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When is the Fiscal Multiplier High? A Comparison of Four Business Cycle Phases*

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Abstract

We synthesize the recent, at times conflicting, empirical literature regarding whether fiscal policy is more effective during certain points in the business cycle. Evidence of state dependence in the multiplier depends critically on how the business cycle is defined. Estimates of the fiscal multiplier do not change when the unemployment rate is above or below its trend. However, we find that the multiplier is higher when the unemployment rate is increasing relative to when it is decreasing. This result holds using both a long time-series at the U.S. national level and for a panel of U.S. states.

Keywords: Fiscal multipliers; countercyclical policy; cross-sectional analysis; local projections

JEL classification: E62; C31; C32.

*The views expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Reserve Board.

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1 Introduction

The Great Recession triggered a focus on the fiscal multiplier, and especially the question of whether the multiplier varies over time. The question is of great importance to fiscal policymakers, since an answer in the affirmative implies that well-designed and well-timed fiscal policy can spur economic growth even if the multiplier is below unity on average.

Empirical evidence on whether the multiplier for fiscal expenditure varies over the business cycle is mixed. Auerbach and Gorodnichenko (2012b) is one prominent study to find that the fiscal multiplier depends on the state of the economy. Using regime-switching models, Auerbach and Gorodnichenko find that fiscal policy is considerably more efficacious in the U.S. during recessions than expansions. In contrast, when Ramey and Zubairy (2018) look for state-dependence in the multiplier using a long history of news about changes to military spending in the United States, they do not find evidence that the fiscal multiplier varies over the business cycle. Further, the Ramey and Zubairy estimate of the multiplier is also below one.

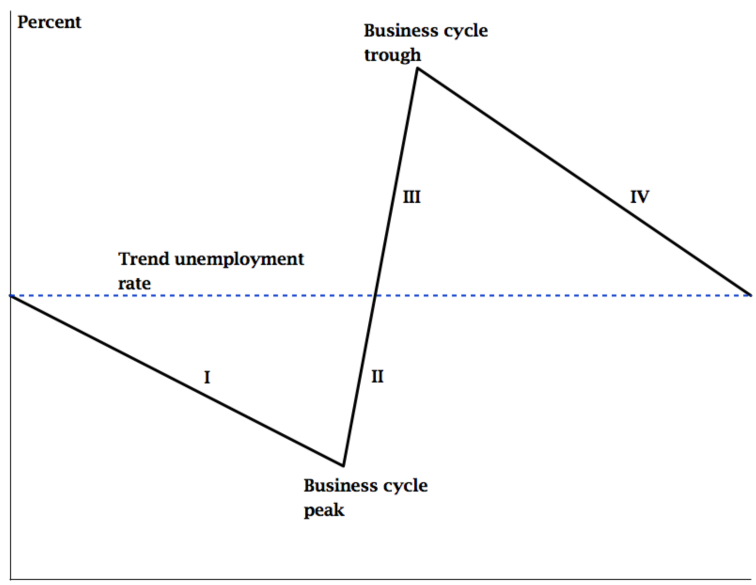
This paper contributes to this literature by highlighting how estimates of the fiscal multiplier are sensitive to the manner in which state dependence is defined. To motivate our results, consider figure 1, which shows a highly stylized path of the unemployment rate over the business cycle. There are four distinct stages of the business cycle. In stage I, the economy is 'running hot' with the unemployment rate below its natural rate, and economic activity is expanding. This phase occurs until the business cycle peak. In stage II, the economy is still operating above trend, but economic activity is slowing and the unemployment rate rising. We have labeled stage III as the period in which economic activity continues to contract and the unemployment rate is above its trend. Finally, stage IV is when the unemployment rate is above its trend but economic activity is expanding and the unemployment rate falling.[1] From this figure, we label four distinct stages of the business cycle. Stages I and II are a boom, since the economy is operating above its trend. In contrast, stages III and IV are a slump. Stages I/IV and II/III are the business cycle expansion and recession, respectively.

We show that the simple distinction between boom/slump and expansion/recession can largely reconcile the empirical results described above. When we compare estimates of the fiscal multiplier conditional on whether the economy is in a boom or slump, we find similar multipliers in both states that

[1] The stylized unemployment rate is purposefully asymmetric across the business cycle, reflecting the fact that unemployment rises much more quickly than it falls. Similarly, for simplicity we have drawn the trend unemployment rate as time-invariant, although it may well vary over time.

are typically not statistically different. However, fiscal multipliers are significantly higher when the economy is in recession compared to when it is in expansion. Furthermore, multipliers in recessions are in almost all specifications higher than one. This result is robust to a broad series of alternative controls for the state of the economy, as well as different algorithms used to define the peaks and troughs in the unemployment rate. We also show that the exact transformation of variables used in the analysis matter, in particular the transformation of government expenditures.[2] We claim that detrended government expenditures as a share of potential output are a more appropriate choice due to a secular trend in government expenditures.

Figure 1: Stylized behavior of unemployment rate across the business cycle.



Notes: Roman numerals denote various business cycle phases. See text for details.

Estimating the fiscal multiplier requires identifying exogenous changes to government expenditures. The recent literature has taken two alternative approaches to resolving this problem. The first is to use a very long time-series of historical data, as in Ramey and Zubairy (2018), and identify shocks via a narrative approach. The second is to use a panel dataset, as in Nakamura and Steinsson (2014), who use a panel of U.S. states to estimate 'open-economy' relative fiscal multipliers.[3]

Since identifying exogenous changes to government expenditure is difficult, we will conduct our analysis using both datasets. To make the results comparable, we use the same definition of the business

[2] We use a Gordon and Krenn (2010) transformation for all variables, but the government expenditures. See figure 4 and discussion on page 11 for a details.

[3] Nakamura and Steinsson (2014) find mixed evidence that the fiscal multiplier varies across slumps and booms, depending on whether the slump/boom is defined using output or unemployment.

cycle, finding business cycle peaks and troughs in the unemployment rate either at the national or state level. As in Ramey and Zubairy (2018), we do not find state-dependence conditional on periods when unemployment is above or below its trend but do find evidence of state dependence depending on whether the unemployment rate is increasing versus when it is decreasing. When we conduct the analysis using defense spending shocks from Nakamura and Steinsson (2014), we find fiscal multipliers are higher when the U.S. state is in recession compared to periods when it is expanding. Again, there is no evidence that the fiscal multiplier is different in slumps versus booms. We can also study each stage of the business cycle separately using state-level data. We confirm that the multipliers are significantly higher in stage II and III of the cycle compared to the other stages of the business cycle. In sum, we are largely able to reconcile the results of Ramey and Zubairy (2018) and Nakamura and Steinsson (2014).

These empirical findings have important implications for theoretical work that aims to micro-found fiscal multipliers that vary across the business cycle. Typically, economic models that produce time-variation in fiscal multipliers rely on convexity in the aggregate supply curve. In this situation, the fiscal multiplier is larger when the economy is operating below its potential. In Michaillat (2014), for example, the supply curve is convex because it is more costly to hire labor when labor markets are tight. Alternatively, Canzoneri et al. (2016) postulate that financial frictions are smaller when the output gap is small. While both provide intuitive mechanisms for state-dependence that match some of the empirical evidence, an alternative mechanism is needed to match results in this paper, because these mechanisms imply that the multiplier varies across booms/slumps, whereas we find the strongest evidence of time-variation to be based on chronologies that describe recessions and expansions. One possibility is the model with loss-aversion utility, as in Santoro et al. (2014), which has been shown to generate state dependance for monetary policy shocks over GDP growth cycles that roughly correspond to increases and decreases in the unemployment rate.

Besides Auerbach and Gorodnichenko (2012a) and Ramey and Zubairy (2018), several other papers study whether the multiplier is higher during recessions.[4] Auerbach and Gorodnichenko (2012b) find evidence of state-dependence using a sample of OECD countries. Other papers that use U.S. data and find evidence of state-dependence in the fiscal multiplier include: Bachmann and Sims (2012), Baum et al. (2012), Shoag (2013), Candelon and Lieb (2013), Fazzari et al. (2015), and Dupor and Guerrero (2017).

[4] It is worth noting that Ramey and Zubairy (2018) do find evidence that the multiplier is higher when interest rates hit the zero lower bound state, in line with predictions from DSGE models (e.g., Christiano et al., 2011).

Our work is also related to the literature studying regional business cycle differences across U.S. states. Carlino and Defina (1998) examine the differential impact of monetary policy across U.S. states and regions and find that manufacturing regions experience larger reactions to monetary policy shocks than industrially-diverse regions. Furthermore, Blanchard and Katz (1992) study the behavior of wages and employment over regional cycles, and Driscoll (2004) details the effect of bank lending on output across U.S. states. Owyang et al. (2005) and Francis et al. (2018) also use state-level data to evaluate business cycles and countercyclical policy.

The remainder of this paper proceeds as follows. Section 2 describes our strategy to identify the business cycle phases in figure 1, both for national-level data in the United States as well as for state-level data. Section 3 describes the data. Results and robustness checks are presented in section 4, and finally section 5 concludes.

2 Identifying business cycle phases

2.1 Business cycles at the national level

We use the unemployment rate to define the phases of the business cycle. We take this approach because the unemployment rate is highly cyclical, and because a number of recent papers indicate that labor market variables meaningfully identify business cycle phases.[5] The other advantage of using the unemployment rate is that there are estimates at both the national and state levels, so that we can perform our analysis at different geographical levels using the same methodology.

The Bry and Boschan (1972) algorithm (BB algorithm) identifies our recession chronologies. The algorithm identifies local peaks and troughs in a given series, as in figure 1.[6] After local peaks and troughs are obtained, three restrictions are enforced onto the resulting chronology. First, peaks and troughs must alternate. In the case that two peaks are sequential, then the peak corresponding with the lower unemployment rate is used. The converse identifies local troughs. Secondly, the BB algorithm enforces a minimum duration of each business cycle phase, six months or two quarters. Finally, for the state-level data, we add a restriction that business cycle troughs correspond to a cumulative rise in the unemployment rate of at least 0.5 percentage point from the previous peak. This restriction is required for identifying state-level business cycles because it ensures that small movements in the state-level unemployment rate, which

[5] See, e.g., Hamilton and Owyang (2012), Francis et al. (2018), and Berge and Pfajfar (2019).

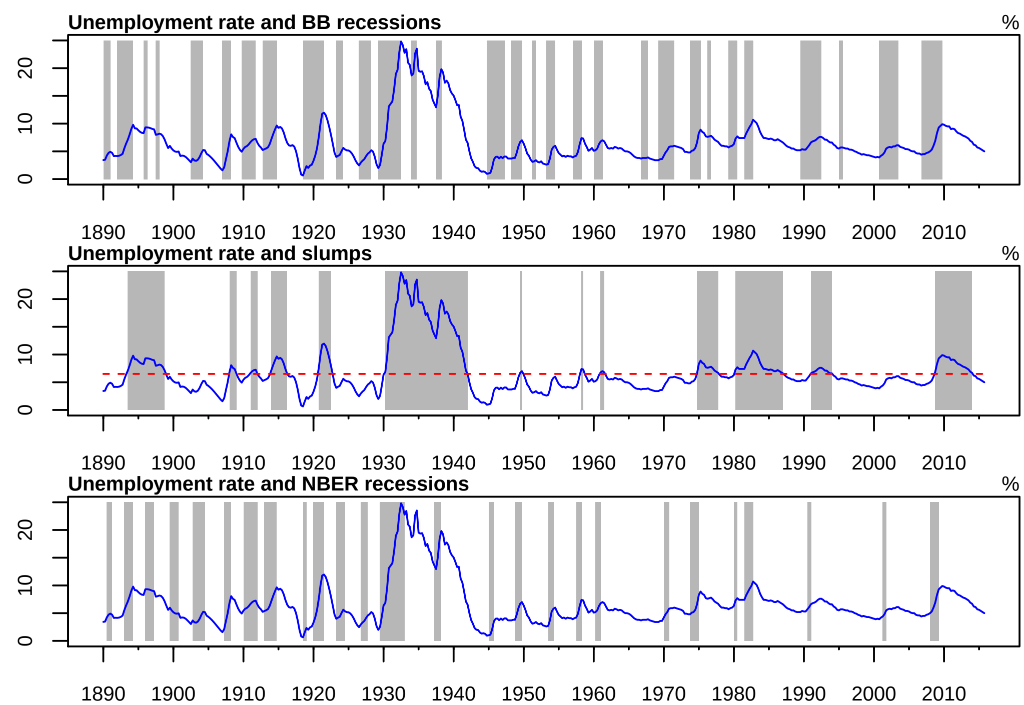
[6] For details on the implementation of the algorithm, see Bry and Boschan (1972). Harding and Pagan (2002) and Stock and Watson (2014) provide recent applications to macroeconomic data.

may be due its relatively large sampling error, are not erroneously identified as turning points (Bureau of Labor Statistics, 2017). As a point of comparison, we will perform our analysis using the NBER-defined recession chronology.

We also require a method to identify slumps and booms. We follow Ramey and Zubairy (2018) and impose a time-invariant threshold of 6.5 percent. Slumps are periods when the unemployment rate is above 6.5 percent, whereas periods when the unemployment rate is below 6.5 percent is a boom.

Figure 2 and table 1 show the series and provide summary statistics. The three panels of figure 2 plot the unemployment rate and each business cycle chronology: the BB algorithm is shown in the top panel; the second panel shows periods when the unemployment rate is above 6.5 percent; and for comparison, the final panel shows the NBER recession dates.

Figure 2: Various business cycle phases in the United States.



Notes: The blue line in each panel is the U.S. unemployment rate. Grey bars indicate the state of the economy as identified by the BB algorithm, the 6.5 percent threshold, or by the NBER business cycle dating committee. See the text for details.

The figure and summary statistics highlight importance of the chronology when measuring state-dependence. NBER-defined recessions have the shortest duration, as the NBER committee looks across many different indicators to identify the peaks and troughs in economic activity. The Bry-Boschan algorithm produces business cycle peaks that roughly coincide with those from the NBER. However, the BB recessions are somewhat longer in duration than those identified by the NBER, especially in the post-

Great Moderation period and the so-called 'jobless recoveries.' Relative to the NBER dates, the BB algorithm produces several brief false positives associated with very small upward movements in the unemployment rate (for example, 1934, 1967, 1977, and 1995), as well as one false negative (1900). There is also one period that the NBER has identified as a double-dip that the BB algorithm identifies as one long recession, 1918–1921. However, on the whole, the two recession chronologies are quite similar. This result gives us confidence that the BB algorithm applied to state-level unemployment rates will result in meaningful recession chronologies.[7]

In contrast, slumps are clearly quite different from the two recession series, since they measure the presence of economic slack and not simply whether the economy is expanding or contracting. The start of slumps roughly coincide with business cycle peaks, but have much longer duration. Indeed, slumps are only weakly correlated with NBER recessions, whereas BB recessions largely coincide with NBER recession dates.

Table 1: Summary statistics of U.S. downturns 1890–2015.

	Slump	BB recession	NBER recession
N. obs	13	29	26
Duration (quarters)			
Mean	13.9	7.5	5.6
Median	10	7	5
Std dev	13.2	3.5	2.5
Min	2	3	3
Max	48	14	15

Notes: Table shows summary statistics for three different business cycle downturns: slumps, defined as periods when the unemployment rate is above 6.5 percent; BB-defined recessions; and NBER-defined recession dates. Sample period 1890–2015, duration measured in quarters. See the text for details.

Table 2 summarizes the behavior of the unemployment rate, conditional on each phase. While the unemployment rate is about flat over slumps and booms, it clearly increases during recessions and falls during expansions, whether defined by the BB algorithm or the NBER. It is worth noting that the minimum unemployment rate occurred in 1918Q3, a quarter defined as a business cycle peak by both the BB algorithm and the NBER.

Finally, we also provide two alternative BB chronologies as a robustness check, shown in figure A.3 and table A.2. Because the BB algorithm produces chronologies that differ in their average duration and

[7] Further, in our robustness exercises, we impose further restrictions on the BB algorithm regarding the duration of business cycles. These restrictions produce a recession series that very closely mirrors the NBER recession dates, see figure A.3.

Table 2: Summary statistics of U.S. unemployment rate by business cycle phase.

	Slump	Boom	BB rec.	BB exp.	NBER rec.	NBER exp.
N. phases	13	12	29	28	26	25
Behavior of unemployment rate						
Mean change	0.1	0.0	0.5	-0.3	0.6	-0.3
Mean	10.3	4.6	6.4	6.8	7.1	6.4
Std dev	4.6	1.2	4.0	4.0	4.5	3.8
Min	6.5	0.6	0.6	0.8	0.6	0.8
Max	24.8	6.4	24.8	24.1	24.8	23.5

Notes: Table shows summary statistics of the U.S. unemployment rate, in percent, conditional on each business cycle phase. Sample period 1890–2015. See text for details.

produces several very brief false positive recession events, we compute two alternatives. In the first, we impose that the duration of the complete cycle has to be at least 7 quarters. In the second, we impose that complete business cycle has duration of at least 16 quarters. We denote these two alternatives as "prolonged (7)" and "prolonged (16)" cycles. We also provide an alternative measure of slumps and booms by identifying the trend using an HP filter.

2.2 Local business cycles

The methodology described in the previous section is also applied to state-level unemployment rate data to define state-level business cycle chronologies. However, while we use monthly data to determine the U.S. state-level chronologies our regression analysis uses annual data. We define a given state-year as recession if more than 6 months in a given year are identified as a recession.[8,9] Panel (a) of figure 3 shows Bry-Boschan state-level recession chronologies. In panel (b) we show our measure of slumps. Because we do not wish to impose the same level of the natural rate across states, we define slumps as periods when the state's actual unemployment rate is above its HP-filtered trend. Again, we identify a year as a slump if 7 or more months within that year are slumps.

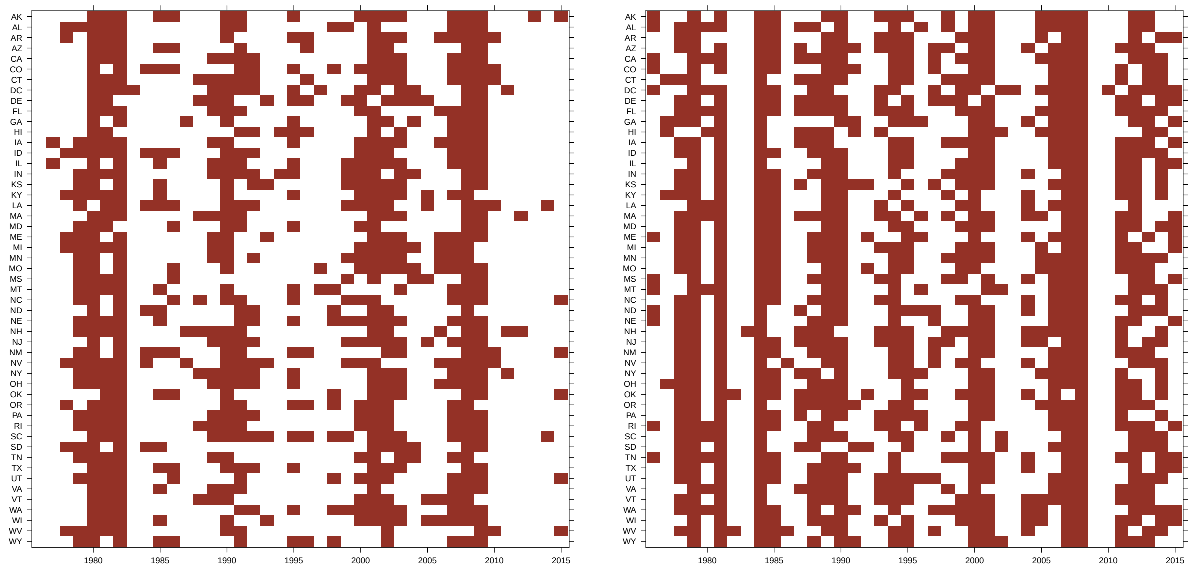
3 Data

In this paper we use both U.S. historical national data and U.S. state level data to calculate fiscal multipliers. Ramey and Zubairy (2018) collect a long time-series of U.S. quarterly data, from 1889 through

[8] Summary statistics are provided in table A.3 in Appendix.

[9] As a robustness check, we have also generated recession chronologies using a state-level coincident index as our measure of economic activity. We find that our chronologies are qualitatively unchanged.

Figure 3: State-level recession chronologies from Bry-Boschan algorithm and state-level slumps using HP filter.



(a) Recessions

(b) Slumps

Notes: Each row denotes a U.S. state, by time. Red shaded area denotes recession as determined by Bry-Boschan algorithm (left panel) or slumps as determined by the HP filter (right panel). See text for details.

2015. The data includes nominal GDP, the GDP deflator, government purchases, federal government receipts, population, the unemployment rate, interest rates, Blanchard and Perotti (2002) shocks, and news about defense spending. These news shocks represent the present value of changes in expected defense spending divided by trend nominal GDP. News about defense spending are detailed in Ramey (2011b); the series has been extended in Ramey and Zubairy (2018). The data is shown in figures A.1 and A.2. Details on the underlying sources of this data, as well as the treatment applied to create consistent series is provided in Ramey and Zubairy (2018).

Turning to the state-level data, annual state-level real GDP growth is obtained from the Bureau of Economic Analysis (BEA), and is available over the post 1976 period. We obtain two variables on military spending from Nakamura and Steinsson (2014) up to 2007, thus our sample for the analysis is 1977–2007. The first includes prime military procurement, which consists of all contracts valued over $25,000 ('prime'). The second is a broader measure including direct financial compensation to employees. The

the Bureau of Labor Statistics (BLS) also provides state-level unemployment rates, which we use to measure business cycle phases.[10]

We are also able to include many control variables in our state-level regressions. To control for state heterogeneity in the labor market, we add controls for labor market dynamism, firm size, union power, and minimum wages. Dynamism is measured through the reallocation rate, defined as the sum of job destruction and job creation rates. Firm size is measured by the average number of employees per firm. We account for differences in state minimum wages with the ratio of minimum to median wages, which are compiled using data from the BLS. Collins (2014) provides data on union power, which is defined by the absence of *right-to-work* laws in a state. The other control variables relate to the structure of the economy. The share of workers employed by the government is included since government expenditures are relatively insensitive to shocks. The share of workers employed in services controls for sectoral composition: certain industries may be more vulnerable to demand fluctuations. The data are summarized in table

Table 3: Summary statistics for state-level data and controls.

	Mean	SD	Obs.	Min.	Max.	Source
Biannual state GDP growth	5.4	5.1	1,478	-12.8	33.5	BEA
Military spending shocks						
Growth in prime military exp. - state	0.02	0.02	1,478	-5.1	4.0	NS
Growth in broad military exp. - state	0.03	0.03	1,478	-5.1	4.0	NS
Growth in prime military exp. - national	0.00	0.00	29	-0.4	0.7	NS
Growth in broad military exp. - national	0.01	0.01	29	-0.5	0.8	NS
State control variables						
Labor market dynamism	0.29	0.05	1,836	0.18	0.69	BDS
Firm size	18.8	3.2	1,836	10.4	29.3	BDS
Minimum state wage/ median state wage	0.4	0.1	1,683	0.3	0.7	CPS/BLS
Union power	0.6	0.5	1,938	0	1	Collins
Share services	0.7	0.1	1,734	0.5	0.8	CPS
Share government	0.1	0.0	1,734	0.0	0.2	CPS

Notes: BEA is Bureau of Economic Analysis; NS stands for Nakamura and Steinsson (2014); Collins stands for Collins (2014); CPS is Current Population Survey; BLS is Bureau of Labor Statistics; BDS indicates the Business Dynamics Statistics of the Census Bureau.

4 Revisiting state-dependence of the fiscal multiplier

Section 2 identified the states of the world wherein the fiscal multiplier may vary. We now turn to estimating the fiscal multiplier itself. We estimate the multiplier in two different ways. First we use the military

[10] See, https://www.bls.gov/web/laus/laumstrk.htm. We obtain our data from the FRED database, https://research.stlouisfed.org/pdl/337.

news shocks introduced by Ramey (2011b) and recently updated in Ramey and Zubairy (2018). We then turn to the panel data approach of Nakamura and Steinsson (2014).

4.1 Estimating fiscal multipliers with historical time-series

4.1.1 Empirical approach

We first identify fiscal shocks using the narrative-based fiscal policy news series of Ramey (2011b) and Ramey and Zubairy (2018). With the identified fiscal policy shocks in hand, the response of real government spending and real GDP to the news shock is measured using the local projections of Jordà (2005):

$$y_{t+h} = \alpha_{y,h} + \beta_{y,h} shock_t + \gamma_{y,h} z_{t-1} + \epsilon_{y,t+h} \tag{1}$$

$$g_{t+h} = \alpha_{g,h} + \beta_{g,h} shock_t + \gamma_{g,h} z_{t-1} + \epsilon_{g,t+h} \tag{2}$$

Here, y_{t+h} is the cumulative change in per capita GDP between t and $t+h$, g_{t+h} is the cumulative change in per capita government spending, $shock_t$ is the identified fiscal spending shock, and z is a vector of controls. The β_h coefficients in equations (1)–(2) give the average response of output or government expenditure to a military news shock in horizon h. To estimate business cycle phase-dependent effect of defense news on GDP, for example, the shocks and covariates are interacted with a dummy variable indicating the phase of the business cycle:

$$y_{t+h} = I_{t-1}\big(\alpha_{1,h} + \beta_{1,h} shock_t + \gamma_{1,h} z_{t-1}\big) + \big(1 - I_{t-1}\big)\big(\alpha_{0,h} + \beta_{0,h} shock_t + \gamma_{0,h} z_{t-1}\big) + \epsilon_{t+h}. \tag{3}$$

The fiscal multiplier can then be calculated as the ratio of the cumulative effect of the news shock to output relative to that on spending. Specifically, the cumulative multiplier m_j over an H-quarter horizon is:

$$m_j = \sum_{h=1}^{H} \beta_{y,j,h} / \sum_{h=1}^{H} \beta_{g,j,h}, \tag{4}$$

where the subscript j denotes the fact that the multiplier may be either an average response or a phase-dependent response.

An equivalent estimation of the multiplier can be obtained from an IV approach (Ramey and Zubairy, 2018). Specifically, we estimate IV regressions for each horizon h:

$$\sum_{j=0}^{h} y_{t+j} = I_{t-1}\left(\alpha_{1,h} + m_{1,h}\sum_{j=0}^{h} g_{t+j} + \gamma_{1,h} z_{t-1}\right) + \left(1 - I_{t-1}\right)\left(\alpha_{0,h} + m_{0,h}\sum_{j=0}^{h} g_{t+j} + \gamma_{0,h} z_{t-1}\right) + \omega_{t+h}, \quad (5)$$

using $I_{t-1} \times shock_t$ and $(1 - I_{t-1}) \times shock_t$ as instruments for cumulated government spending.

Before turning to the results, we discuss the exact transformations of the variables. The cumulative change in GDP is $y_{t+h} = Y_{t+h}/Y_t^p$ and the cumulative change in government spending as $g_{t+h} = (G_{t+h} - G^p)/Y_t^p$. Y^p denotes potential output and G^p is the trend in government expenditures. These transformations depart from those in Gordon and Krenn (2010); our reasoning is shown in figure 4. Per capita government spending as a share of potential output, the top panel, has a secular trend. Failing to account for this trend in the econometric specification will bias the ultimate estimate of the fiscal multiplier downwards, because the local projections will confound exogenous increases in g with the trend. We circumvent this problem by detrending g before dividing it by potential output.[11] Our resulting series is shown in the bottom panel of figure 4. Methodologically, one could interpret this as that we are calculating the multipliers of the discretionary part of government spending and so it is not surprising that the results can be sensitive to the exact transformation.[12]

4.1.2 Results

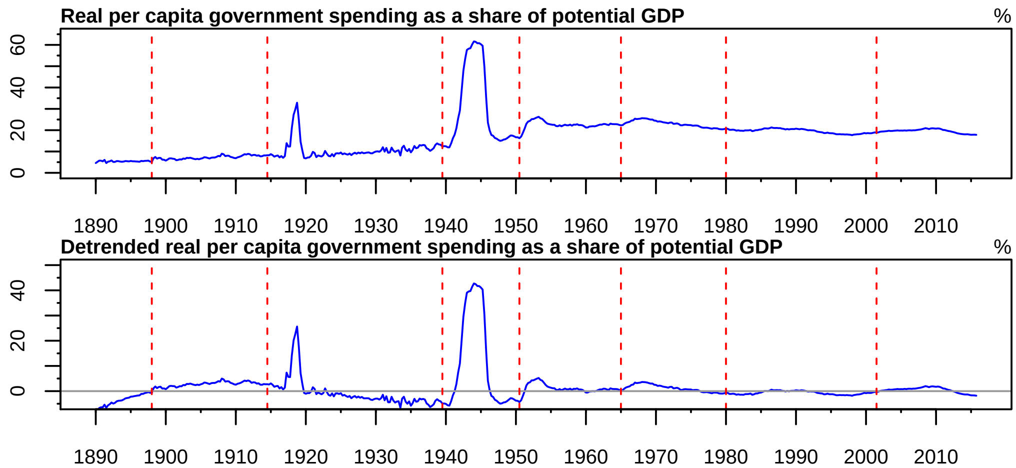
We begin by examining instrument relevance. Our first-stage regression projects cumulated real government spending at each horizon onto the news shock at period t. We consider two instrument sets: the Ramey fiscal news shocks and the Ramey fiscal news shocks alongside the Blanchard-Perotti shocks. We also condition on four lags each of GDP, government expenditure, and controls.[13] Figure 5 plots the difference between the first-stage effective F-statistics and the thresholds computed in Montiel Olea and Pflueger (2013). The purple lines are the values of the F-statistic relative to the threshold when using only the military news shocks as the instrument, while the asterisked orange line shows the value with both instruments. The figure suggests that military news has high relevance during slumps, but otherwise the

[11] This we do by regressing g on time trends up to the fourth power.

[12] Alternatively, one could control for trends in the local projection analysis. We have found that the results are very similar between these alternatives, but that one should be careful when estimating state-dependent multipliers with trends, as the two procedures described above are no longer equivalent. It is also not clear whether state-dependent trends are conceptually appropriate. Thus, we have opted to adjust the transformation of variables to control for the secular trend in g.

[13] The vector of control variables includes the ratio of GDP to potential, the ratio of government spending to potential, lags of those two controls, and lagged news shocks.

Figure 4: Real government expenditures before and after controlling for its secular trend.



Notes: Figure shows the raw and the detrended measure of real government expenditures per capita in the United States. Vertical dashed lines denote start of various wars (Spanish-American, WWI, WWII, Korean, Vietnam, response to Soviet invasion of Afghanistan, and Sept 11, 2001). See text for details.

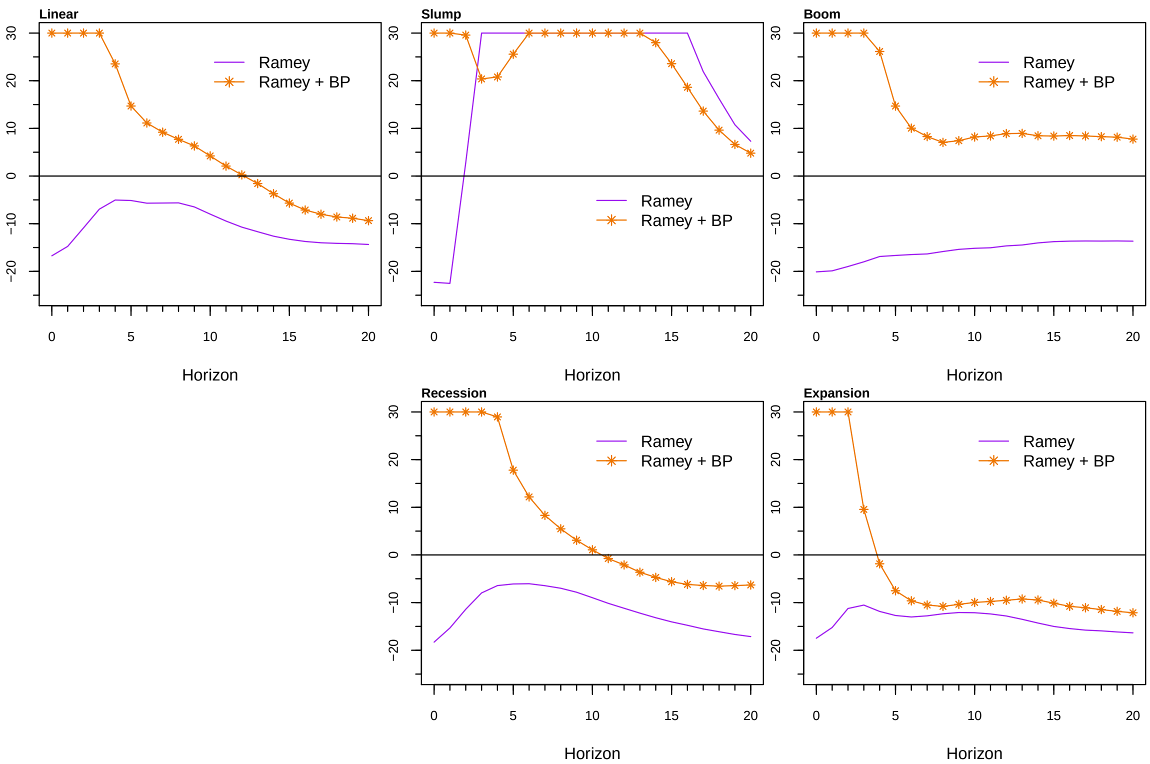
F-statistic remains below the relevant thresholds for other cases considered, including the linear case. In general, using both shocks appears to be a more powerful instrument than the military news shock alone, although at longer horizons the F-statistics tend to fall bellow the relevant thresholds.

Table 4 presents multiple estimates of the cumulative fiscal multiplier. Column 2 contains multipliers from the linear model. Columns 3-4 contains results for slumps and booms, while the rightmost columns present the results calculated over recessions and expansions. For each regression specification we cumulate the fiscal multiplier over a two year and four year period. The blocks of the table present different regression specifications. The baseline specification uses the same controls as Ramey and Zubairy (2018), but note the transformation of government expenditures is different in all our estimations. Specification 2 adjusts the regression for average tax rates and inflation. Specifications 3 and 4 use both military news shocks and Blanchard-Perotti shocks as instruments for both the full sample and excluding WWII.[14]

There is little evidence of state dependence when we compare the fiscal multiplier across slumps and booms when we instrument using only the military spending shock, but there are some signs of state dependance when we use both shocks as instruments. During periods when the unemployment rate is above 6.5 percent the cumulative two-year multiplier in the baseline specification is .76, compared to its estimated value of .57 periods when the unemployment rate is low. The null hypothesis the two estimates are the same cannot be rejected using any standard threshold. Relative to Ramey and Zubairy (2018), our

[14] In the appendix we report results using threshold VARs. Fiscal multipliers estimated using TVARs suggest little difference across the business cycle phases at the two year integral, although there is some evidence of asymmetry at four year horizon.

Figure 5: Montiel Olea and Pflueger tests of instrument relevance.



Notes: Lines show the difference between the first-stage F-statistic and the 5 percent level threshold from Montiel Olea and Pflueger (2013). Purple line uses Ramey's news variable as the instrument; asterisked orange line uses both Ramey news variable and BP shocks as instruments. Regression specified as in *Baseline* (military spending shock) in table 4. See text for details.

estimated multipliers during slumps and the linear multipliers are a touch higher. These differences are due to our slightly different transformation of government spending. When we add additional controls for taxes and inflation, the estimated multiplier increases, especially during slumps, but remains statistically indistinguishable from the boom-time multiplier. Finally, the estimates of the fiscal multiplier are below one; the only specification where slump-specific multiplier is larger than one occurs when we exclude WWII.

Results that compare recessions and expansions are somewhat different. In the baseline specification, the two-year cumulative multiplier is 1.6 in recessions, compared to .6 during expansions, a statistically relevant difference at the 5 percent level. The standard errors of the recession multipliers are significantly larger than those from the slump/boom chronologies, reflecting a relative paucity of data points during recessions. The difference between the estimated multiplier in recession versus expansion is typically not statistically different in the other specifications, although the estimated multiplier is always higher in recessions than expansions.

Table 4: Estimated fiscal multipliers.

	Linear	Above/below trend		Peak to trough (BB alg)	
	All	Slump	Boom	Recession	Expansion
1. Baseline (military spending shock)					
2 year integral	0.72	0.76	0.57	1.60	$0.64^{\dagger}$
	(0.09)	(0.11)	(0.10)	(0.42)	(0.11)
4 year integral	0.78	0.76	0.63	1.93	$0.74^{\dagger}$
	(0.06)	(0.05)	(0.10)	(0.57)	(0.08)
2. Military spending shock, taxes and inflation as additional controls					
2 year integral	0.74	0.86	0.63	1.28	0.67
	(0.09)	(0.17)	(0.10)	(0.33)	(0.09)
4 year integral	0.79	0.82	0.66	1.48	0.78
	(0.07)	(0.08)	(0.12)	(0.46)	(0.06)
3. Military spending shock + BP shocks					
2 year integral	0.50	0.83	$0.42^{\dagger}$	0.88	0.54
	(0.08)	(0.18)	(0.08)	(0.28)	(0.11)
4 year integral	0.71	0.75	$0.56^{\dagger}$	1.37	$0.69^{\dagger}$
	(0.06)	(0.05)	(0.08)	(0.41)	(0.09)
4. Military spending shock + BP shocks, excluding WWII					
2 year integral	0.47	1.94	$0.33^{\dagger}$	0.57	0.42
	(0.16)	(0.83)	(0.13)	(0.37)	(0.26)
4 year integral	0.77	1.67	0.59	1.20	0.59
	(0.35)	(0.71)	(0.31)	(0.48)	(0.52)

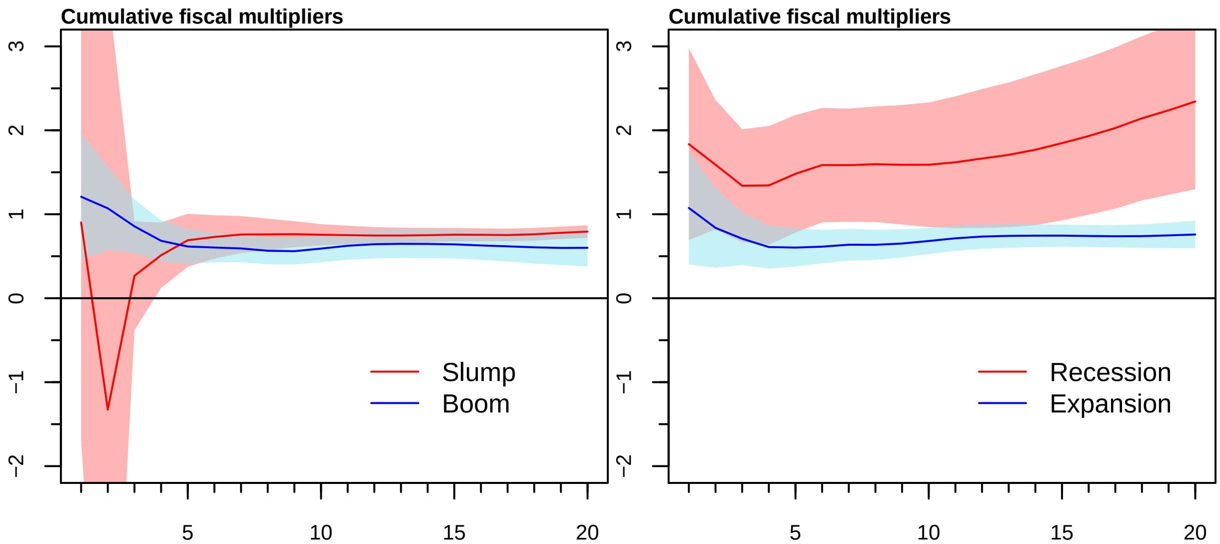
Notes: Newey-West standard errors in parentheses. BP denotes Blanchard and Perotti (2002). Specification 4 excludes observations from 1941Q3 to 1945Q4. See text for details.
† indicates that the difference across phases is statistically significant at 10 percent level.

Figure 6 presents cumulated multipliers for the baseline specification. The left panel compares booms and slumps, while the right panel shows recessions versus expansions. This figure shows a clear state-dependence in the multiplier when comparing recessions to expansions, whereas the multiplier is very similar across booms and slumps. The multiplier is always higher when a shock occurs during recession, and this difference is significant at several horizons.

To further clarify these fiscal multipliers, figure 7 show the impulse responses of real government spending and GDP to a news shock equivalent to 1 percent of GDP and under the baseline estimation. The top row shows the estimated response of government expenditure to the news shock, and the response of output is in the bottom panels. The two left panels compare booms and slumps, while the right panels show the results comparing expansions and recessions instead. The same linear multiplier is added to each graph as a reference.

The figures reveal large differences in the response of government expenditure to a military spending news shock. During slumps, the response of government expenditure to a news shock is delayed—actual government expenditure peaks four years after the shock. Further, the standard errors in the first two years after the news shock are quite narrow. These results run counter to the case studies in Ramey

Figure 6: Cumulative fiscal multipliers.

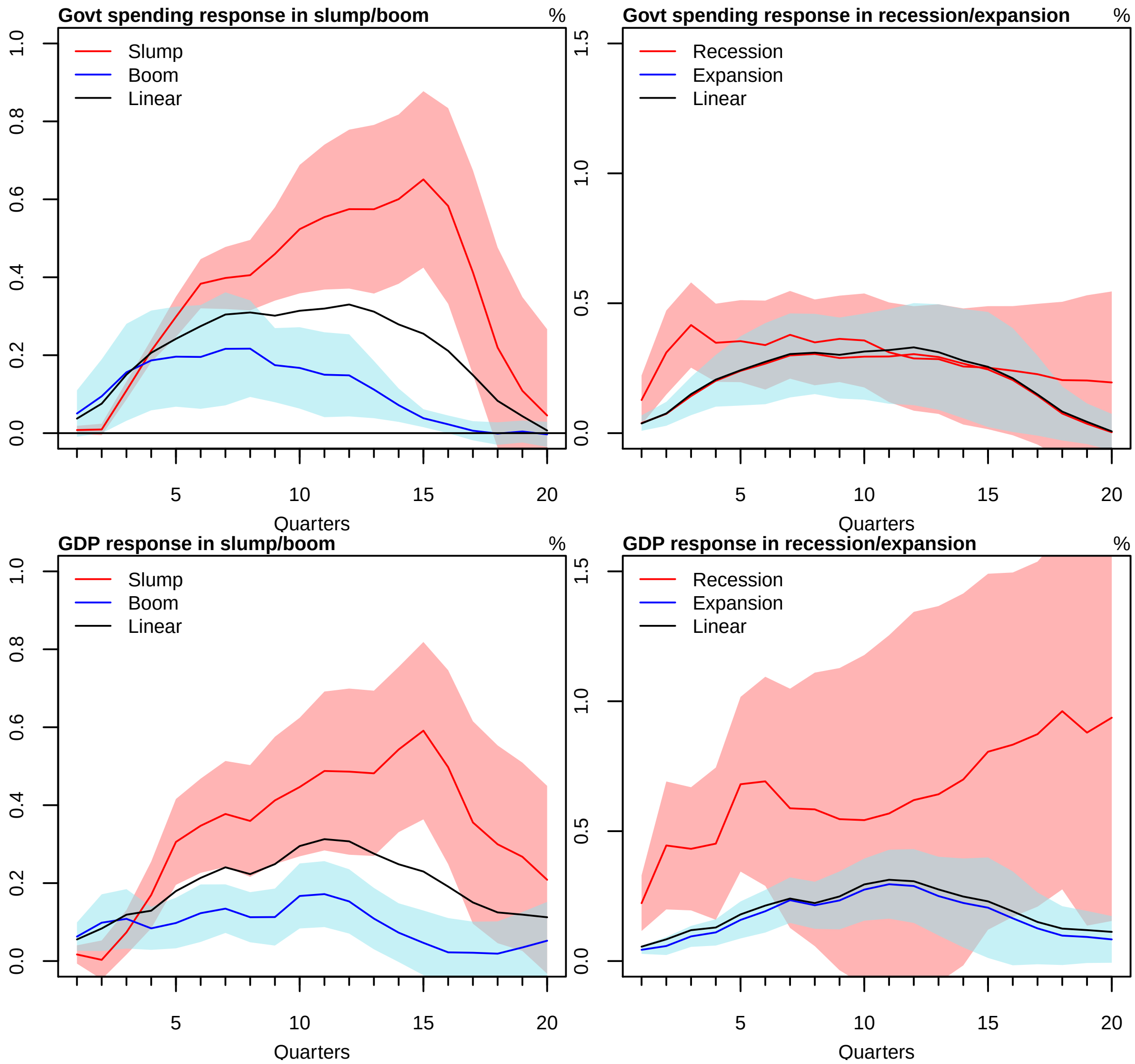


Notes: Figures show cumulative fiscal multipliers conditional on business cycle phase. Results are from the Baseline specification of table 4. Blue line represents multipliers in booms/expansions, while red line shows estimated multiplier in slumps/recession. Shaded areas denote 90 percent confidence intervals. See text for details.

(2011a) and Ramey and Zubairy (2018), which point to significant heterogeneity in the response of g. In contrast, during recessions the peak in spending happens after just three quarters. When Ramey (2011a) studies the timing of shocks in detail, she argues that it takes a few quarters after the military spending news before the military spending actually materializes, although Ramey and Zubairy (2018) present case studies where the response is further delayed, between one and two years. The three quarter peak we find during recessions is consistent with the event study for both the the Korean and the Vietnam wars. During the First and Second World Wars, government spending increased immediately following the news shocks, and peaked six to eight quarters after. In addition, during recessions government spending remains at the elevated level for several years. This is in line with the case studies of several wars mentioned above. All told, while there is substantial heterogeneity in the response of government spending after the news, we believe that the response during recessions is more consistent with the event studies mentioned above than the response shown for slumps.

Putting the responses of government expenditure and output together, one can reconcile the multipliers from figure 6 by mentally applying equation 4. In recessions, the response of government expenditure is front-loaded and peaks at a smaller level than the response during slumps. At the same time, the response of output is cumulatively larger in recessions than in expansions, especially in the first two years after the shock. (Because there are few news shocks during our identified recessions, the responses

Figure 7: Phase-specific response of government spending and GDP to a news shock.



Notes: Panels show phase-specific response of government expenditure (top row) and GDP (bottom row) to a military expenditure news shock scaled to 1 percent of GDP. Regression specification is the baseline specification in table 4. Red lines show the response in slumps (left) or recessions (right). Blue line is the response in booms (left) or expansions (right). Black lines are the response from the linear model. Shaded areas denote 90 percent confidence intervals.

of both government expenditure and output are very uncertain.) In contrast, as we can see by the response of government expenditure during slumps, the bulk of government expenditure is quite delayed from the news shock itself. Given that the average recession in our sample lasts just over 1.5 years, it is unlikely that government expenditure actually occurs during periods of severe economic distress. The response of output itself is also ultimately smaller. Overall, we view these results as supporting the idea that fiscal multipliers are larger during periods of economic distress, but emphasize that the period of time in which the multiplier is relatively large may be quite short.

4.1.3 Robustness checks

In this subsection we document the robustness of our results to several different business cycle chronologies, shown in figure A.3. The multipliers associated with these alternative chronologies are given in table 5. The first alternative chronology we calculate is an alternative slumps/boom chronology, where we define slumps as periods when the unemployment rate is below or above its HP-filter implied trend. The results are qualitatively similar to those for slumps and booms based on a fixed threshold of 6.5 percent. For the chronology based on the HP filter trend, the multiplier is always estimated to be higher in slumps than in booms, but as before, the difference is not statistically meaningful.

Next, we recompute fiscal multipliers under three different definitions of recession. The resulting estimates of the fiscal multiplier are in the remaining columns of table 5. Our results are on the whole robust to the alternative recession/expansion chronologies. For each chronology and regression specification, we find that the multiplier is higher in recession than in expansion, although the difference is not always statistically relevant. The estimated multiplier in expansions is typically around 0.5, while in recession, the estimated multiplier often exceeds one. Since the NBER business cycle chronology is quite similar to the chronology based on the Bry-Boschan algorithm, it is not surprising that the results using the NBER's chronology are by and large similar to those presented in the previous section. The results of the two prolonged BB chronologies are also quite similar to the original results.

4.2 State-level analysis using military spending shocks

We next show that we again find evidence that the fiscal multiplier varies across the business cycle when we follow the approach of Nakamura and Steinsson (2014). Nakamura and Steinsson identify exogenous variation in state-level fiscal policy by assuming that the federal government does not alter national spending in response to the relative performance of the U.S. states.[15] This approach has the advantage that it introduces a panel element to the data, which may improve the precision of the estimates of the fiscal multiplier. Since we produce business cycle chronologies at the state level, we add tests of whether the multiplier differs across the four business cycle phases.

[15] Compared to the analysis in Nakamura and Steinsson (2014), we use a shorter sample, without the Korean war, as advocated by Dupor and Guerrero (2017).

Table 5: Estimated fiscal multipliers:alternative chronologies.

	Linear	Above/below HP filter trend		NBER chronology		BB (prolonged 7)		BB (prolonged 16)	
	All	Slump	Boom	Recession	Expansion	Recession	Expansion	Recession	Expansion
1. Baseline (military spending shock)									
2 year integral	0.72	0.73	0.60	1.36	0.59	1.88	0.62†	1.65	0.64†
	(0.09)	(0.25)	(0.10)	(0.56)	(0.13)	(0.63)	(0.12)	(0.44)	(0.11)
4 year integral	0.78	0.77	0.65	1.98	0.70†	2.30	0.73†	2.00	0.74†
	(0.06)	(0.20)	(0.16)	(0.69)	(0.10)	(0.70)	(0.08)	(0.58)	(0.08)
2. Military spending shock, taxes and spending as additional controls									
2 year integral	0.74	0.94	0.74	1.20	0.67	1.50	0.67	1.29	0.67
	(0.09)	(0.34)	(0.12)	(0.52)	(0.08)	(0.49)	(0.09)	(0.34)	(0.09)
4 year integral	0.79	0.93	0.76	1.64	0.77	1.75	0.76†	1.48	0.78
	(0.07)	(0.26)	(0.17)	(0.74)	(0.06)	(0.57)	(0.06)	(0.46)	(0.06)
3. Military spending shock + BP shocks									
2 year integral	0.50	0.63	0.42	0.95	0.50	1.02	0.54	0.88	0.54
	(0.08)	(0.21)	(0.09)	(0.44)	(0.12)	(0.31)	(0.11)	(0.27)	(0.11)
4 year integral	0.71	0.78	0.53	1.60	0.64†	1.50	0.69†	1.38	0.69†
	(0.06)	(0.21)	(0.13)	(0.50)	(0.11)	(0.40)	(0.09)	(0.40)	(0.09)
4. Military spending shock + BP shocks, excluding WWII									
2 year integral	0.47	0.80	0.35	1.02	0.44	0.50	0.43	0.53	0.41
	(0.16)	(0.41)	(0.17)	(0.70)	(0.29)	(0.36)	(0.30)	(0.37)	(0.25)
4 year integral	0.77	1.17	0.53	1.77	0.57	1.07	0.63	1.13	0.54
	(0.35)	(0.51)	(0.38)	(0.62)	(0.52)	(0.44)	(0.52)	(0.48)	(0.51)

Notes: Newey-West standard errors in parentheses. BP denotes Blanchard and Perotti (2002). Alternative chronologies calculated as: above/below HP filter trend; NBER recession chronology; BB algorithm with minimum duration of seven quarters; BB algorithm with minimum cycle of 16 quarters. Regression specification 4 excludes observations from 1941Q3 to 1945Q4. See text for details.
† indicates that the difference across phases is statistically significant at 10 percent level.

Nakamura and Steinsson (2014) estimate a two-stage instrumental variables regression. In the first stage, the change in military spending at the state level is regressed onto the change in national military spending and controls:

$$\Delta\mu_{s,t} = \beta_s \Delta\mu_{nat,t} + I_{s,t-1}\big(\alpha_{1,s} + \xi_{1,s}(L)z_t\big) + \big(1 - I_{s,t-1}\big)\big(\alpha_{0,s} + \xi_{0,s}(L)z_t\big) + \Phi_s^{'} c_{s,t} + \epsilon_{s,t}, \tag{6}$$

where μ_s and μ_{nat} are biannual changes in state and federal military expenditure as a percentage of GDP, z is a vector of controls, and c are fixed effects. I_{st} is the dummy variable that indicates the state of the business cycle in state s at period t. The second stage regression regresses the fitted values from the first stage onto state-level GDP:

$$\Delta y_{s,t} = I_{s,t-1}\big(\alpha_{0,s} + \psi_{0,s}(L)z_t + \gamma_0 \Delta\widehat{\mu}_{s,t}\big) + \big(1 - I_{s,t-1}\big)\big(\alpha_{1,s} + \psi_{1,s}(L)z_t + \gamma_1 \Delta\widehat{\mu}_{s,t}\big) + \phi_s^{'} c_{s,t} + \eta_{s,t}, \tag{7}$$

where Δy measures biannual growth in state GDP while $\widehat{\mu}$ denotes the fitted value of equation 6. The parameters γ_0 and γ_1 capture the phase-dependent multipliers. It is worth emphasizing that these equations estimate an open economy relative multiplier for federal spending, which quantifies increases in state GDP relative to others after increases in military expenditure. Thus, caution should be used when comparing these multipliers to those calculated in section 4.1.[16]

Table 6 present estimates of the open-economy multiplier. The first row of the table presents regression estimates that include only time fixed effects. Again, each subsequent row presents alternate specifications. The linear regression estimates a fiscal multiplier of 1.5–2. These values imply that a 1 percent increase of relative military spending as a percentage of state GDP increases its GDP relative to other states by 1.5–2 percent within two years of the increase in spending. Turning to the phase-dependent estimates, we find very little evidence that the open-economy fiscal multiplier differs across slumps and booms. Indeed, for many of the regression specifications, the point estimate of the fiscal multiplier during slumps is actually smaller than that from booms, although neither are precisely estimated. In contrast, we find evidence that the multiplier varies depending on whether the state is in recession or expansion. The point estimate of the fiscal multiplier in recession is notably higher, around 2.5, whereas in expansions,

[16]In the Nakamura and Steinsson (2014) dataset, the dates that military contracts were awarded are available but the exact timing of the actual expenditure is not known. We calculate the multipliers at the horizon of two years, similar to our analysis using national data. This biannual specification is consistent as long as the majority of funds is spent within two years of assignment. However, the result of this assumption is that the exact timing of the fiscal spending shocks is unclear, and for this reason we are not able to calculate local projections.

the multiplier is about one. However, the standard errors of these estimates tend to be large, such that we usually cannot reject the null hypothesis that the multiplier is the same in the two phases of the business cycle.

Table 6: Open-economy fiscal multipliers by business cycle phase.

	Linear	Above/below trend		Peak to trough (BB alg)	
	All	Slump	Boom	Recession	Expansion
1. Baseline (year fixed effects only)					
Two year integral	1.97	1.96	1.97	2.58	1.03
	(0.66)	(1.08)	(0.94)	(1.08)	(1.57)
2. Year fixed effects; size of military					
Two year integral	1.60	1.18	1.46	3.07	-0.31†
	(0.68)	(0.86)	(0.82)	(0.85)	(0.96)
3. Year and state fixed effects; size of military					
Two year integral	2.02	2.09	1.95	2.77	0.65
	(0.68)	(1.19)	(1.01)	(1.16)	(1.57)
4. Year and state fixed effects; size of military; labor market/industry					
Two year integral	1.82	1.81	1.94	2.63	0.71
	(0.58)	(0.95)	(1.12)	(0.88)	(1.30)
5. Year and state fixed effects; size of military; labor market/industry; lagged dep. var.					
Two year integral	1.69	1.59	1.61	2.33	0.74
	(0.47)	(0.77)	(0.71)	(0.72)	(1.01)

Notes: Standard errors clustered by time and state. Number of observations varies from 1,223 to 1,325.
† indicates that the difference across phases is statistically significant at 10 percent level.

Rows 2-5 in table 6 show that the results are broadly robust to various regression specifications. The regressions in row 2 control for the level of military expenditure as a percent of state GDP, since particular cyclically sensitive industries are likely particularly sensitive to defense spending. Row 3 adjusts the regressions with state fixed effects. In row 4, we add controls for state labor market institutions and the sectoral composition. Finally, the last specification adjusts for a lagged dependent variable. Table 7 presents results from identical specifications but in these regressions, military expenditure includes both direct compensation and prime spending. Results across both sets of tables are qualitatively similar: whereas we find no evidence that the multiplier differs in periods of slack versus boom, there is evidence that the multiplier is larger when the economy is in recession versus periods of expansion.

Lastly, given the large amount of data we now have at our disposal, we evaluate the multiplier in each of the four stages of the business cycle we described in figure 1. Table 8 reports results for each individual business cycle phase. We find that point estimates of the fiscal multiplier in stages II and III of the cycle—periods when the unemployment rate is increasing—are always higher than the other stages, although the differences is not always statistically meaningful. The table also shows why the multipliers are not

Table 7: Open-economy fiscal multipliers by business cycle phase (direct compensation + prime spending).

	Linear	Above/below trend		Peak to trough (BB alg)	
	All	Slump	Boom	Recession	Expansion
1. Baseline (year fixed effects only)					
Two year integral	1.71	1.50	1.86	2.34	0.83
	(0.67)	(0.92)	(0.77)	(0.93)	(1.22)
2. Year fixed effects; size of military					
Two year integral	1.24	0.78	1.13	2.62	-0.40†
	(0.63)	(0.78)	(0.72)	(0.77)	(0.78)
3. Year and state fixed effects; size of military					
Two year integral	2.57	2.55	2.58	3.30	1.45†
	(0.71)	(0.98)	(0.86)	(1.01)	(1.31)
4. Year and state fixed effects; size of military; labor market/industry					
Two year integral	2.17	2.31	2.30	2.96	1.29†
	(0.61)	(0.81)	(0.79)	(0.74)	(1.06)
5. Year and state fixed effects; size of military; labor market/industry; lagged dep. var.					
Two year integral	1.84	1.80	1.71	2.55	1.01†
	(0.44)	(0.52)	(0.43)	(0.55)	(0.68)

Notes: Standard errors clustered by time and state. Number of observations varies from 1,223 to 1,325.
† indicates that the difference across phases is statistically significant at 10 percent level.

different between slumps and booms, since each of these periods is comprised of periods in time with increasing or decreasing unemployment rate, and therefore high and low multipliers.

4.2.1 Robustness checks

We perform several robustness checks of our estimated open-economy fiscal multipliers. As before, we check for the robustness using a different definition of recessions and/expansions.[17] Results using these alternative chronologies—the NBER dates and the two prolonged Bry-Boschan chronologies—are reported in table 9.

The evidence for phase-dependence of the fiscal multiplier using these alternate specifications is more mixed. For the NBER chronology, we find that the multiplier is actually *smaller* in recessions for certain regression specifications. In contrast, alternative BB algorithms again show evidence that multipliers differ across recessions and expansions. Indeed, the difference between recessions and expansions is often more pronounced under these alternative chronologies and more often statistically significant at standard levels.

[17] Because we do not believe the 6.5 percent threshold is sensible for all states, our baseline slump/boom chronology is based on each state's HP filtered unemployment rate. We do not present results for an alternative slump/boom chronology.

Table 8: Estimated open economy fiscal multipliers by phase of business cycle.

	Linear	Stage I		Stage II	
	All	Stage I	Other stages	Stage II	Other stages
1. Baseline (year fixed effects only)					
Two year integral	1.97	0.88	2.37	2.93	1.58
	(0.66)	(1.41)	(0.99)	(1.24)	(1.08)
2. Year fixed effects; size of military					
Two year integral	1.60	0.15	1.76	3.31	0.75†
	(0.68)	(0.88)	(0.87)	(1.12)	(0.74)
3. Year and state fixed effects; size of military					
Two year integral	2.02	0.55	2.42	3.05	1.54
	(0.68)	(1.24)	(1.10)	(1.38)	(1.16)
4. Year and state fixed effects; size of military; labor market/industry					
Two year integral	1.82	1.28	1.90	3.18	1.64
	(0.58)	(1.23)	(0.99)	(1.20)	(0.95)
5. Year and state fixed effects; size of military; labor market/industry; lagged dep. var.					
Two year integral	1.69	1.37	1.65	2.29	1.51
	(0.47)	(0.89)	(0.75)	(0.98)	(0.71)

	Linear	Stage III		Stage IV	
	All	Stage III	Other stages	Stage IV	Other stages
1. Baseline (year fixed effects only)					
Two year integral	1.97	2.22	1.85	1.46	2.04
	(0.66)	(1.28)	(1.08)	(2.12)	(0.93)
2. Year fixed effects; size of military					
Two year integral	1.60	3.15	0.67†	-0.36	1.84†
	(0.68)	(0.82)	(0.86)	(1.28)	(0.75)
3. Year and state fixed effects; size of military					
Two year integral	2.02	2.48	1.79	1.34	2.13
	(0.68)	(1.38)	(1.13)	(1.94)	(1.04)
4. Year and state fixed effects; size of military; labor market/industry					
Two year integral	1.82	2.43	1.33	1.23	1.97
	(0.58)	(0.91)	(1.24)	(1.57)	(0.95)
5. Year and state fixed effects; size of military; labor market/industry; lagged dep. var.					
Two year integral	1.69	2.26	1.22	0.65	1.81
	(0.47)	(0.73)	(0.85)	(1.42)	(0.71)

Notes: Table reports estimates from the two-stage GMM estimator in equations 6 and 7. Phases correspond to those labeled in figure 1. Numbers in parentheses are standard errors, clustered by time and state. Number of observations varies from 1,223 to 1,325.
† indicates that the difference across phases is statistically significant at 10 percent level.

5 Conclusion

This paper studies fiscal multipliers over different stages of the business cycles using two distinct approaches to estimating the multiplier. The first is based on a long time-series of national-level data, whereas the second introduces a panel element by looking at the effects of fiscal expenditure across U.S. states. We view the bulk of the evidence presented here as supporting the idea that the fiscal spending multiplier is likely larger in recessions than expansions. We usually find that the point estimate of the fiscal multiplier is higher in periods of time when the unemployment rate is increasing relative to periods when it is decreasing. In contrast, there is scant evidence that the multiplier varies when the unemploy-

Table 9: Estimated open economy fiscal multipliers, alternative chronologies.

	Linear	NBER		BB (prolonged 7)		BB (prolonged 16)	
	All	Recession	Expansion	Recession	Expansion	Recession	Expansion
1. Baseline (year fixed effects only)							
Two year integral	1.97	1.85	2.02	2.06	1.14	2.10	1.72
	(0.66)	(0.80)	(1.24)	(1.01)	(1.35)	(1.15)	(1.95)
2. Year fixed effects; size of military							
Two year integral	1.60	1.44	1.09	2.82	-0.55†	3.18	-0.41†
	(0.68)	(1.32)	(0.84)	(0.77)	(0.79)	(0.84)	(1.02)
3. Year and state fixed effects; size of military							
Two year integral	2.02	1.58	2.23	3.21	1.43	2.58	0.62
	(0.68)	(0.82)	(1.33)	(1.12)	(1.60)	(1.25)	(2.21)
4. Year and state fixed effects; size of military; labor market/industry							
Two year integral	1.82	0.65	2.09	3.18	0.57†	2.73	-0.17†
	(0.58)	(0.82)	(1.20)	(0.66)	(1.02)	(0.71)	(1.46)
5. Year and state fixed effects; size of military; labor market/industry; lagged dep. var.							
Two year integral	1.69	0.68	1.79†	2.97	0.20†	2.60	-0.30†
	(0.47)	(0.57)	(0.84)	(0.56)	(0.73)	(0.63)	(1.26)

Notes: Table reports estimates from the two-stage GMM estimator in equations 6 and 7. Phases correspond to those labeled in figure 1. Numbers in parentheses are standard errors, clustered by time and state. Number of observations varies from 1,223 to 1,325.
† indicates that the difference across phases is statistically significant at 10 percent level.

ment rate is above or below its trend. We interpret these results as a simple possible synthesis of the often conflicting results found in the literature that measures the fiscal multiplier.

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A Online appendix (not for publication)

A.1 Estimates from a threshold VAR

We also employ a threshold VAR approach, as in Auerbach and Gorodnichenko (2012b) and section 6 of Ramey and Zubairy (2018). We write the threshold VAR in reduced-form:

$$Y_t = I_{t-1}\Psi_1(L)Y_{t-1} + \left(1 - I_{t-1}\right)\Psi_0(L)Y_{t-1} + u_t, \tag{8}$$

where I indicates the phase of the economy, $\Psi(L)$ is a lag polynomial of VAR coefficients, $u_t \sim N(0,\Omega)$, and $\Omega = I_{t-1}\Omega_1 + \left(1 - I_{t-1}\right)\Omega_0$.

Military news shocks are identified using a Choleski decomposition with the following ordering $Y = [news_t, g_t, y_t]$. Our measures of government spending, g_t, and output, y_t, are as in the main text.

Table A.1 presents the results. Each panel gives the estimated multiplier using a particular estimated business cycle chronology. The top row gives our baseline results, using the 6.5 percent threshold and the BB algorithm, respectively. The middle and bottom rows present results using the alternative chronologies.

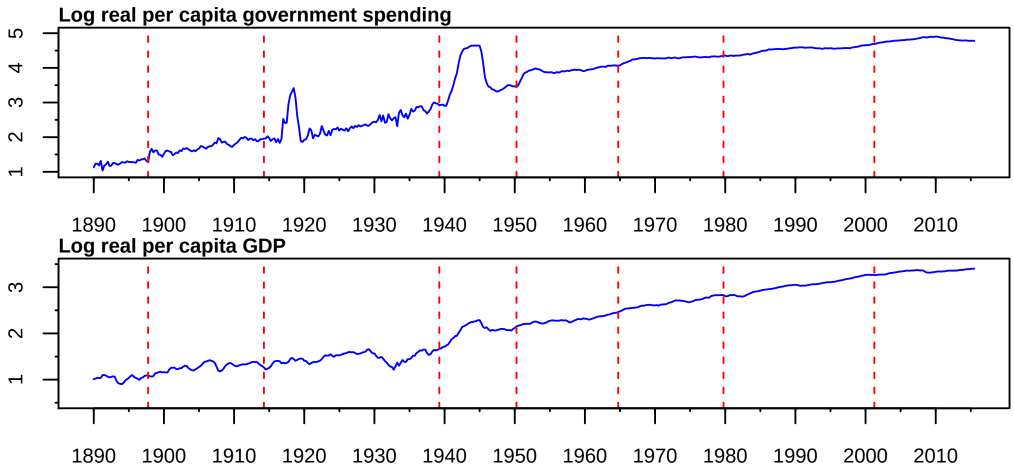
Table A.1: Estimates of Multipliers across the Cycle

	Linear	Above/below trend		Peak to trough (BB alg)	
	All	Slump	Boom	Recession	Expansion
2 year integral	0.66	0.81	0.55	1.04	0.60
4 year integral	0.79	1.68	0.60	1.35	0.63
	Linear	NBER Business Cycle		Prolonged Peak to Trough (BB alg)	
	All	Recession	Expansion	Recession	Expansion
2 year integral	0.66	1.26	0.55	1.96	0.61
4 year integral	0.79	1.51	0.65	2.39	0.64
	Linear	Above/Below Trend(HP filter)		Alt. Peak to Trough (BB alg)	
	All	Recession	Expansion	Recession	Expansion
2 year integral	0.66	0.72	0.77	1.05	0.63
4 year integral	0.79	1.28	0.68	1.35	0.65

Notes: Table gives estimated fiscal multipliers from a threshold VAR. Top row gives results from our baseline slump/boom and recession/expansion chronologies. Middle and bottom rows give results from alternative chronologies. See text for details.
† indicates that the difference across phases is statistically significant at 10 percent level.

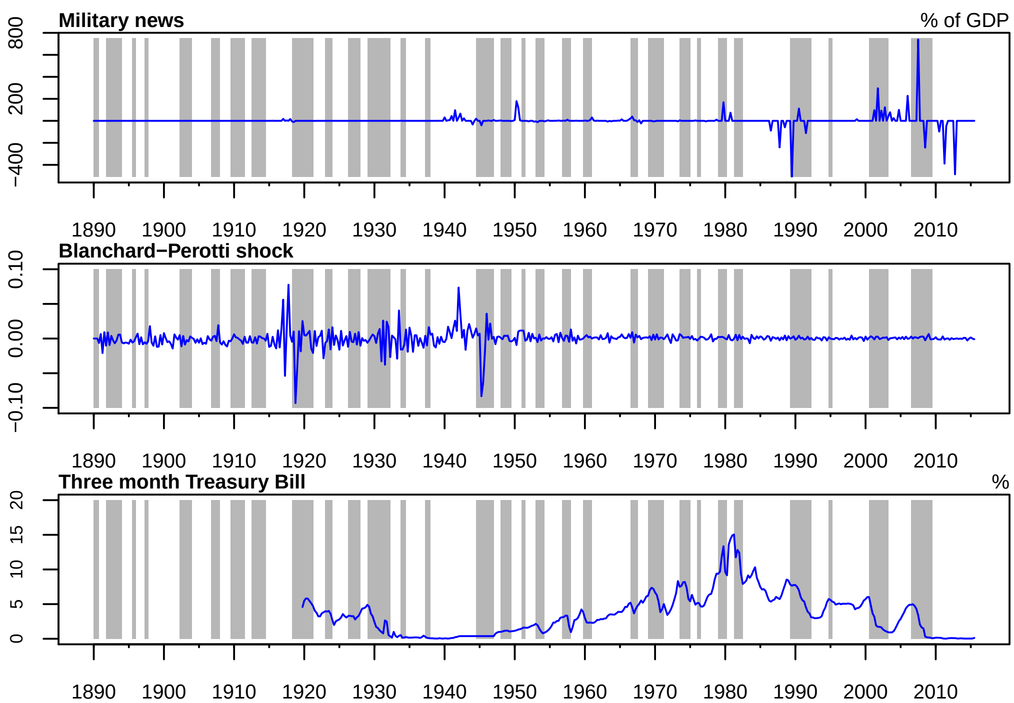
A.2 Additional figures and tables

Figure A.1: Real per capita output and government expenditure.



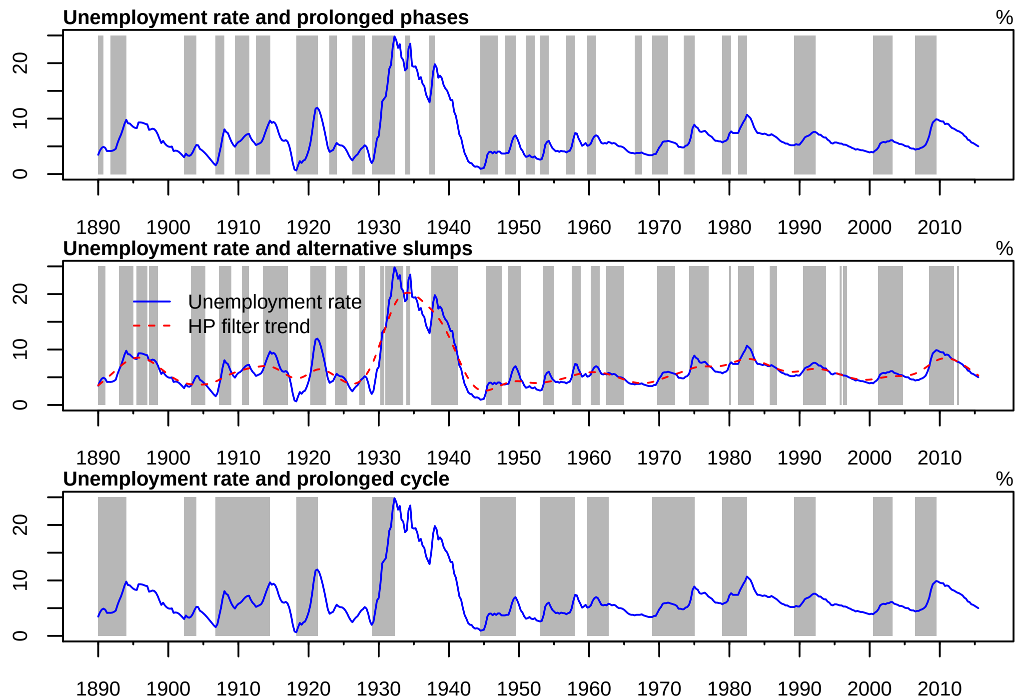
Notes: Figure shows raw data from Ramey and Zubairy (2018). Vertical dashed lines denote start of various wars (Spanish-American, WWI, WWII, Korean, Vietnam, response to Soviet invasion of Afghanistan, and Sept 11, 2001).

Figure A.2: Military spending news, Blanchard-Perotti shock, and Treasury bill.



Notes: Figure shows raw data from Ramey and Zubairy (2018). Gray shaded bars denote baseline BB-defined recessions.

Figure A.3: Alternative business cycle chronologies.



Notes: The blue line in each panel is the U.S. unemployment rate, and is the same across panels. Red dashed line in middle panel shows the unemployment rate trend as defined by the HP filter. Each panel's grey bars indicate the business cycle phase as determined by: BB algorithm with prolonged phases; alternative trend unemployment rate; BB algorithm with prolonged complete cycle. See the text for details.

Table A.2: Summary statistics of U.S. downturns 1890–2015, alternative definitions.

	BB recession: prolonged	HP Slumps	BB recession: alternative
N. phases	13	33	26
Mean duration (qtrs)	16	7	7
Median duration (qtrs)	13	7	6
Min duration (qtrs)	7	1	3
Max duration (qtrs)	31	15	13

Notes: Table shows summary statistics for three alternative business cycle downturns: the prolonged Bry-Boschan recession dates, the alternative Bry-Boschan recession dates, and HP filter Slumps. Sample period 1890–2015, duration measured in quartes. See the text for details.

Table A.3: Summary statistics for state-level recessions and expansions.

	Recessions					Expansions				
State	Count	Median	Std. dev.	Min.	Max	Count	Median	Std. dev.	Min.	Max
AK	8	21	12	8	40	7	37	18	7	61
AL	5	25	16	17	55	5	69	29	12	89
AR	4	27	13	14	39	4	66	47	47	147
AZ	6	21	7	11	30	6	54	34	10	101
CA	4	39	6	33	46	4	71	23	39	94
CO	8	19	13	10	43	8	25	19	10	62
CT	6	37	19	11	57	6	41	13	18	58
DC	8	24	14	11	48	8	24	21	6	65
DE	7	24	10	11	42	7	28	25	7	70
FL	4	41	11	22	46	4	68	20	49	96
GA	9	11	10	8	36	9	23	23	6	70
HI	6	26	13	10	44	6	42	37	7	101
IA	5	39	17	12	54	5	46	36	17	107
ID	6	29	5	22	37	6	44	33	6	92
IL	7	20	15	13	55	7	34	21	6	71
IN	5	25	8	21	40	5	70	46	7	126
KS	7	20	14	11	55	7	43	26	10	75
KY	6	20	21	12	66	6	37	38	14	107
LA	9	29	15	8	49	9	16	19	8	63
MA	4	33	9	26	47	4	67	24	52	108
MD	6	26	12	12	43	6	45	16	34	70
ME	5	29	7	22	40	5	69	41	8	115
MI	5	27	12	19	47	5	74	40	10	105
MN	5	26	14	19	55	5	74	35	11	93
MO	5	22	20	11	58	5	70	42	10	105
MS	6	20	14	11	47	6	37	37	19	115
MT	6	19	14	14	46	6	42	24	19	84
NC	7	23	10	11	36	6	47	25	11	83
ND	7	18	5	12	26	7	54	27	12	79
NE	6	27	20	16	65	6	36	21	19	74
NH	4	31	16	19	52	4	71	25	55	111
NJ	6	25	14	10	41	6	47	37	8	92
NM	8	25	8	12	36	7	44	19	8	59
NV	4	48	10	38	57	4	63	16	48	87
NY	5	35	16	13	53	5	43	32	16	101
OH	5	40	16	13	54	5	61	21	30	74
OK	8	17	9	8	32	7	35	25	10	82
OR	6	25	10	11	39	6	42	29	9	86
PA	4	38	5	36	46	4	71	19	48	93
RI	4	42	8	31	48	4	71	21	44	95
SC	7	32	14	14	53	7	21	24	7	73
SD	5	23	18	14	59	5	33	70	7	179
TN	7	24	14	8	47	7	36	30	7	78
TX	7	27	9	9	32	7	41	23	10	74
UT	7	17	17	9	55	6	48	17	18	64
VA	5	34	11	14	38	5	59	31	18	102
VT	5	37	14	14	48	5	63	40	6	105
WA	4	36	16	30	64	4	67	19	46	92
WI	4	33	18	11	49	4	80	19	56	98
WV	5	23	17	12	57	4	74	28	49	113
WY	6	21	9	12	35	6	50	39	6	114

Notes: Table shows characteristics of completed state-level business cycle phases from Bry-Boschan algorithm, January 1976–December 2015. Median, standard deviation, minimum and maximum indicate phase duration in months. See text for details.