regression includes observations for each state i and is of the form:

(2) $PI_i = b_0 + b_1*L1CAMELS345_i + b_2*L1UR_i + b_3*L1FFRgap + b_4*L2FFRgap + b_5*L1DHIGH_i*L1FFRgap + b_6*L2DHIGH_i*L2FFRgap + b_7*L1DLOW_i*L1FFRgap + b_8*L2DLOW_i*L2FFRgap + b_9*DFedFiscal + b_{10}*DSLFiscal_i + \gamma_i + \varepsilon$,

where L is the lag operator. PI is the growth rate of real per capita personal income in the state, CAMELS345 is the deposit-weighted share of banks in the state with a CAMELS rating of 3, 4, or 5, and UR is the change in the state's unemployment rate. FFRgap is the change in (the real effective federal funds rate minus the Laubach-Williams two-sided real equilibrium federal funds rate). To allow for the estimated effects across states to differ, FFRgap is interacted with DHIGH and DLOW, which are (1,0) dummy variables for the 15 states with the highest and the 15 states with the lowest average shares of employment in the most interest sensitive industries. The interacted terms indicate differential effects relative to the base group of the 20 states in the middle in terms of employment shares. DFedFiscal is a (1,0) dummy variable that takes on a

value of one during the two subperiods identified earlier when the federal cyclically adjusted surplus ratio was steadily rising: 1990-2000 and 2009-2014. DSLFiscal is a state-specific (1,0) dummy variable that takes on a value of one for the periods when nominal state and local expenditures decline until those expenditures again reach their prior peak value.[8] The equation includes a state fixed effect, γ.

Nominal personal income is converted to real using the personal consumption expenditures deflator. The nominal federal funds rate has been converted to the real federal funds rate using the four-quarter core personal consumption expenditures inflation rate. The Summary of Deposits database is used to determine the weights for the CAMELS345 variable. For each state, each commercial or savings bank with one or more branches in the state has a weight equal to its share of the total commercial and savings bank deposits in the state in that year. The confidential bank supervisory CAMELS ratings are integers from one to five, with a rating of one indicating the healthiest banks, and a rating of five indicating the least healthy banks. DSLFiscal is based on the adjusted measure of state and local expenditures that removes federal funds that pass through the state budget as described earlier.

We also consider an alternative measure of federal fiscal austerity based on the measure of federal broad expenditures described above. This measure is a (1,0) dummy variable that takes on a value of one when the nominal federal broad expenditures measure declines and continues to have a value of one until it again reaches its level prior to the decline. While the four components described earlier do not match up well at the individual state level, for the total federal broad expenditure series, the splice is not that bad using a growth rate splice to combine the CSG total series for 2011 through 2015 to the FES/CFFR series up through 2010.

DHIGH and DLOW are based on auxiliary quarterly regressions using national employment data for 14 industries: agriculture, forestry, fishing, and hunting; mining; utilities; construction; manufacturing; retail and wholesale trade; transportation and warehousing; information; finance, insurance, real estate, rental, and leasing; professional and business services; educational services, health care, and social assistance; arts, entertainment, recreation,

[8] The timing of the state and local variable is based on state fiscal years. Thus, rather than being lagged one year, the measure is actually lagged one and a quarter year for most states, given that for most states the fiscal year ends on June 30, while the federal fiscal year ends on September 30.

accommodation, and food services; other services, except government; and government. The regressions take the form:

(3) $EMPL_j = c_0 + c_1*GDP + c_2*L1UR + c_3*L5FFRgap + c_4*L6FFRgap + c_5*L7FFRgap + c_6*L8FFRgap + \mu$,

where EMPL is the quarterly growth rate of industry j, GDP is the quarterly growth rate of real per capita GDP, UR is the unemployment rate, and FFRgap is the change in the federal funds rate gap as previously defined. The GDP growth rate controls for the business cycle, the unemployment rate controls for where the economy is along that cycle, and the FFRgap measures are lagged an extra four quarters to allow for the lags in the effects of monetary policy. We designate as the interest sensitive industries those that have a sum of FFRgap coefficients that is negative and statistically significant at the 10 percent level or better (the p-values range from 0.001 to 0.10). The four such industries are: mining; construction; manufacturing; and retail and wholesale trade. We then calculate the share of total employment in each state composed of employees from these four industries. We then calculate the average interest sensitive employment shares for each state during our sample period. The states are then ranked by this share. The 15 states with the highest average employment shares are assigned a one value for DHIGH, and the 15 states with the lowest average employment shares are assigned a one value for DLOW. The middle 20 states are the base group of states. The 15 states in the high employment share group include AL, AR, IA, IN, KY, ME, MI, MS, NC, NH, OH, SC, TN, WI, and WV. The 15 states in the low employment share group include AK, AZ, CA, CO, DE, FL, HI, MA, MD, MT, ND, NV, NM, NY, and VA.

Table 5 provides the summary statistics for the variables used in equation (2). The real per capita state personal income growth rate exhibits substantial variation across states and across time, as does CAMELS345 and the change in the state unemployment rates. The range for FFRgap indicates that the effective federal funds rate can deviate quite a bit from its equilibrium level. The federal austerity dummy variable has a value of one slightly more than half the sample, while the alterative federal fiscal indicator based on the broad measure of federal expenditures has a value of one about 19 percent of the time. The state and local fiscal indicator has a value of one about 14 percent of the time.

Table 6 contains the results from estimating equation (2). The table shows both the individual estimated coefficients and, at the bottom of the table, the sum of coefficients along

with their p-values. The first column is based on an equal weighted regression. Recognizing the substantial differences across states in their relative contribution to national personal income, the second column shows the results of a weighted regression, using the state's average share of personal income relative to the sum of the personal income of the 50 states as the weights. Columns 3 and 4 replace the federal austerity dummy variable with the broad federal expenditure decrease dummy variable.

As expected, across all four specifications, the change in the state unemployment rate has a negative and statistically significant effect. As a state's unemployment rate rises in a recession, the growth rate of real per capita personal income in the state slows. It is also the case that in each specification CAMELS345 has the anticipated negative estimated coefficient that is statistically significant. A deterioration in the health of banks operating in a state, as indicated by a rising share of banks with CAMELS ratings of 3, 4, or 5, will slow down the subsequent growth rate of real per capita personal income in the state. To the extent that banks in the state have a sufficient capital cushion to maintain their supervisory rating when a recession occurs, personal income growth would be insulated from this effect. However, the smaller is the buffer, the less insulation, and thus one would expect a larger increase in CAMELS345 and a larger negative effect on personal income growth.

The traditional monetary policy effect operating through the change in the FFRgap has the expected negative effect, based on the sum of the estimated coefficients shown in the lower part of the table. However, this effect is statistically significant only for the weighted regressions. But more importantly, the differential effect for the set of 15 states with the highest share of interest sensitive industry employment is negative and significant in all four specifications. Thus, for this subset of states, not only is the negative total effect larger (in absolute value) than that for the group of 20 states in the base group, but the effect is significantly different from the base group of states. The subset of least interest sensitive states also have negative estimated coefficients, but of a smaller size than for the most sensitive subset of states. One would expect these effects to be positive rather than negative, although the estimated effect is not significant in the unweighted regressions.

The federal austerity dummy variable has the anticipated negative effect that is statistically significant in both column 1 and column 2. Thus, when the federal government is unwilling or unable to undertake expansionary fiscal policy, the growth rate of state real per capita personal

income slows. Unfortunately, this measure does not distinguish among states in terms of differences in the policy setting or differences in the state's sensitivity. Our alternative measure, a dummy variable that indicates when the nominal broad federal expenditures in a state declines, does allow states to be affected differentially so that all states are not necessarily affected at the same time. However, the effect on personal income is constrained to be the same across states when these expenditures in the state decline. For the unweighted specification, the point estimate is positive, but tiny and not significant. For the weighted regression, the effect is positive and significant rather than the expected negative effect.

Our measure of state and local government fiscal austerity, a dummy variable reflecting a decline in our measure of adjusted state and local nominal expenditures, has a negative and significant (although only at the 10 percent level in column 1) estimated effect in all four specifications, suggesting that when state and local austerity occurs for a state, that state's real per capita personal income growth slows as anticipated.

In summary, for the most part the effects of a depleted policy buffer are as anticipated. We next turn to an analysis of the effects of an average recession with a typical monetary policy response. We then consider how the effects, and the pattern of effects across individual states, are affected by depleted policy buffers. The effects of the absence of the usual policy responses are large and distributed unevenly across states.

Simulated Effects of a Recession with and without Policy Responses

Using the estimated coefficients in column 1 of Table 6, we can derive estimates of the effect of a recession on state real per capita personal income growth. Using the estimated effects of the policy-related variables, we can also calculate the effects when the policy buffers become depleted, short-circuiting the usual policy response. We use a value of a 3 percent increase in the national unemployment rate as characterizing the recession. The estimated "betas" relating changes in individual state unemployment rates to changes in the national unemployment rate are used to calculate the changes in the unemployment rates for the individual states. For the base case, we assume a typical monetary policy response of a reduction of 600 basis points in the nominal federal funds rate along with a 100 basis point reduction in the equilibrium federal funds rate. Thus, the simulation value for the reduction in the FFRgap is 500 basis points. We then apply the estimated coefficients for the change in the FFRgap and for its interaction terms with

DHIGH and DLOW to obtain the countercyclical effects of monetary policy for the individual states.

Figure 17 shows the net effect on real per capita personal income growth of this simulated recession in combination with the countercyclical monetary policy response. The effects range from -1.898 for Illinois to 1.285 for Iowa. That is, the combination of countercyclical policies and differences across states in their sensitivity to increases in the national unemployment rate is able to more than fully offset the recession effects emanating from the 300 basis point increase in the national unemployment rate for some states. The map uses color to highlight the 10 states with the largest negative response and the 10 states that are the least adversely affected, with the value shown for each state. Thus, the map shows that even with an increase in the unemployment rate consistent with a moderate recession, 16 states avoid declines in real per capita income. Interestingly, this includes many Southern states. Note that an important component of this simulation is that monetary policy can fully respond without reaching the ELB. As is apparent in the next figure, much of this ability to continue to grow real per capita personal income can be attributed to the important role played by the monetary policy countercyclical response.

Figure 18 shows the effects on the individual states when the monetary policy response is limited by the ELB. For this simulation, we assume that the federal funds rate beings at 2 percent, but can decline only to zero. In combination with the assumed 1 percentage point decline in the equilibrium funds rate, the decline in the funds rate gap is only 1 percentage point. This limitation on how much monetary policy can respond results in all states now experiencing declines in real per capita personal income, a particularly large switch for many of the Southern states. With this limitation on the monetary policy response, it is primarily the agricultural states in the Midwest that avoid declines in real per capita personal income of less than 1 percent. **Figure 19** shows the effects if all policy buffers become depleted at the same time. The experiment here incorporates the national unemployment rate increasing by 3 percentage points, the equilibrium real federal funds rate declining by 100 basis points, and the effective federal funds rate declining by 2 percentage points (from 2 percent to zero). In addition, we use the estimated betas for the national CAMELS345 measure to attribute the assumed 20 percentage point increase in the national share to changes in the individual state values of CAMELS345. The assumed 20 percentage point increase is less than that associated with the 1990-1991 recession that also was characterized as having a banking crisis. We also activate the austerity

dummy variables for both federal and state and local fiscal policy. As expected, the outcomes for all states worsen further, but not to the same degree. **Figure 20** isolates the effects of depleted buffers; that is, the numbers in the map reflect the difference between the outcomes in Figure 19 compared with those in Figure 17. The effects are large and vary substantially across states. In particular, the Southern states that were positively impacted in the simulation with a full monetary policy response are now among the states most severely adversely impacted when all policy buffers are insufficient and limit policy responses. At the other extreme, Midwestern agricultural states account for most of the states with the smallest negative deviation.

Unsurprisingly, when recessions occur, all states are not affected equally. Equally unsurprisingly, when policy buffers are depleted, the economic performance deteriorates, in some instances substantially. The important takeaway from these simulations is that not only are states differentially affected by recessions, which reflect a number of factors including industry mix, demographics, and sensitivity to interest rate changes, but that states are also differentially affected by the extent to which policy buffers are insufficient to provide adequate countercyclical policy responses. And the differences can be quite large. However, note that the effects are understated insofar as the individual effects are not simply additive. That is, when policy buffers become depleted, economic performance deteriorates, which would in turn be reflected in a further rise in the unemployment rate. This feedback effect, which would tend to magnify both the size of the decline in real per capita personal income growth rates and the divergence in economic performance across states, is not captured by assuming a fixed 3 percentage point increase in the national unemployment rate in the simulations regardless of the extent of the various policy responses.

Conclusion

While monetary policy has been central to countercyclical stabilization policies over the past 50 years, low real interest rates and inflation will provide less room for short-term interest rates to respond to the next recession. In the event that monetary policy hits the ELB in the next recession, monetary policy will not be able to offset as much of the shock. Our simulation shows that the impact will not fall evenly on the states, because states have different industrial mixes which make them more or less cyclically sensitive, and the response to countercyclical monetary policy will also depend, in part, on the industrial mix. Thus, if the ELB is reached in the next

recession, a state such as Michigan, which is both cyclically and interest sensitive, could experience a much more significant downturn than, for example, the states more dependent on agriculture. Moreover, if the next recession not only has a limited monetary policy response, but also has banking problems and a reluctance to mitigate adverse shocks with state or federal spending, the effects would be further magnified. Moreover, the adverse effects would be characterized by a wide range of divergence across the individual states.

From a policy perspective, more attention should be given to establishing appropriate policy buffers to mitigate future shocks. For state and the federal governments, it highlights the potential downside of using up financial capacity during this recovery. For bank regulation, it highlights the importance of maintaining a well-capitalized and resilient banking system. For monetary policy, considering how best to respond to the increased likelihood of hitting the ELB in the future—and either building a larger monetary policy buffer or being more willing to aggressively use nontraditional tools—will be essential.

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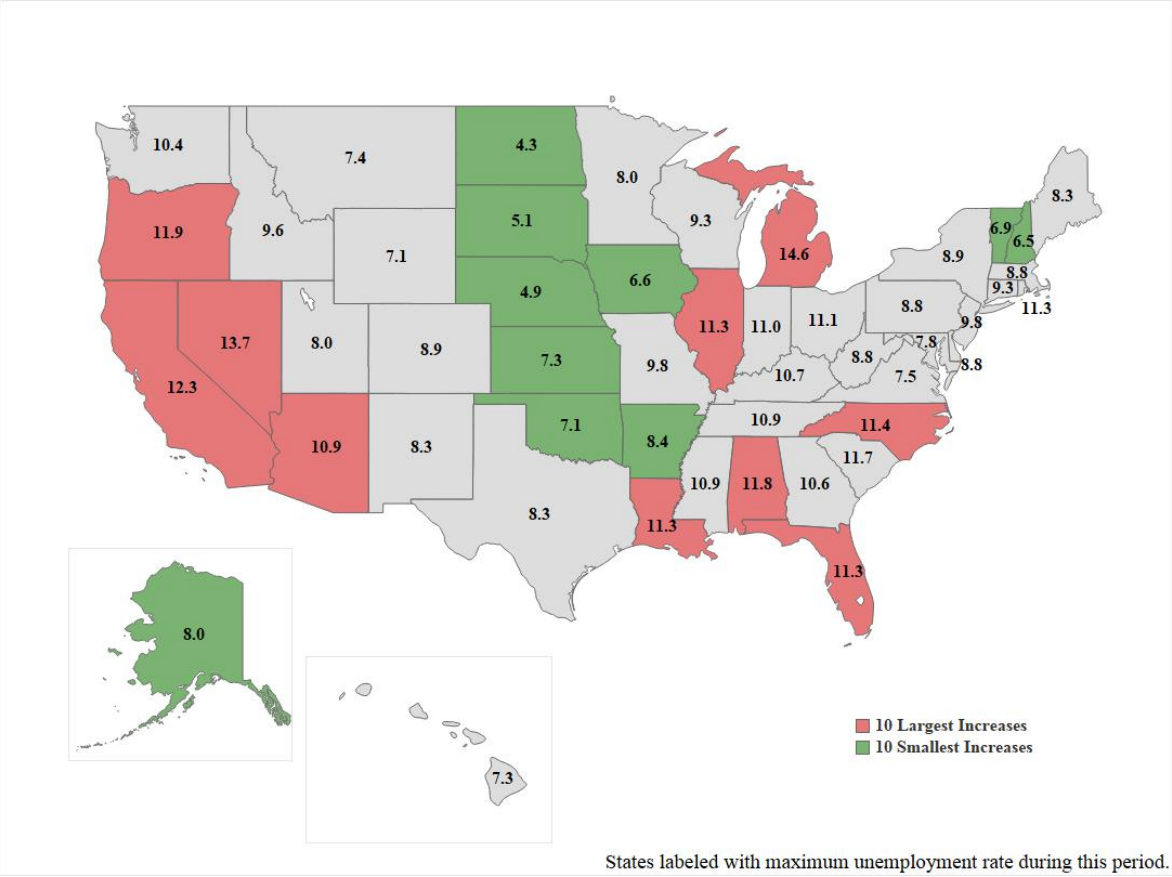
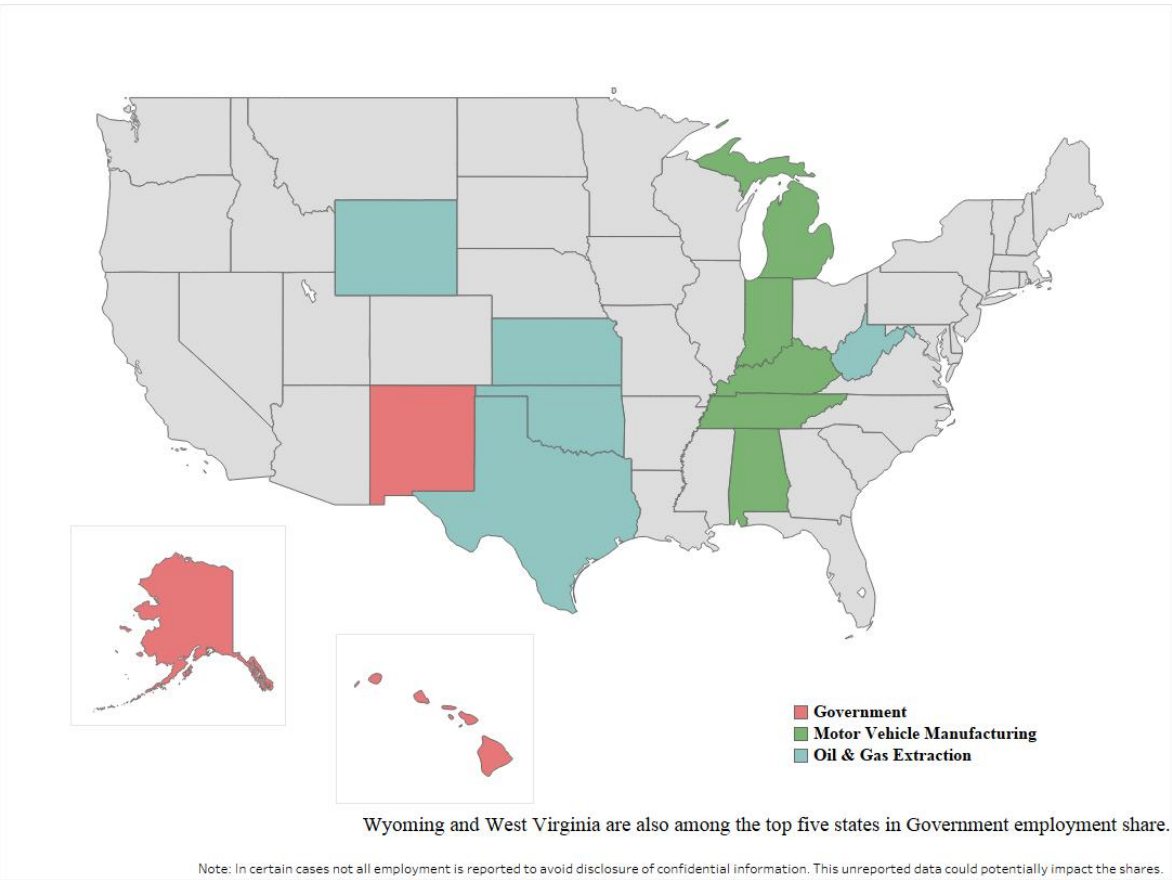
Figure 1: States with the Largest and Smallest Increases in Unemployment Rate – 2005 – 2010



Source: Bureau of Labor Statistics / Haver Analytics

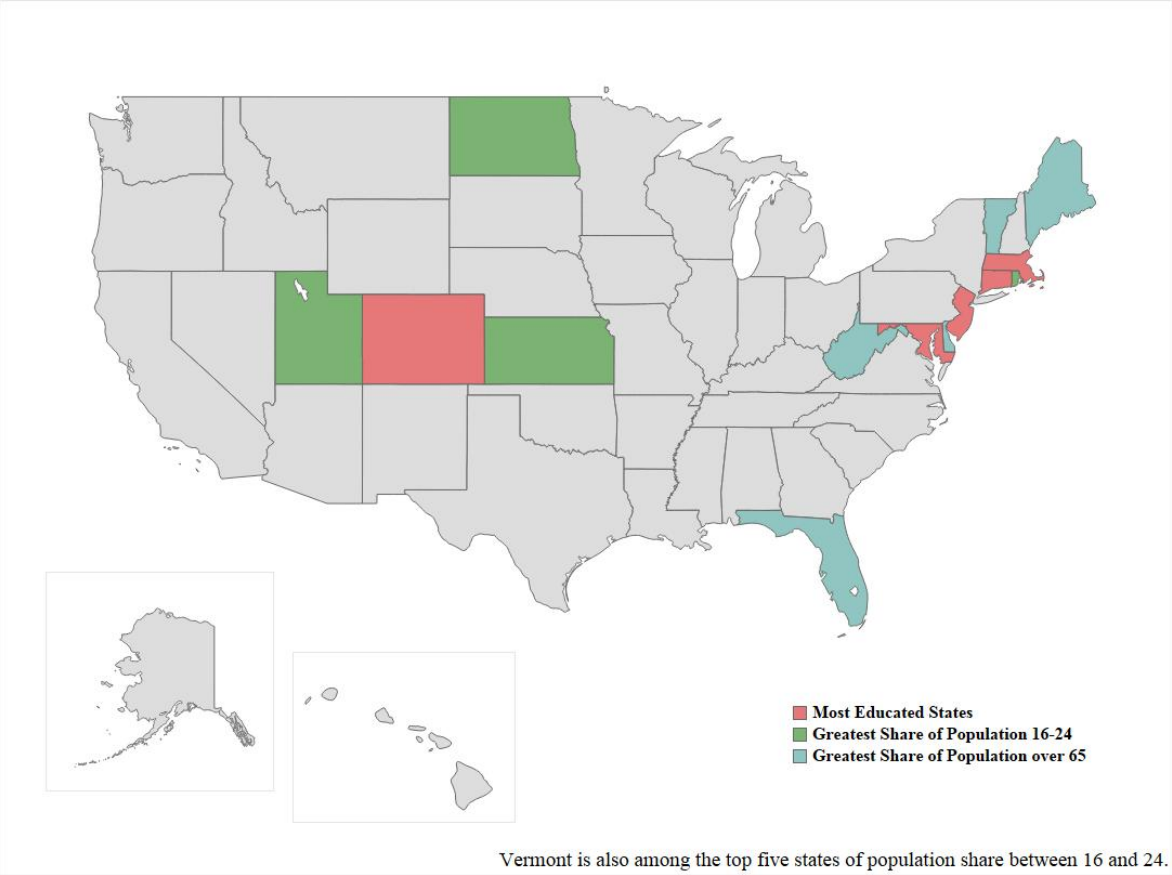
Figure 2: States with the Highest Employment Shares – by Industry



Note: In certain cases not all employment is reported to avoid disclosure of confidential information. This unreported data could potentially impact the shares.

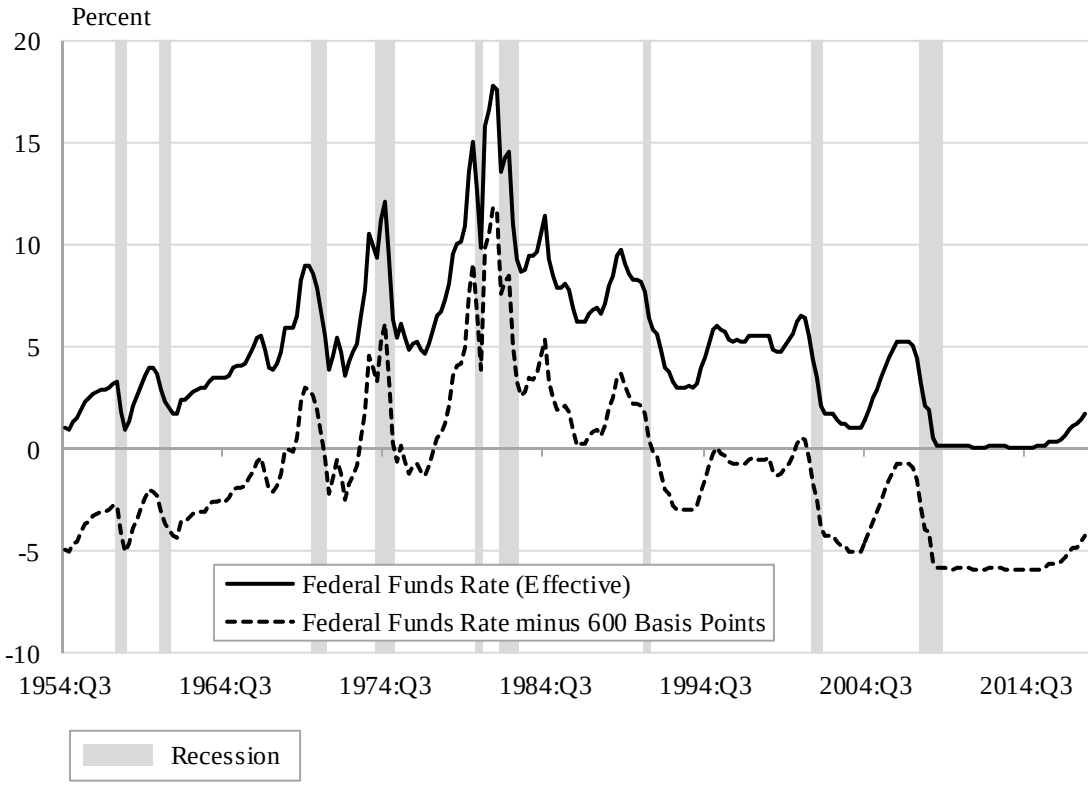
Source: Bureau of Economic Analysis (2016 data) / Haver Analytics

Figure 3: Demographics and Educational Attainment by State



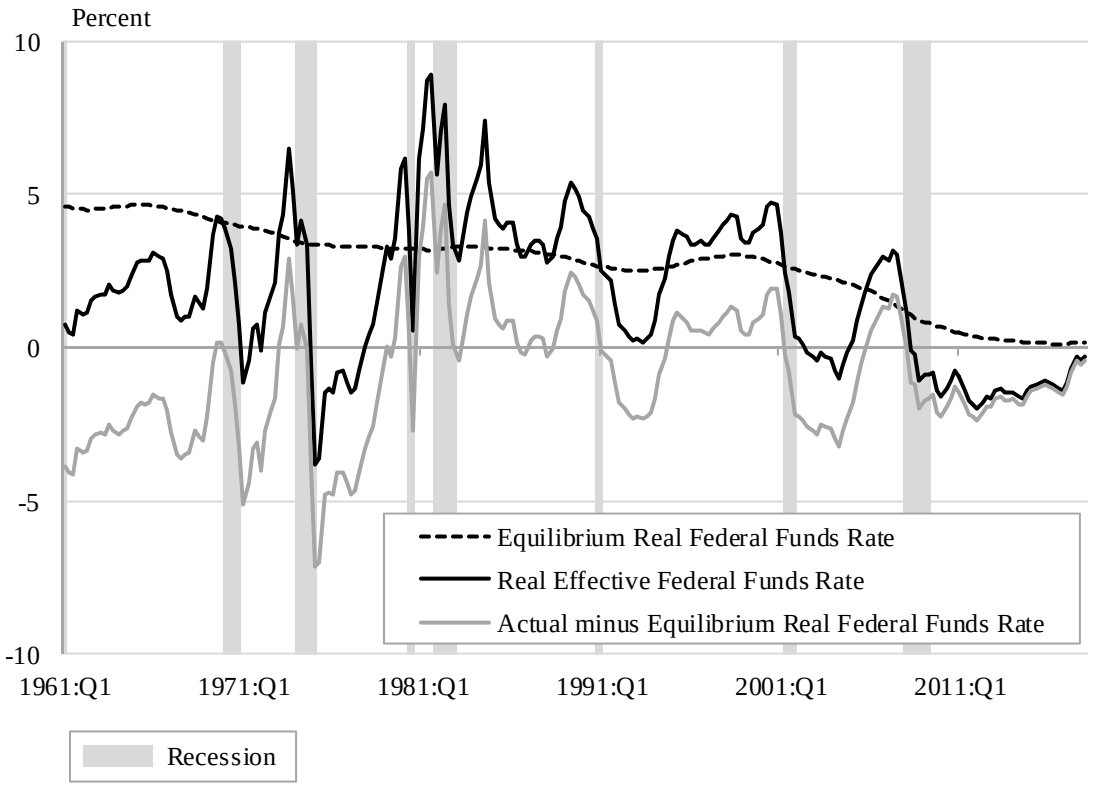
Sources: Census Bureau (Ages, 2017 data) / American Community Survey (Education, 2016 data) / Haver Analytics

Figure 4: The Federal Funds Rate, 1954:Q3 – 2018:Q2



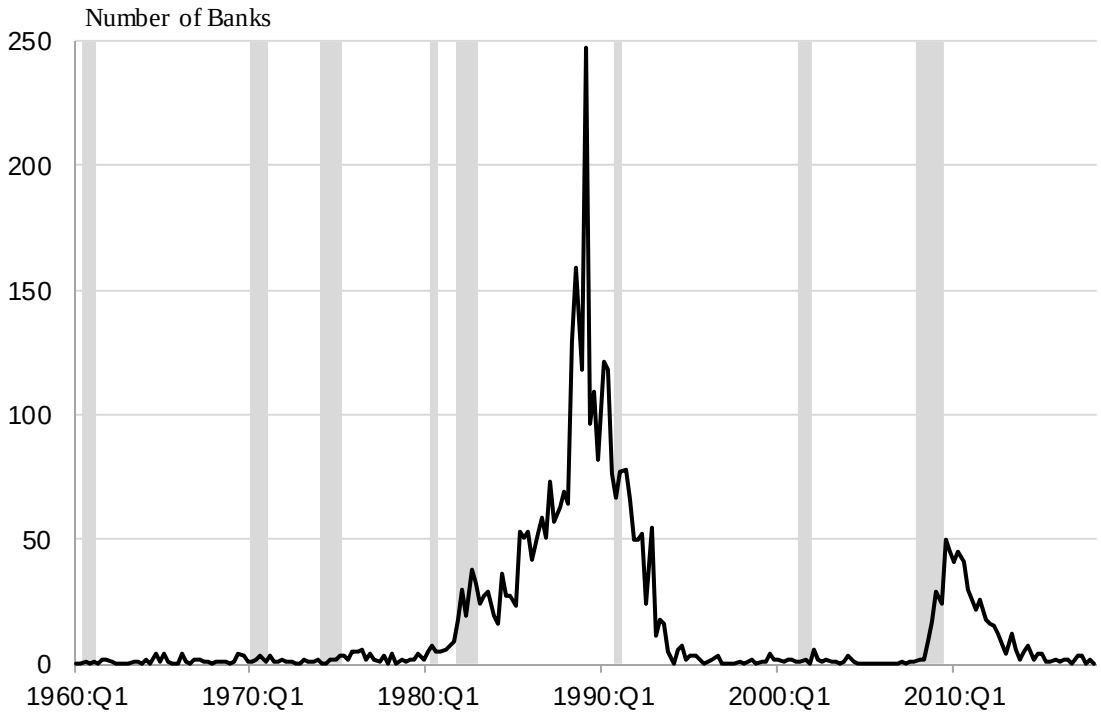
Source: Federal Reserve Board, NBER, Haver Analytics

Figure 5: Actual and Equilibrium Real Federal Funds Rates, 1961:Q1 – 2018:Q1



Source: Federal Reserve Board, Laubach and Williams, BEA, NBER, Haver Analytics

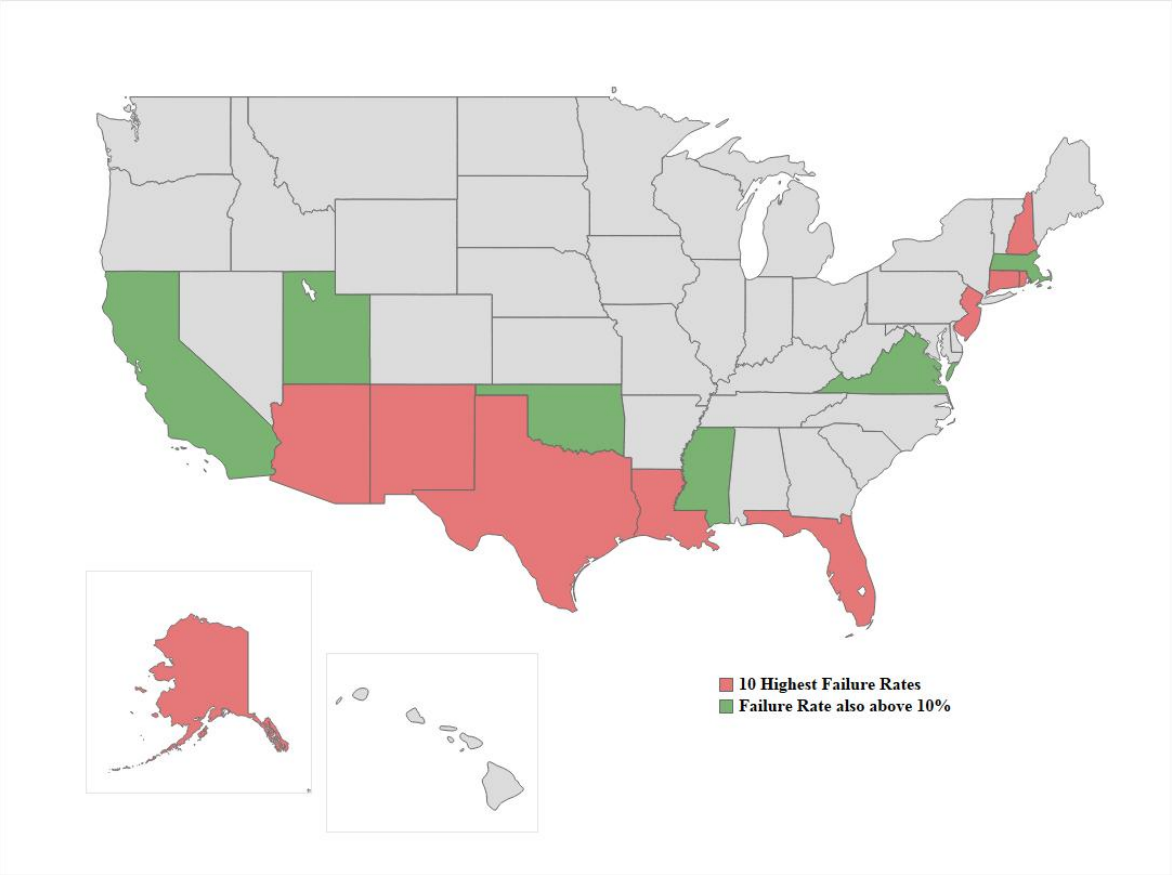
Figure 6: Bank Failures in the U.S., 1960:Q1 - 2018:Q1



Note: Includes both failures and assistance transactions. Banks include commercial banks, savings banks, and savings and loan associations (beginning in 1980).

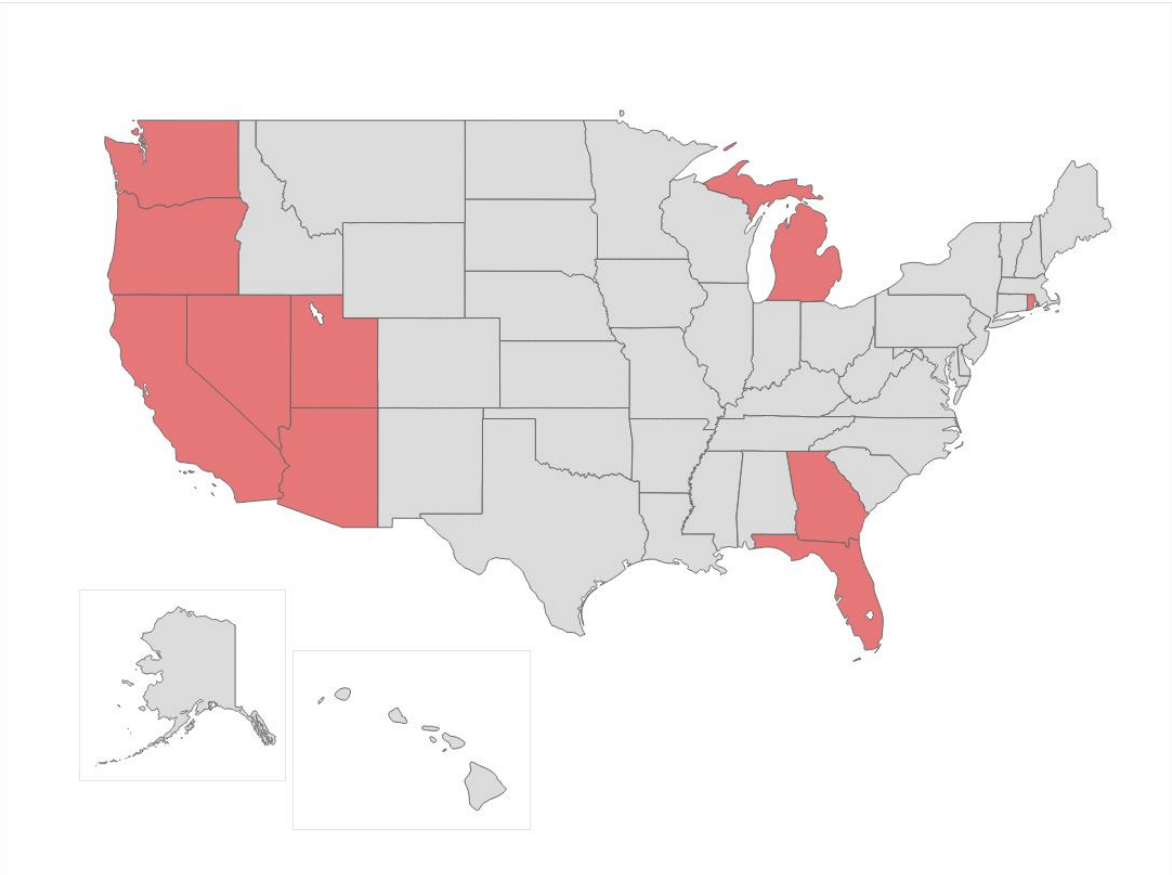
Source: FDIC, NBER, Haver Analytics

Figure 7: States with the Highest Bank Failure Rate – 1990 - 1991 Recession



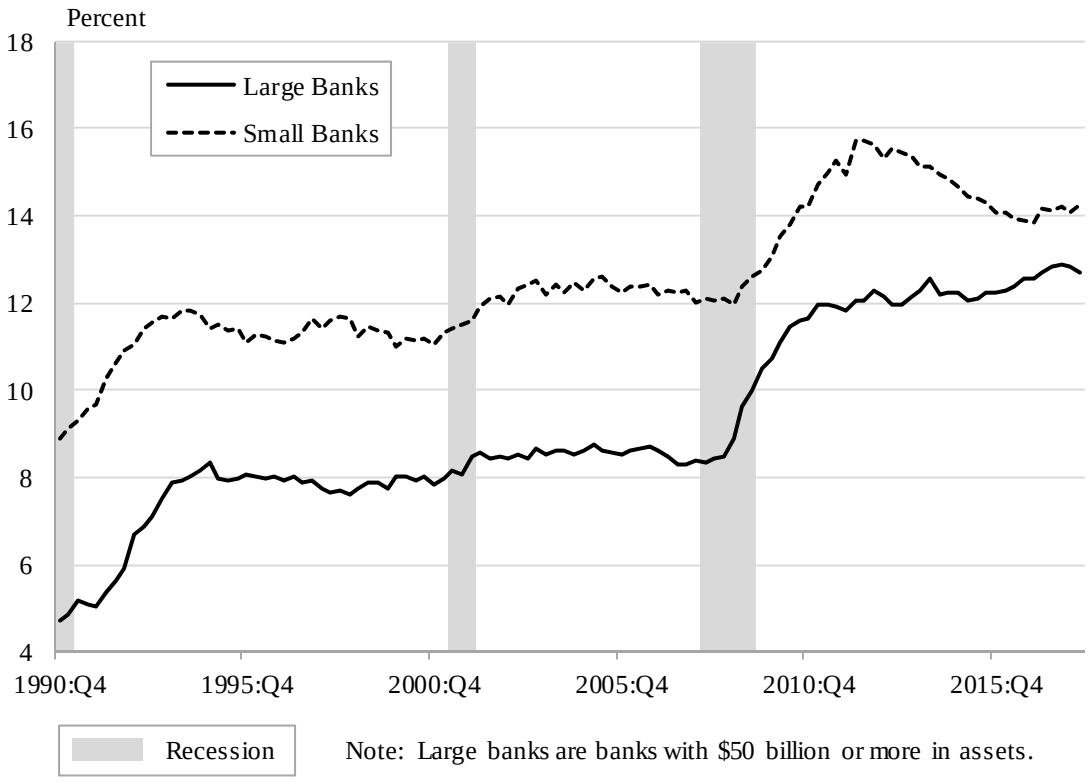
Sources: FDIC and Quarterly Bank Call Reports.

Figure 8: States with the Highest Bank Failure Rate – 2007 - 2009 Recession



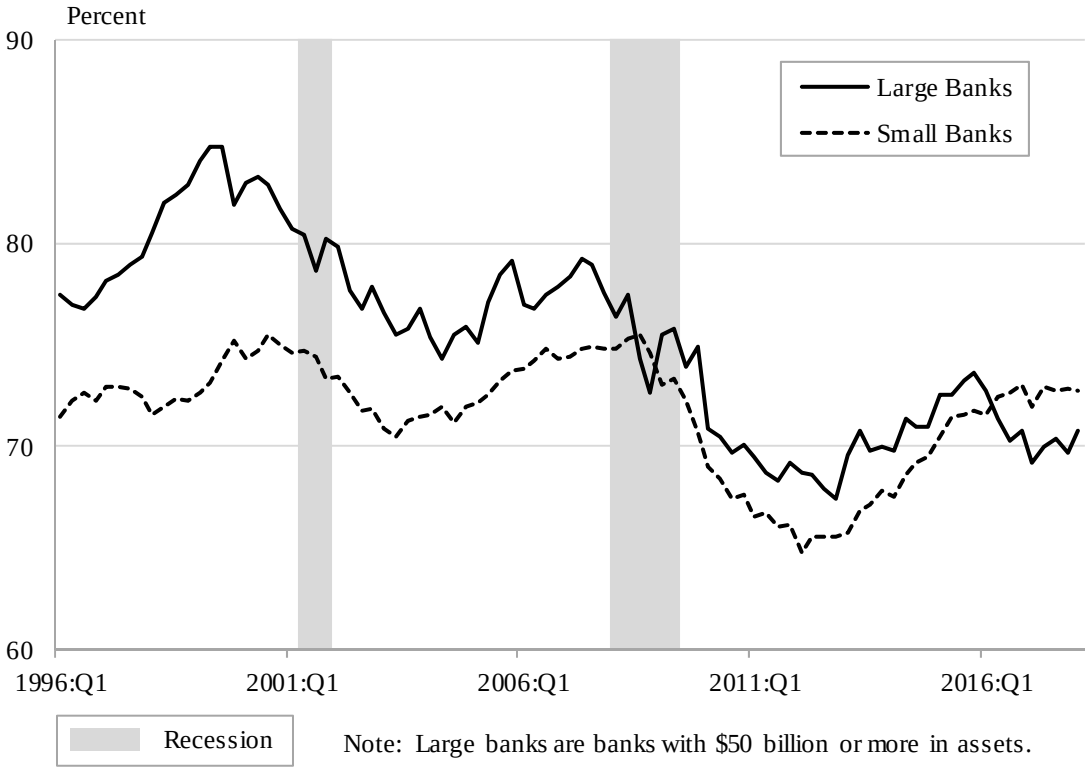
Sources: FDIC and Quarterly Bank Call Reports.

Figure 9: Tier 1 Risk-Based Capital Ratios at Banks by Asset Size, 1990:Q4 - 2018:Q1



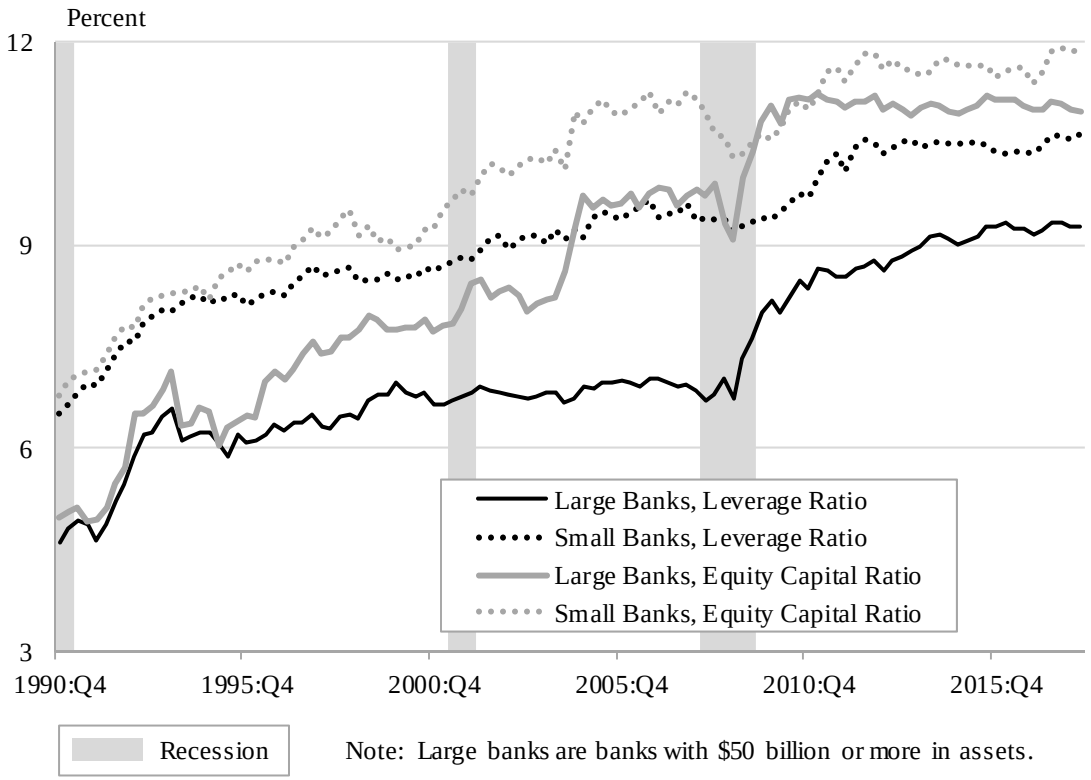
Source: Quarterly Bank Call Reports, NBER

Figure 10: Risk-Weighted Assets Relative to Total Assets at Banks by Asset Size, 1996:Q1 - 2018:Q1



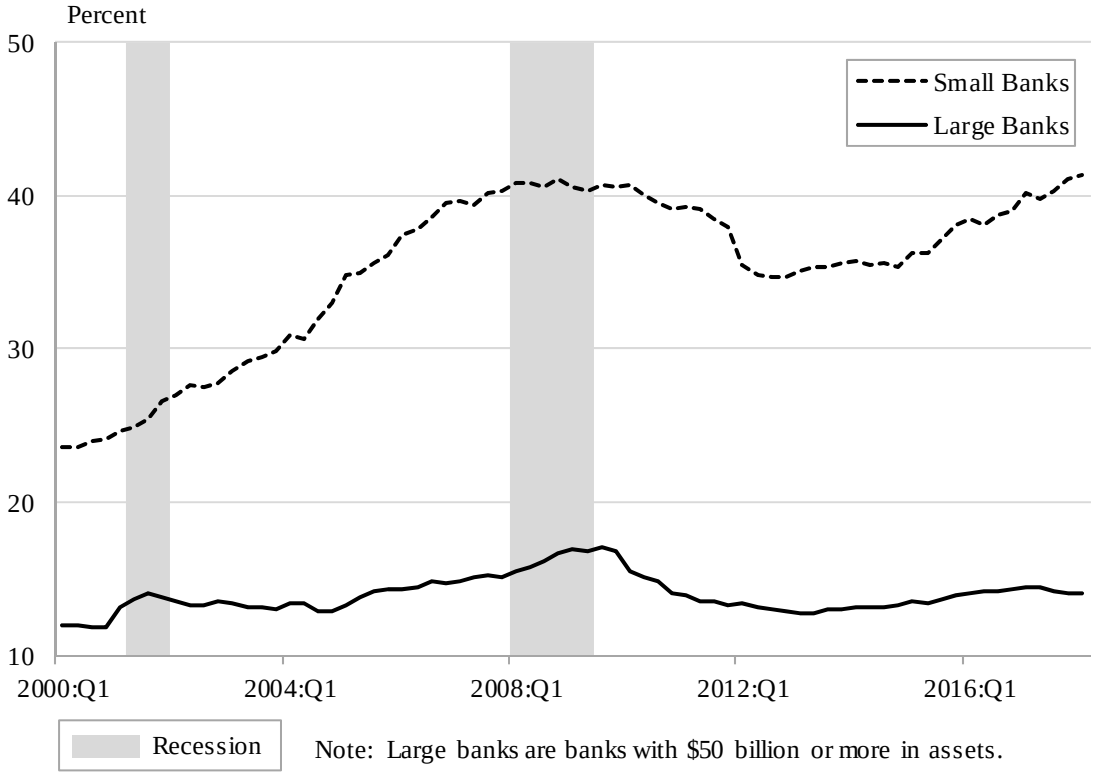
Source: Quarterly Bank Call Reports, NBER

Figure 11: Equity Capital and Leverage Ratios at Banks by Asset Size, 1990:Q4 - 2018:Q1



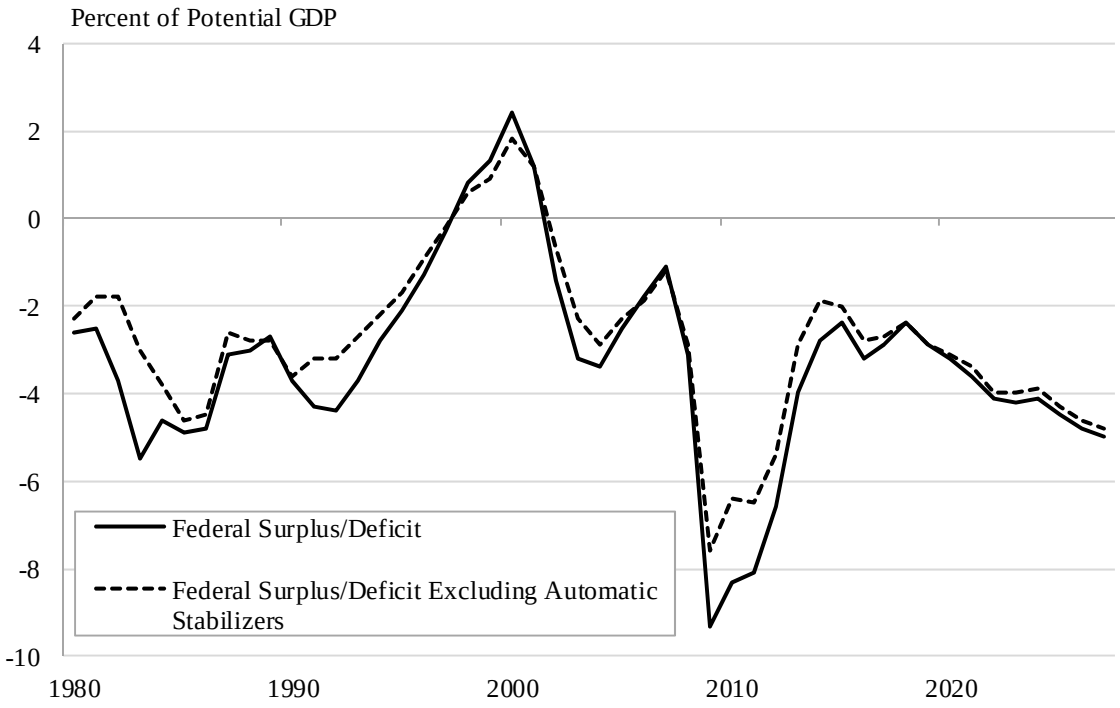
Source: Quarterly Bank Call Reports, NBER

Figure 12: Commercial Real Estate Loans as a Share of Total Loans at Banks by Asset Size, 2000:Q1 - 2018:Q1



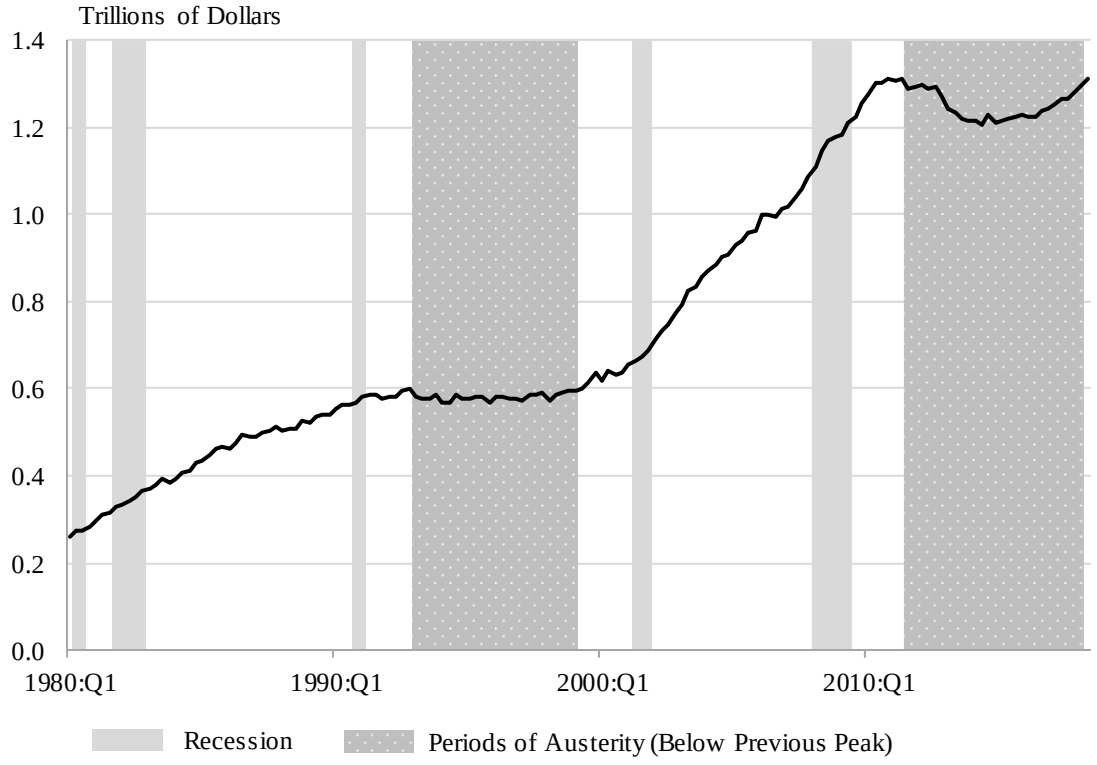
Source: Quarterly Bank Call Reports, NBER

Figure 13: Federal Surplus/Deficit as a Percent of Potential GDP, Federal Fiscal Years 1980 – 2027



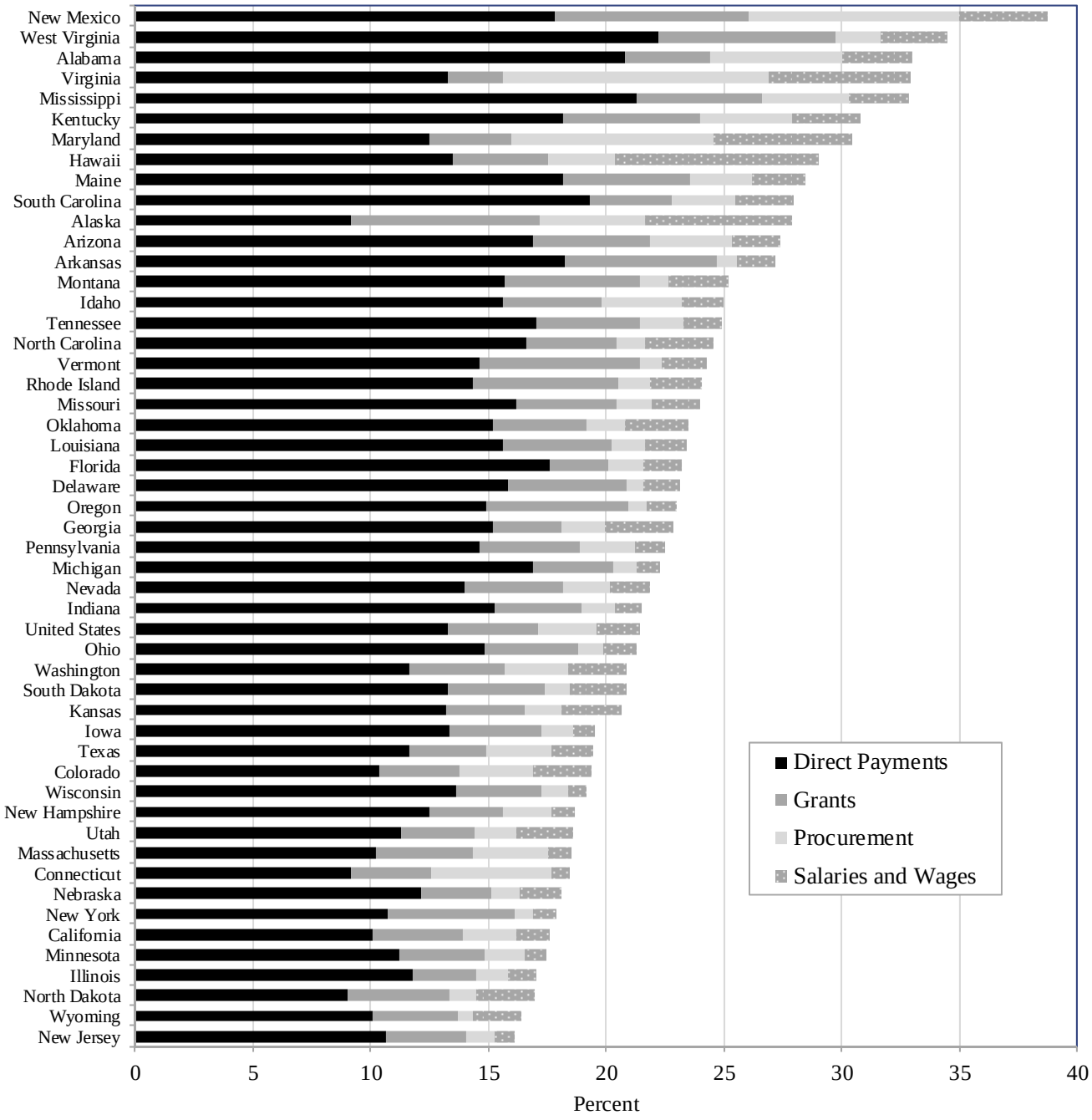
Source: CBO, Haver Analytics

Figure 14: Federal Government Consumption and Investment, 1980:Q1 – 2018:Q2



Source: BEA, NBER, Haver Analytics

Figure 15: Federal Spending as a Percent of State Personal Income, Federal FY 2015

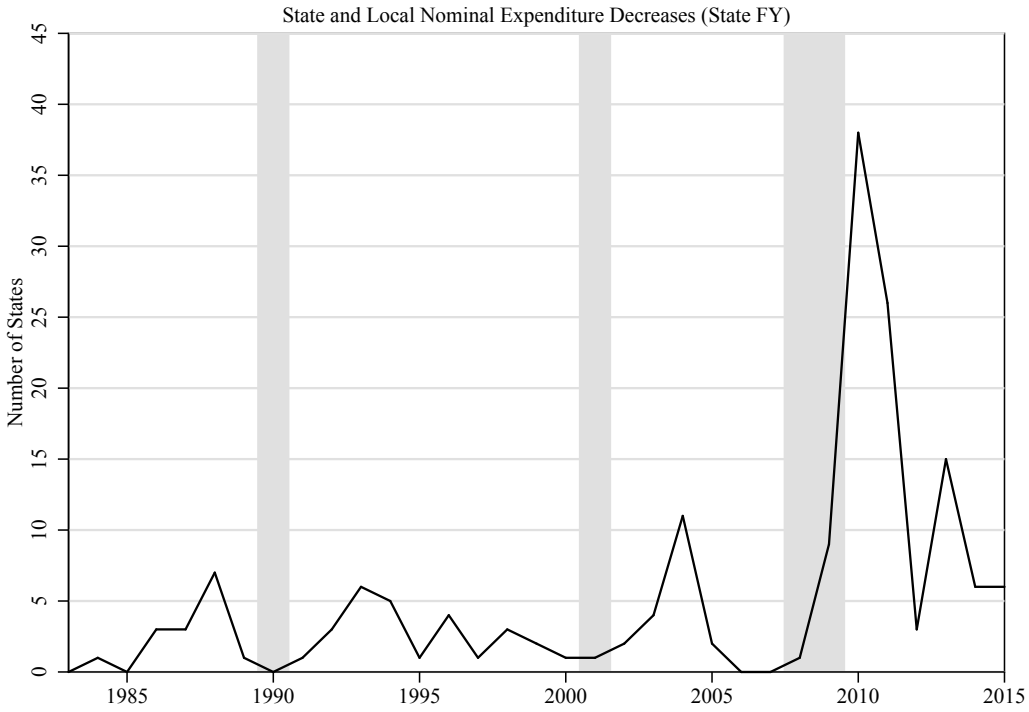


Source: The Council of State Governments' Federal Spending in the States Report, BEA, Haver Analytics

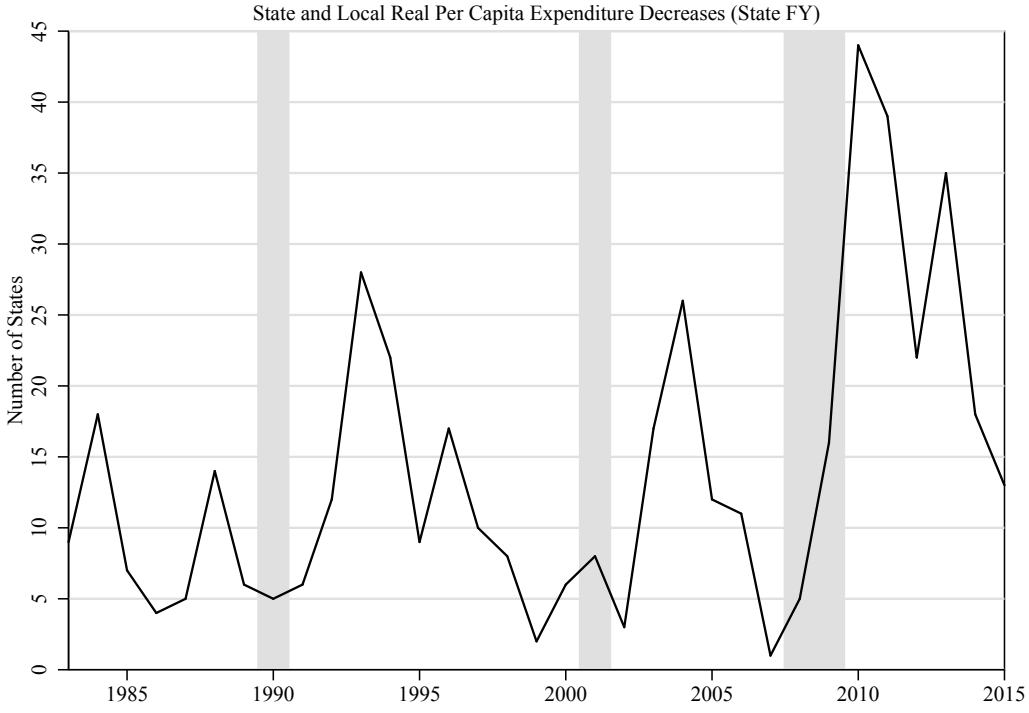
Figure 16: State and Local Expenditure Decreases

State Fiscal Year 1983 - 2015

Nominal

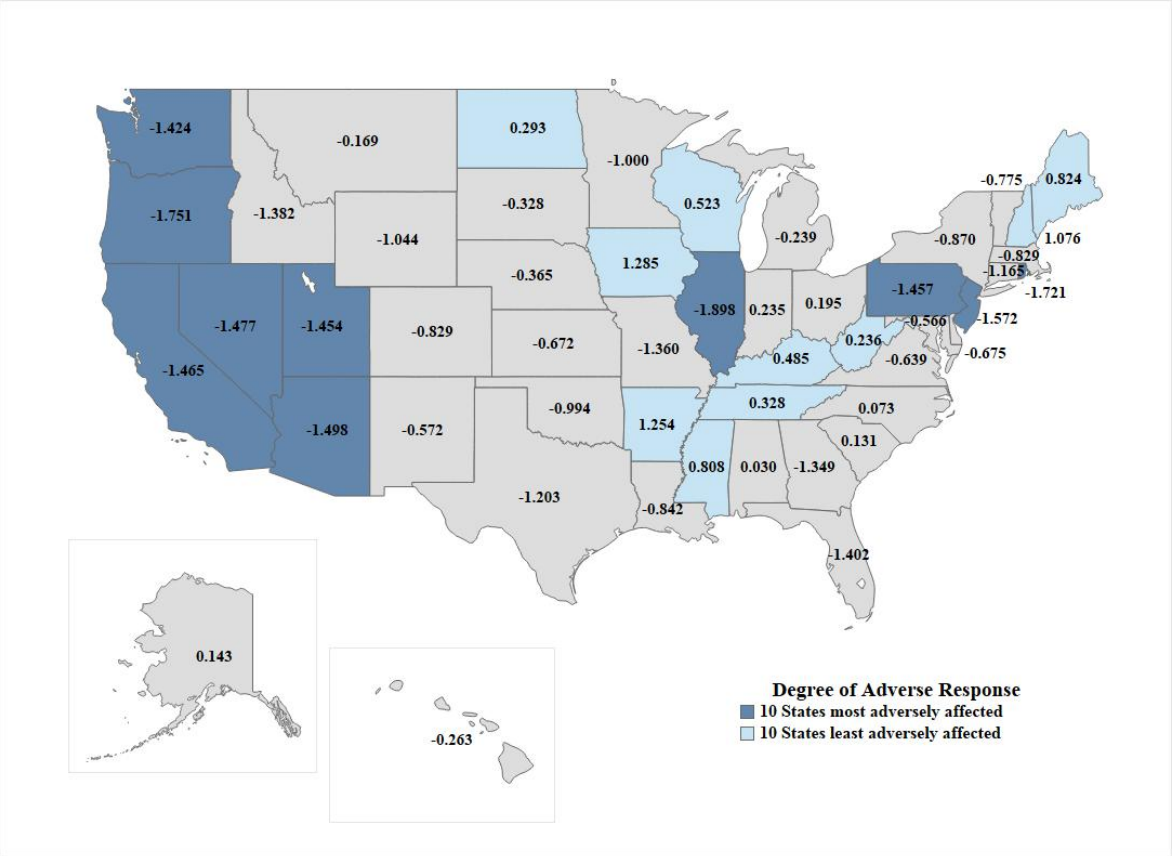


Real Per Capita



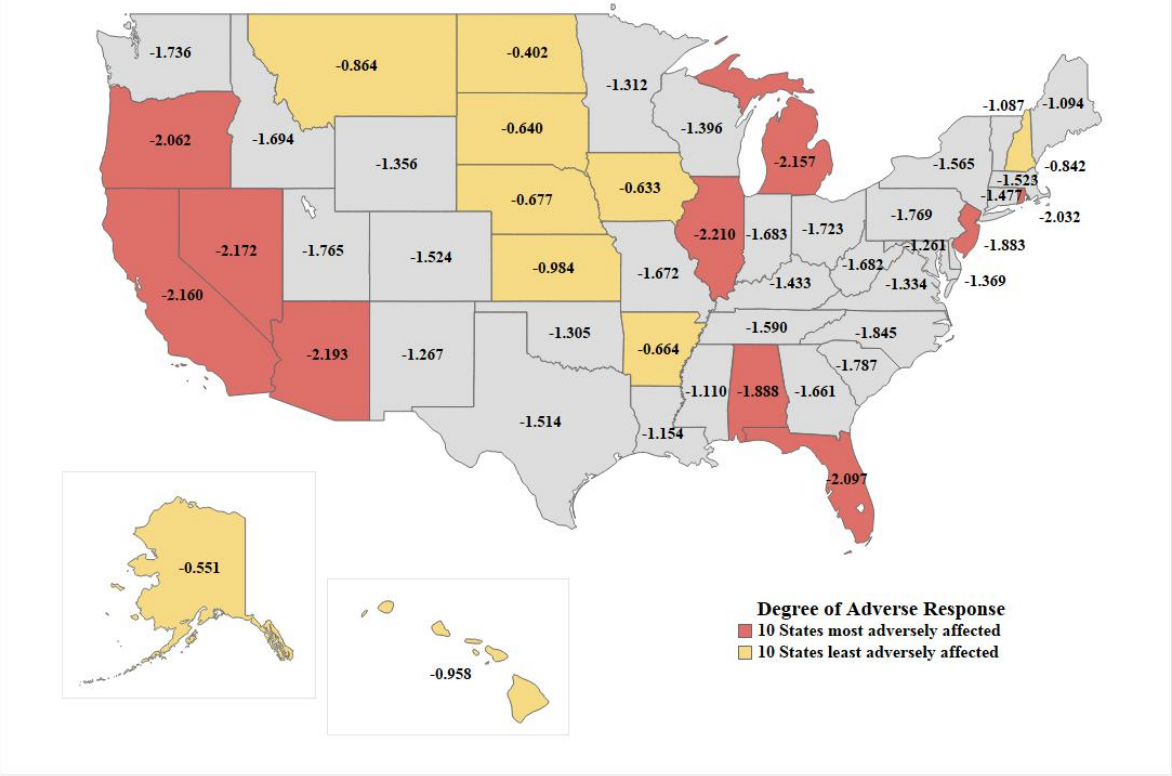
Source: Census Bureau's Annual Survey of State and Local Government Finances, BEA, DOL, Haver Analytics
Note: Missing Data for AL, MI, and TX in FY2015

Figure 17: Estimated Recession Effects



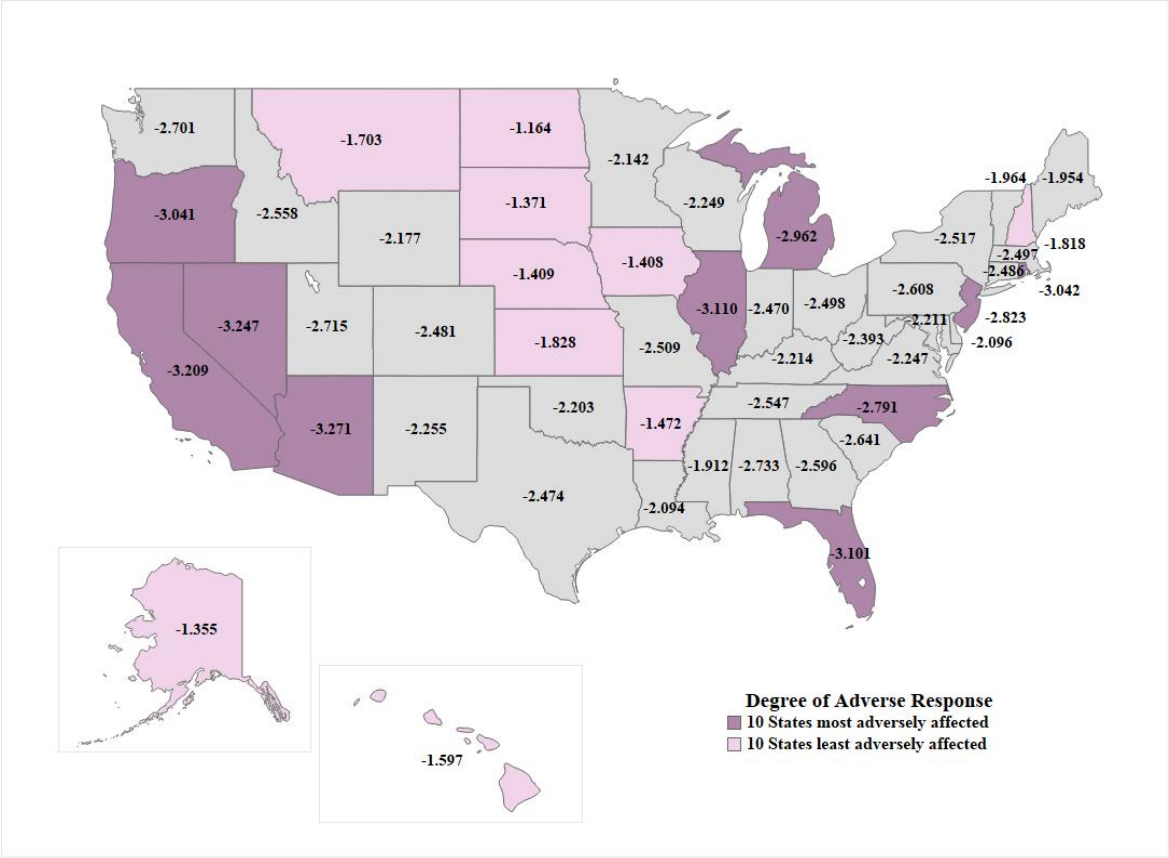
Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, CBO, DOL, BEA, BLS, Haver Analytics.

Figure 18: Typical Recession Effects with Limited Monetary Policy Response



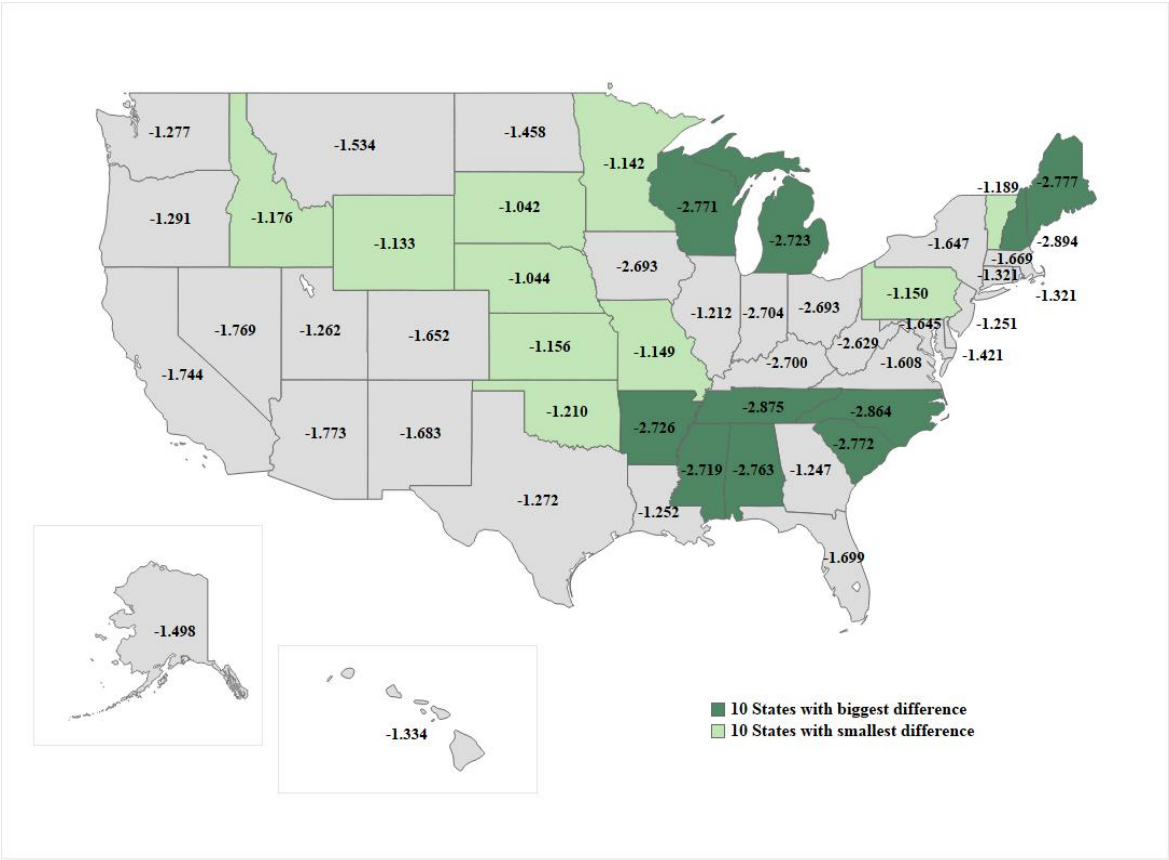
Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, CBO, DOL, BEA, BLS, Haver Analytics.

Figure 19: Typical Recession Effects with Limited Monetary Policy Response and All Other Buffers Depleted



Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, CBO, DOL, BEA, BLS, Haver Analytics.

Figure 20: Difference in Outcomes between No Depleted Policy Buffers and All Buffers Limited



Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, CBO, DOL, BEA, BLS, Haver Analytics.

Table 1: Sensitivity of State to National Real Per Capita Personal Income One-Quarter Growth

1983:Q1 - 2015:Q4

	Sensitivity
	Highest
WA	1.176
CA	1.158
ND	1.150
NY	1.099
NC	1.096
	Median
	0.951
	Lowest
LA	0.713
WV	0.701
MS	0.697
AK	0.556
HI	0.495

Source: BEA, Haver Analytics

Table 2: The Average Funds Rate Reduction in Downturn

Fed Funds Rate @ NBER Peak		Fed Funds Rate @ Rate Trough		Change in the Fed Funds Rate
1960M4	3.92	1961M1	1.45	-2.47
1969M12	8.97	1971M3	3.71	-5.26
1973M11	10.03	1975M5	5.22	-4.81
1980M1	13.82	1980M7	9.03	-4.79
1981M7	19.04	1981M12	12.37	-6.67
1990M7	8.15	1992M12	2.92	-5.23
2001M3	5.31	2003M12	0.98	-4.33
2007M12	4.24	2011M7	0.07	-4.17

Average Rate Change:	-4.72

Fed Funds Rate @ Rate Peak		Fed Funds Rate @ Rate Trough		Change in the Fed Funds Rate
1959M11	4.00	1961M1	1.45	-2.55
1969M8	9.19	1971M3	3.71	-5.48
1973M9	10.78	1975M5	5.22	-5.56
1980M4	17.61	1980M7	9.03	-8.58
1981M6	19.10	1981M12	12.37	-6.73
1989M3	9.85	1992M12	2.92	-6.93
2000M7	6.54	2003M12	0.98	-5.56
2007M3	5.26	2011M7	0.07	-5.19

Average Rate Change:	-5.82

Source: Federal Reserve Board, NBER, Haver Analytics

Table 3: Sensitivity of Federal Expenditures to Fiscal Austerity

Federal Fiscal Year 1983 - 2010

Panel A:
Zero Unemployment Rate Increase

	Sensitivity	Primary Contributor
	Most Restrictive	
KY	-3.002	Procurement
MA	-2.674	Procurement
KS	-2.422	Procurement
MD	-2.206	Procurement
HI	-2.118	Direct Payments
	Median	
	-1.177	
	Least Restrictive	
GA	0.428	Procurement
PA	0.615	Direct Payments
MN	0.968	Direct Payments
OH	1.228	Direct Payments
ND	1.263	Direct Payments

Panel B:
One Percentage Point Unemployment Rate Increase

	Sensitivity	Primary Contributor
	Most Restrictive	
AK	-9.575	Procurement
KS	-5.902	Direct Payments
HI	-5.304	Direct Payments
WI	-3.913	Grants
VA	-2.682	Procurement
	Median	
	-1.230	
	Least Restrictive	
OH	0.153	Direct Payments
MS	0.303	Direct Payments
PA	0.317	Direct Payments
NE	0.575	Direct Payments
GA	0.796	Procurement

Source: Census Bureau's Federal Expenditures by State Report and Consolidated Federal Funds Report, DOL, BEA, BLS, Haver Analytics

Table 4: State Federal Personal Income Tax Revenue

Panel A:
Sensitivity of State to National Real Per Capita
Federal Personal Income Tax Revenue
1984-2015

	Sensitivity
	Highest
CT	2.444
MA	2.202
WY	1.889
NY	1.771
NJ	1.540
	Median
	0.675
	Lowest
MS	0.380
NM	0.359
WV	0.312
AK	0.301
HI	0.250

Panel B:
2015 State Per Capita
Federal Personal Income Tax Revenue

	USD
	Highest
CT	8046
MA	7201
NY	6565
NJ	6480
CA	5377
	Median
	3643
	Lowest
KY	2692
AR	2641
NM	2571
WV	2372
MS	2110

Source: BEA, Statistics of Income, Haver Analytics

Table 5: Summary Statistics
1983 - 2015 Federal Fiscal Year

Variable	Mean	Median	Std. Dev	Min.	Max.	N
Real Per Capita State Personal Income Growth Rate (%)	1.92	2.06	2.21	-7.36	11.8	1,647
L1 Change in State UR (%)	-.0325	-.208	1.04	-4.6	5.93	1,647
L1 CAMELS: State 3-4-5 Share (%)	13.7	5.3	17.5	0	98.4	1,647
L1 Change in Real Eff. - Equil. FFR	-.191	-.236	1.3	-2.84	2.42	1,647
L2 Change in Real Eff. - Equil. FFR	-.0799	-.236	1.46	-2.84	3.65	1,647
Federal Austerity Dummy (1990-2000, 2009-2014)	.516	1	.5	0	1	1,647
Nominal Broad Federal Expenditure Decrease Dummy	.189	0	.391	0	1	1,647
Nominal State & Local Expenditure Decrease Dummy	.142	0	.349	0	1	1,647

Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, Census Bureau's Federal Expenditures by State Report and Consolidated Federal Funds Report, The Council of State Governments' Federal Spending in the States Report, CBO, DOL, BEA, BLS, Haver Analytics.

Notes: The Personal Consumption Expenditures Price Deflator is used to convert state nominal personal income to real personal income. The CAMELS measure is the share of banks, using deposit weights, with branches operating in the state that have a bank supervisory confidential bank rating of 3, 4 or 5 (integer scale of 1 to 5). Real Eff. - Equil. FFR is the Real Effective Federal Funds Rate minus the Laubach-Williams two-sided Equilibrium Real Federal Funds Rate. Nominal interest rates are converted to real interest rates by subtracting the four-quarter Core Personal Consumption Expenditures inflation rate. The Federal Austerity Dummy is measured from the trough to peak of the federal budget surplus without automatic stabilizers as a percentage of national potential GDP. The Expenditure Decrease Dummy variables take on a value of one when nominal expenditures decline until expenditures regain the level prior to the decline. State and Local Expenditures are state and local general expenditures minus federal intergovernmental revenue plus state unemployment insurance expenditures. Broad Federal Expenditures are federal expenditures in each state comprised of grants, direct payments, procurement, wages and salaries, and unemployment insurance advances to the state funds. The sample is based on federal fiscal years from 1983 to 2015. State and local expenditure data use state fiscal year timing. For AL, MI, and TX, 2015 data are unavailable.

Table 6: Real Per Capita State Personal Income Growth Rate
1983 - 2015 Federal Fiscal Year

	Unweighted	Weighted	Unweighted	Weighted
L1 Change in State UR (%)	−0.644***	−0.735***	−0.661***	−0.750***
	(0.059)	(0.012)	(0.059)	(0.012)
L1 CAMELS: State 3-4-5 Share (%)	−0.014***	−0.011***	−0.016***	−0.013***
	(0.003)	(0.001)	(0.003)	(0.001)
L1 Change in Real Eff. - Equil. FFR	0.171***	0.075***	0.154**	0.057***
	(0.066)	(0.015)	(0.066)	(0.014)
L2 Change in Real Eff. - Equil. FFR	−0.249***	−0.207***	−0.255***	−0.212***
	(0.055)	(0.012)	(0.055)	(0.012)
L1 High Interest Rate Ind. Emp. Share Dummy*Ch. Real Eff.-Equil. FFR	−0.369***	−0.353***	−0.369***	−0.350***
	(0.093)	(0.021)	(0.093)	(0.021)
L2 High Interest Rate Ind. Emp. Share Dummy*Ch. Real Eff.-Equil. FFR	−0.033	−0.079***	−0.030	−0.077***
	(0.083)	(0.019)	(0.083)	(0.019)
L1 Low Interest Rate Ind. Emp. Share Dummy*Ch. Real Eff.-Equil. FFR	−0.137	−0.137***	−0.138	−0.142***
	(0.092)	(0.018)	(0.093)	(0.018)
L2 Low Interest Rate Ind. Emp. Share Dummy*Ch. Real Eff.-Equil. FFR	0.041	−0.148***	0.043	−0.150***
	(0.083)	(0.016)	(0.083)	(0.016)
Federal Austerity Dummy (1990-2000, 2009-2014)	−0.361***	−0.324***		
	(0.104)	(0.022)		
Nominal Broad Federal Expenditure Decrease Dummy			0.005	0.186***
			(0.137)	(0.031)
Nominal State & Local Expenditure Decrease Dummy	−0.282*	−0.444***	−0.365**	−0.593***
	(0.163)	(0.038)	(0.165)	(0.039)
Constant	2.307***	2.244***	2.151***	2.093***
	(0.080)	(0.017)	(0.068)	(0.015)
Total Obs.	1647	1647	1647	1647
Adj. R-squared	0.146	0.216	0.140	0.212
Change in Real Eff. - Equil. FFR: Sum	−0.078	−0.132	−0.101	−0.154
Change in Real Eff. - Equil. FFR: P-Value	0.363	0.000	0.239	0.000
High Int. Rate Ind. Emp. Share Dum*Ch. Real Eff.-Equil. FFR: Sum	−0.402	−0.432	−0.399	−0.427
High Int. Rate Ind. Emp. Share Dum*Ch. Real Eff.-Equil. FFR: P-Value	0.001	0.000	0.001	0.000
Low Int. Rate Ind. Emp. Share Dum*Ch. Real Eff.-Equil. FFR: Sum	−0.096	−0.285	−0.095	−0.292
Low Int. Rate Ind. Emp. Share Dum*Ch. Real Eff.-Equil. FFR: P-Value	0.437	0.000	0.445	0.000

Sources: Authors' calculations using Federal Reserve System, Federal Reserve Board, Laubach and Williams, Census Bureau's Annual Survey of State and Local Government Finances, Census Bureau's Federal Expenditures by State Report and Consolidated Federal Funds Report, The Council of State Governments' Federal Spending in the States Report, CBO, DOL, BEA, BLS, Haver Analytics.

Notes: The dependent variable is the Real Per Capita State Personal Income Growth Rate. The Personal Consumption Expenditures Price Deflator is used to convert nominal values to real values. The CAMELS measure is the share of banks, using deposit weights, with branches operating in the state that have a bank supervisory confidential bank rating of 3, 4 or 5 (integer scale of 1 to 5). Real Eff. - Equil. FFR is the Real Effective Federal Funds Rate minus the Laubach-Williams two-sided Equilibrium Real Federal Funds Rate. Nominal interest rates are converted to real interest rates by subtracting the four-quarter Core Personal Consumption Expenditures inflation rate. High (Low) Interest Rate Industry Employment Share Dummy variable takes on a value of one for the 15 states with the highest (lowest) average shares of interest rate sensitive industry employment during the sample period. The interest rate sensitive industries are mining, construction, manufacturing, and retail and wholesale trade. The Federal Austerity Dummy is measured from the trough to peak of the federal budget surplus without automatic stabilizers as a percentage of national potential GDP. The Expenditure Decrease Dummy variables take on a value of one when nominal expenditures decline until expenditures regain the level prior to the decline. State and Local Expenditures are state and local general expenditures minus federal intergovernmental revenue plus state unemployment insurance expenditures. Broad Federal Expenditures are federal expenditures in each state comprised of grants, direct payments, procurement, wages and salaries, and unemployment insurance advances to the state funds. For the weighted regressions, the weights are each states average share over the sample period of the total personal income of all 50 states. The sample is based on federal fiscal years from 1983 to 2015. State and local expenditure data use state fiscal year timing. For AL, MI, and TX, 2015 data are unavailable. The regressions include state fixed effects. Standard errors are in parentheses: *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.