

THE REGIONAL EFFECTS OF MONETARY POLICY: THE CASE OF THE AMERICAN SOUTH

David Beckworth
Department of Economics
Western Kentucky University
david.beckworth@wku.edu

A number of studies over the past decade find that US monetary policy generates asymmetric effects on regional economies. These studies further find that the variation in industry composition across US regions is a key reason for these regional effects of monetary policy. One implication from these findings is that should a US region undergo a major restructuring of its economy that region would likely find its response to monetary policy shocks to change as well. This possibility is explored in this article by examining the regional effect of monetary policy shocks during and after the dramatic economic transformations of the American South in the twentieth century.

Introduction

What are the consequences of having a one-size-fits-all monetary policy for the large US economy? One consequence, according to a number of recent studies, is that US monetary policy often generates very different regional effects. These studies show that the economies of some US regions are highly sensitive to monetary policy shocks while others are not. These studies further find that differences in industry composition across US regions is a key reason for the asymmetric regional effects of monetary policy (Gerald Carlino and Robert Defina 1998, 1999a, 1999b;

Ted Crone 2005, 2007; Michael Owyang and Howard Wall 2005, 2008).¹ Collectively, these studies imply that should a US region undergo a major restructuring of its economy that region would likely find its response to monetary policy shocks to change as well. This possibility is explored explicitly for the first time in this article by examining the regional effect of monetary policy shocks during and after the dramatic economic transformations of the American South in the twentieth century. From the close of the Civil War up through World War II the South's economy had been relatively undeveloped and isolated from the rest of the United States. Suddenly, though, this region's economy started modernizing in the 1940s and began to converge with the rest of the US economy over the next forty years (Gavin Wright 1986). Along the way there were significant structural changes in the South's economy. It went from being a largely closed and predominantly agricultural-based economy to an open and more diversified one. These changes make the South's economy over this time a kind of natural experiment for testing whether the regional effects of monetary policy shocks do in fact change in response to a restructuring of a regional economy.

This article undertakes its task by using impulse response functions (IRFs) from estimated vector autoregressions (VARs) to examine the effect of monetary policy shocks on nominal income for the states that comprise the American South—defined here as the 11 states of the former Confederacy—before and after 1980. Most observers believe that by 1980 the South had largely completed its convergence with the national economy (Wright, 1986; Kris Mitchener and Ian McLean, 1999; Francesco Caselli and Wilbur Coleman, 2001; Edward Glaeser and Kristina Tobio, 2008).² Consequently, by comparing monetary policy

¹ Industry composition has also been found to be important in explaining regional responses to monetary policy shocks within other countries (Ivo Arnold and Evert Vrugt 2004) and across countries (Georgios Georgiadis 2014).

² Ideally, we would compare the estimated IRFs from the post-1980 period to the IRFs from the pre-1940 period before the convergence

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shock-generated IRFs in this region before and after 1980 this article exploits the important change in the economy of the American South as a way to test whether monetary policy's effectiveness depends on the structure of industry.

One potential issue with this analysis is that the time period around 1980 is known in macroeconomics as the beginning of a new US monetary policy regime where managing inflation was taken more seriously (John Taylor 1999; Richard Clarida et al. 2000; Jean Boivin and Mark Giannoni 2006).³ To account for this development, state IRFs are carefully compared to the national IRFs to determine whether the changes in the state IRFs are more than just changes in the systematic conduct of monetary policy. The article also examines shorter periods within the convergence and post-convergence periods to confirm the results are robust to this change in monetary policy.⁴

Looking ahead to the conclusions, this article finds that for the convergence period many states in the South responded to a sudden tightening of monetary policy in a significantly different and more severe manner than that for the United States as a whole. During the post

process began. Collection of high-frequency regional economic data, however, began in the 1940s and therefore we are limited to using the convergence period.

³ Boivin and Giannoni (2006) report several years in the early 1980s when one could make the case for a structural break in the conduct of US monetary policy. They show, however, that 1980 serves as a good estimate of the actual break.

⁴ Another reason to compare national IRFs to state IRFs is that US banking became more integrated during the post-convergence period. Donald Morgan et al. (2004) show the advent of out-of-state bank holding companies and interstate banking in the 1980s and 1990s caused business cycles across states to become more similar. This implies that monetary policy should have a more uniform effect nationally during this period and reduce the asymmetric regional effects of monetary policy. Therefore, it is important to compare changes in the states to national changes to control for this influence.

convergence period, though, the state responses are closer to and in some cases less severe than the national response. Given these findings, the article uses cross-sectional regression methods to assess whether the changing industry structure in the Southern states over this time can explain some of the change in the states' IRFs. The regressions suggest that about two-thirds of the IRF changes can be attributed to the increased industry diversification of the Southern economy.

Related Literature on the Regional Effects of Monetary Policy and the American South

A number of studies examine whether US monetary policy shocks create asymmetric effects on regional economies. Carlino and Defina (1998, 1999a, 1999) provide the seminal papers in this literature. They estimate a series of VARs to determine the impact of monetary policy shocks on regional economies for the period 1958:Q1 to 1992:Q4. Carlino and Defina estimate the cumulative IRFs of each state's real personal income from a shock to monetary policy (i.e. a shock that increases the federal funds rate) and find great variation among the states IRFs. In particular, the Great Lakes region is found to be the most adversely affected by monetary policy shocks while the states in the Southwest and Rocky Mountain regions are the least affected. In a related study, Crone (2005) creates a new set of economic regions based on the similarities in state business cycles for the period 1959:Q1 – 1993:Q1 and uses them in a VAR identical to the one used in Carlino and Defina (1998). Crone also finds the Great Lakes area to be the most adversely affected from a monetary policy shock while the area he calls the energy belt—comprised of portions of the Southwest and Rocky Mountain regions as classified by the Bureau of Economic Analysis (BEA)—is the least affected. In two similar studies, Owyang and Wall (2005, 2008) estimate the impact of monetary policy shocks on real personal income for the BEA regions and 19 sub-BEA regions. They estimate the VAR for the periods 1960:Q1 – 1978:Q4, 1983:Q1 – 2002:Q4. They too find the Midwest-Great Lakes area to be the most harmed by monetary shocks for all periods while the Rocky Mountain, Southwest, and Far West areas tend to be the least

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affected. Lastly, they show that the effects of monetary policy shocks on the regions lessened in the latter period.

All of these studies show that US monetary policy generates asymmetric regional effects. A natural follow-up question is why? In an attempt to answer this question, these same studies regress the asymmetric regional effects—as measured by the IRFs at a certain horizon—against various proxies for well-known monetary policy transmission channels. The only robust finding to emerge from these inquiries is that monetary policy's regional asymmetric effects can be explained, in part, by the varying industry composition across regions. In particular, these studies find that regions with a relatively high share of their economy in Manufacturing and Construction are more adversely affected than others by negative monetary policy shocks. This observation is consistent with studies that examine the US economy (Ben Bernanke and Mark Gertler 1995; Marvin Barth and Valerie Ramey 2002) and other national economies (Luca Dedola and Francesco Lippi 2005; Georgiadis 2014) and find that capital-intensive industries are more sensitive to monetary policy shocks applied to the target interest rate. Two explanations are given for these findings. First, the demand for capital-intensive produced goods is very interest-rate sensitive, particularly durable goods. This is the traditional interest rate channel of monetary policy (Gert Peersman and Frank Smets 2005). Second, interest rate shocks also affect the supply side by altering the cost of capital a firm faces. This is the cost-of-capital channel (Barth and Ramey 2002). Together, they make capital-intensive production relatively more sensitive to monetary policy shocks.

The regional studies also find that those states and regions with a higher share of their economy in extractive industries of mining and drilling are less affected—and sometimes even improve—by negative monetary policy shocks (Crone 2007). The reasons for this finding are not clear, but these studies are consistent with Clifton Loo and William Lastrapes (1998)

who find a similar relationship between mining and monetary conditions at the national level.⁵

Collectively, these findings also imply that varying the composition of industry should cause the effect of monetary policy shocks to vary.⁶ If true, then the impact of monetary policy shocks should change for a region undergoing a major structural transformation of its economy. This implication, however, has never been examined explicitly. The radical transformation of the American South after World War II provides a natural experiment for examining this question.

To appreciate fully the extent of this structural change it is important to recognize that the American South remained relatively undeveloped and isolated from the rest of the US economy for eighty years following the Civil War. The South's economic backwardness stood in stark contrast to the robust economic gains elsewhere in the United States that made it the leading industrial power in the world by the late nineteenth century. The South remained mired in a poverty trap until the policies of the New Deal and World War Two opened up the South's economy and increased public capital investment in it (Wright 1986; Fred Bateman et al. 2009). This "Big Push" was followed by other developments in the South including improved human capital formation (Michelle Connolly 2004), an active industrial policy (James Cobb 1982), and increased political competition

⁵ They, however, identify money supply shocks using long-run restrictions rather than identifying interest rate shocks. Nonetheless, they find a positive money supply shock temporarily lowers the interest rate and simultaneously causes mining output to fall. This negative relationship is consistent with the regional literature which finds a positive interest rate shock has no effect and in some cases improves mining activity.

⁶ Donald Schunk (2005) indirectly tests this notion by observing that the capital intensity of the U.S. economy has declined on average among all states and consequently should lead to smaller IRFs from a monetary policy shock over time. He finds evidence that supports this view.

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(Timothy Besley et al. 2005).⁷ Collectively, these developments led to robust economic gains in the region over the next forty years and along the way changed the structure of the South's economy.⁸

The South's great economic convergence can be seen in Figure 1, which compares personal income per capita in the South to the national level. The South personal income per capita was just over 50 percent of the national level in 1929, but by 1980 it was almost 90 percent. Since then it has gravitated near 90 percent, indicating that most of the South's rapid economic gains had occurred by 1980. This conclusion is consistent with most observers who have studied the South's convergence with the rest of the US economy (Wright 1986; Mitchener and McLean 1999; Caselli and Coleman 2001; Glaeser and Tobio 2008).

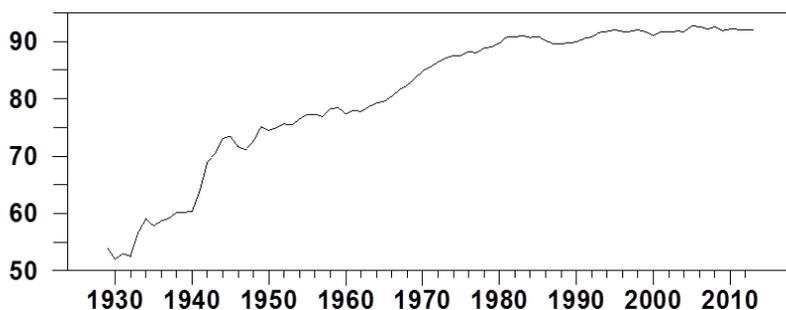
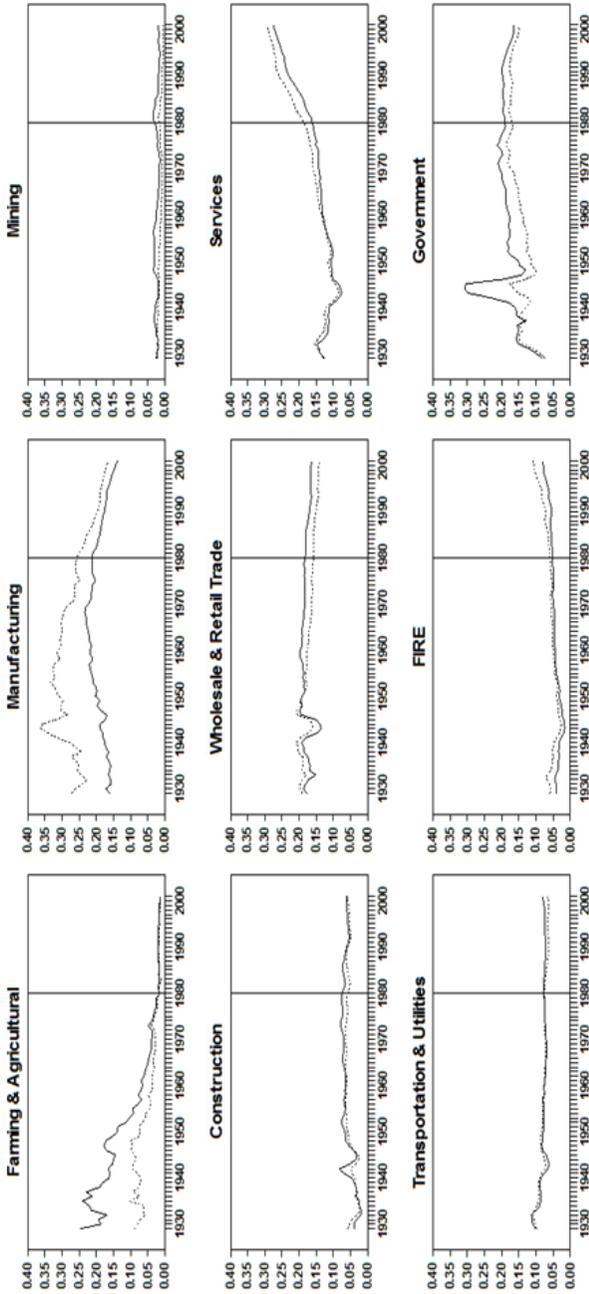


Figure 1

The Convergence of the South: South Per Capita Personal Income as a Percentage of USA Per Capita Personal Income

⁷ Raymond Arsenault (1984) also attributes the advent of air-conditioning as an important contributor to take-off of the South.

⁸ Some observers have also attributed the rebound of the South's economy to a climate or "Sunbelt" effect. Glaeser and Tobio (2008), however, provide evidence against this view.



Notes: The solid vertical line marks the year 1980. — South - - - - - Non-South USA
 Source: Bureau of Economic Analysis Regional Accounts.

Figure 2
 Sectoral Share of Personal Income

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Figure 2 plots the industry sector shares of personal income over much of the same period and shows that the South went from being a regional economy that was comparatively more dependent on Farming and Agricultural to one that was more diversified and closer in structure to the rest of the United States. The change in the share of the South's income coming from Farming and Agriculture is especially striking, going from about 25 percent in 1929 to just over 1 percent in 2001.⁹ By comparison, the rest of the United States had a 9 percent Farming and Agriculture income share in 1929 and by 2001 just over 1 percent. The South's Manufacturing's share in 1929, at 16 percent, was also notably different than the rest of the country at 27 percent. Both regions experienced Manufacturing growth after 1929, but whereas the rest of the country's Manufacturing share of personal income peaked in the early 1950s the South's continued to grow through the mid-1960s. Both regions, though, began a sustained decline in Manufacturing's share after that time. The final noteworthy development in the South was the sustained growth of the service sector after 1940. Both the official BEA service sector and the FIRE (Fire, Insurance, and Real Estate) Service sector became increasingly important in the South. All of these developments point to substantial economic transformation of this region.

This dramatic change in the economic diversification of the South is further illustrated in Table 1. This table shows a measure of economic diversification that is based on the idea that the state or regional economy should have an industry portfolio that is allocated among economic sectors or industries in a way that minimizes the volatility of its overall economy. Following Michael Conroy (1975), the volatility of the industry portfolio can be measured as follows:

$$\sigma_p^2 = \sum_{i=1}^N \sum_{j=1}^N w_i w_j \sigma_{ij} \quad (1)$$

where w_i and w_j are the proportions of the state economy in economic sectors i and j , and σ_{ij} is the covariance between returns in these sectors.

⁹ The SIC industry data come to an end in 2001. Since that time NAIC industry data are available, but are inconsistent with the SIC data, the only source for earlier historical data on the South.

Table 1
Diversification of the Southern Economy

Regions	Industry Portfolio Standard Deviation	
	1950-1979	1980-2001
Rest of USA	2.82%	2.07%
South	2.87%	1.55%
Deep South	3.80%	2.03%
AL	3.86%	1.82%
AR	4.65%	2.75%
FL	3.33%	1.91%
GA	4.62%	3.76%
LA	2.80%	2.15%
MS	4.37%	3.06%
NC	4.02%	2.43%
SC	5.04%	2.36%
TN	3.36%	2.21%
TX	2.74%	2.32%
VA	3.29%	2.37%

Note: The industry portfolio is comprised of personal income earned from the 10 SIC industries and from farming. The standard deviation of this portfolio provides a measure of economic diversification for a region. The lower the standard deviation the greater is the economic diversification.

Sector returns are measured using the annual growth rate of real personal income from the 10 SIC industries plus Farming while the weights are relative shares of total personal income for these industries.¹⁰

¹⁰ The BEA reports only the combined measure of wholesale and retail trade SIC industries up through 1958. Consequently, the combined measure of these industries is used for consistency in the rest of the sample.

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The square root of equation (1) is taken to get volatility in terms of the portfolio's standard deviation. The smaller the standard deviation the less volatile is the industry portfolio and hence the economy. This measure shows that South's standard deviation fell from 2.87 percent during the convergence period to 1.55 percent after 1980, a decline of 132 basis points. If we look at the 'Deep South'—defined here as Alabama, Arkansas, Georgia, Mississippi, and South Carolina—the change is even more pronounced. For this group, the industry portfolio standard deviation goes from 3.80 percent to 2.03 percent, a decline of 177 basis points. This reduction in volatility is large compared to rest of the United States, which experienced a decline of only 75 basis points, and underscores the fact that the South's economy underwent a dramatic structural change. These structural changes, then, were large compared to the rest of the nation and make the South's economy before and after 1980 an ideal candidate for testing whether the regional effects of monetary policy shocks do in fact change in response to a restructuring of a regional economy.

Estimating the Regional Effect of Monetary Policy Shocks

In order to estimate the effect of monetary policy shocks on the South over the convergence and post-convergence periods, a consistent indicator of the stance of monetary policy is needed that spans both periods. The previous studies that examine the regional effects of monetary policy turn to the widely-used recursive VAR where innovations to the federal funds rate are identified as monetary policy shocks. This approach does not work for this study for several reasons. First, the available federal funds rate data do not span the entire sample. Second, it is generally understood that the federal funds rate has not always been the intermediate target of monetary policy and therefore cannot be used a consistent measure of the stance of monetary policy across both periods.¹¹ What is needed, then, is a measure

¹¹ Specifically, between 1979 and 1982 the Federal Reserve targeted non-borrowed bank reserves.

that reflects the stance of monetary policy, but is invariant to the specific choice of intermediate target.¹²

One way to do this is to look directly at monetary policy's effect on aggregate demand. This requires, however, recognizing that monetary policy can both actively and passively shape the path of total dollar spending. In the former case, the central bank explicitly changes its intermediate target to alter aggregate demand. For example, a central bank may slow down total dollar spending by raising its target interest rate. Conversely, it may speed up total spending by lowering its target interest rate. This is the standard view of how monetary policy operates.

A passive change in the stance of monetary policy occurs, however, when the central bank does not explicitly change its intermediate target but because of changing economic conditions passively allows the path of aggregate demand to be altered. For example, a central bank may allow total dollar spending to fall by choosing not to offset an increase in money demand or a tightening of fiscal policy. Conversely, it may allow total dollar spending to rise by choosing not to offset a decrease in money demand or a loosening of fiscal policy. The key point is that the central bank could offset the passive changing of monetary policy, but may choose not to do so. This understanding is implicit in numerous studies that show the effect of fiscal policy is muted when central banks are actively offsetting shocks to the economy.¹³

¹² Note that many observers consider an interest rate target as the 'instrument' of monetary policy. However, it is more precise to call it the intermediate target of monetary policy as shown by Michael Belongia and Melvin Hinch (2009).

¹³ For example, see Eric Leeper et al. (2011), Lawrence Christiano et al. (2011), and Michael Woodford (2011). Only at the zero lower bound where monetary policy is limited does this literature show a sizeable fiscal multiplier for fiscal policy. David Romer (2011) sums up this view nicely: "Consider estimating the effects of fiscal policy over the period from, say, 1985 to 2005. Central banks were actively trying to offset other forces affecting the economy, and they had the tools to do so. Thus if they were successful, one would expect the estimated effects of fiscal policy to be

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The key insight here for VAR identification purposes is that monetary policy is the final arbiter of the growth path of aggregate demand. Consequently, any shocks to total dollar spending represent a non-expected movement in the stance of monetary policy.¹⁴

This approach takes a broader view of the stance of monetary policy than does the standard interest rate view, but arguably it is a better one. It avoids the issue of having to interpret what interest rates mean for the stance of monetary policy and is robust across all monetary regime periods.¹⁵ This last point is important for the purposes of this article since the objective is to compare the effects of monetary policy shocks across two very different periods. This article adopts this approach by looking at non-forecasted innovations to nominal income—which by definition equals nominal spending or aggregate demand—as the measure of monetary policy shocks.¹⁶ Table 2 summarizes this understanding of the stance of monetary policy.

close to zero. But this would tell us nothing about the effects of fiscal policy in situations where monetary policymakers are unable or unwilling to offset other forces” (p. 4).

¹⁴ Joshua Hendrickson (2012) shows the Federal Reserve effectively stabilized nominal income during the Great Moderation period of 1984-2007.

¹⁵ To know what a target interest rate says about the stance of monetary policy, one must compare it to the short-run natural interest rate. The latter, however, is unobservable and attempts to approximate it using a Taylor Rule are subject to the challenges facing such rules. See Robert Hetzel (2000) for more on this point.

¹⁶ This approach can also be viewed from a Monetarist’s perspective. The equation of exchange says nominal income is equal to the product of the money supply and the velocity of money: $PY = MV$. Consequently, by focusing on nominal income this approach implicitly also focuses on the interaction between the money supply and money velocity.

Table 2
The Stance of Monetary Policy

	Δ in Intermediate Target	No Δ in Intermediate Target
$PY_t^{Actual} > PY_t^{Expected}$	Active Easing	Passive Easing
$PY_t^{Actual} < PY_t^{Expected}$	Active Tightening	Passive Tightening

Note: PY_t = nominal income at period t

As a robustness check for this identification strategy, Figure 3 reports the IRFs from estimating a VAR with the following vector of endogenous variables:

$$z_t = (py_t, p_t, \hat{y}_t)'$$

where py_t is log nominal income, p_t is the log price level, and \hat{y}_t is the output gap for the United States as a whole.¹⁷ These are measured using personal income, the Consumer Prices Index (CPI), and the Congressional Budget Office's output gap measure.¹⁸ The IRFs are constructed using a Choleski decomposition of the covariance matrix using 5 lags.¹⁹ To be consistent with the state analysis that follows, the VAR was estimated over for the convergence period of 1948:Q1 – 1979:Q4 and the post-convergence period of 1980:Q1 – 2007:Q4.

¹⁷ To be consistent with the state VAR analysis that follows, the estimated structural shocks to national nominal income from the state VAR in the next section are used here for the nominal income variable. We thus apply the same shock to state VAR and the national VAR.

¹⁸ Personal income is used here to be consistent with the state VAR analysis. All data come from the St. Louis FRED database.

¹⁹ The justification for these lags is discussed later in the state VAR section.

The reported IRFs show the dynamic responses of the variables to a permanent negative 100 basis point shock to nominal income in both periods. This is the identified monetary policy shock for the reasons laid out above. The IRFs show responses that are consistent with a standard aggregate demand-aggregate (AD-AS) model. That is, a permanent tightening of monetary policy leads to permanent decline in the price level, but only a temporary negative output gap. Since VARs are linear models, a positive shock would create a mirror image in the other direction. The consistency of these IRFs with a standard AD-AS model indicates the simple use of non-forecasted innovations or shocks to nominal income is a reasonable way to estimate a consistent measure of the stance of monetary policy over the convergence and post-convergence periods in the South.

A second estimation issue for this article is how to deal with the degrees of freedom problem implicit in estimating the effect of monetary policy shocks over many states. That is, a fully-identified structural VAR with multiple macroeconomic variables and eleven state variables will quickly run into information constraints as the lags on the VAR increase. This article addresses this challenge in two ways. First, the vector of macroeconomic variables is limited to just nominal income because, as noted above, non-forecasted innovations to nominal income can be viewed as an unexpected change or shock to the stance of monetary policy. Second, restrictions are imposed on the estimated VAR such that the state economies in the VAR cannot influence the rest of the VAR but themselves can be influenced by the macroeconomic portion.²⁰ Doing so allows a macroeconomic innovation, specifically the monetary policy shock, to influence a state economy upon impact and afterwards but not vice versa.

²⁰ Other studies that have taken a similar approach include Barth and Ramey (2002), Steven Davis and John Haltiwanger (2001), Michael Frantantoni and Scott Schuh (2003), William Lastrapes (2004, 2006), and Owen Irvine and Scott Schuh (2005).

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As shown by Lastrapes (2004, 2006), this approach can be formally demonstrated by beginning with the autoregressive structural model of the form:

$$A_0 z_t = A_1 z_{t-1} + \dots + A_p z_{t-p} + u_t$$

where A_0, \dots, A_p are $n \times n$ structural parameters matrices, z_t is a $n \times 1$ vector of endogenous variables, and u_t is a $n \times 1$ vector of uncorrelated structural shocks that are assumed to be multivariate normal with mean zero and unit variance.

The endogenous vector of variables can be partitioned so that

$$z_t = \begin{pmatrix} z_{1t} \\ z_{2t} \end{pmatrix}$$

where z_{1t} contains the macroeconomic variables or the “common factors” while the z_{2t} contains the state economy variables. Here, z_{1t} consists solely of aggregate nominal income while z_{2t} consists of state nominal incomes for the 11 states of the South.

The overidentifying restrictions outlined above are imposed on the VAR as follows. First, z_{1t} is made block exogenous with respect to z_{2t} and second, the state economy variables in z_{2t} are made mutually independent with respect to each other. The block-exogeneity creates zero restrictions in the A_i matrices, where $i=0, 1, \dots, p$, and requires aggregate nominal income to be determined independent of the individual state nominal incomes. The second set of restrictions imposes separately for each state zeroes in the A_i matrices for the other states so that they do not interact.

These overidentifying restrictions make it possible to estimate the large VAR in a parsimonious two-step procedure: first, the macroeconomic portion of the VAR is estimated, and second, the state economy conditional on the macroeconomic variable and itself can be estimated. This strategy is pursued by repeatedly estimating the following vector of endogenous variables by seeming unrelated regression for each of the 11 Southern states:

$$z_t = (py_t^{usa}, py_t^{state})'$$

where py_t^{usa} is log nominal income for the country and py_t^{state} is log nominal income for a particular state. The results from estimating this VAR 11 times for each state produce the same estimates as would estimating the large VAR, but without the degrees of freedom problem. Given the block exogeneity restrictions and the use of the Choleski decomposition of the covariance matrix, the state variables in no way affect the macroeconomic variables, both upon impact and afterwards. As a result, only one macroeconomic system is being estimated and hence, only one set of monetary policy shocks is being estimated. The same monetary policy shocks, therefore, get applied across all state economies as each VAR is estimated.

Once the model is estimated, IRFs are used to show the dynamic response of the state nominal incomes to a monetary policy shock. The VAR is estimated for both the convergence period and the post-convergence period and in both cases a 100 basis point monetary policy shock is applied to the estimated systems. This allows a comparison of same size monetary policy shocks across both periods. In addition, the response of national nominal income to the monetary policy shocks is estimated as a benchmark to see if the observed changes in the state IRFs are reflecting more than the changes in systematic monetary policy across the two periods. Standard error bands for the IRFs are estimated by running 5000 Monte Carlo simulations.²¹

The measure of nominal income used here is state personal income. Though this measure is not quite total nominal income, it does track the aggregate measure closely with a R^2 of 99.97 percent and consistently makes up about 80 percent of it. This measure is also used by the previous studies. These studies deflate state personal income by the national CPI

²¹ The standard error bands are technically fractiles that come from using Monte Carlo integration techniques to estimate the posterior density of the response coefficients. Chris Sims and Tao Zha (1999) recommend with this approach, which characterizes the likelihood shape, the use of a 68 percent posterior probability which approximates a one-standard error band.

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to derive state real personal income measures, which is problematic since this ignores important regional variations in the price level and may bias the estimates (Michael Dowd and Jim Lesage 1997). To avoid this problem, this article uses the directly observable nominal personal income.

Data are available on a quarterly frequency from the BEA for state personal income from 1948:Q1. Consequently, VARs are estimated for the convergence period of 1948:Q1 – 1979:Q4 and the post-convergence period of 1980:Q1 – 2007:Q4.²² As a robustness check, two shorter-sample periods are used to estimate the models. The first runs from 1948:Q1 – 1967:Q4 and the second from 1988:Q1 – 2007:Q4. Both are 20-year periods that touch the end points of the sample and represent a check against the longer sample results.

Since a standard unit root test indicates nonstationarity in the levels of the variables, this article follows the common practice of estimating the VAR in log-levels since it has been shown that doing so does not asymptotically bias the coefficient estimates of the VAR parameters (Chris Sims et al., 1990). Moreover, estimating in levels allows for cointegration while not imposing it. Here, five lags are chosen for the VARs since this number is enough to eliminate serial correlation and is adequate according to the Akaike Information Criteria and Likelihood Ratio tests.²³

²² The latter sample period ends in 2007:Q4 to exclude the Great Recession.

²³ These tests show five lag lengths are appropriate for all state VARs except Georgia, Tennessee, and Virginia where three lag lengths are suggested. However, five are chosen for all models so as to keep the estimated monetary policy shocks consistent across all states and to eliminate serial correlation.

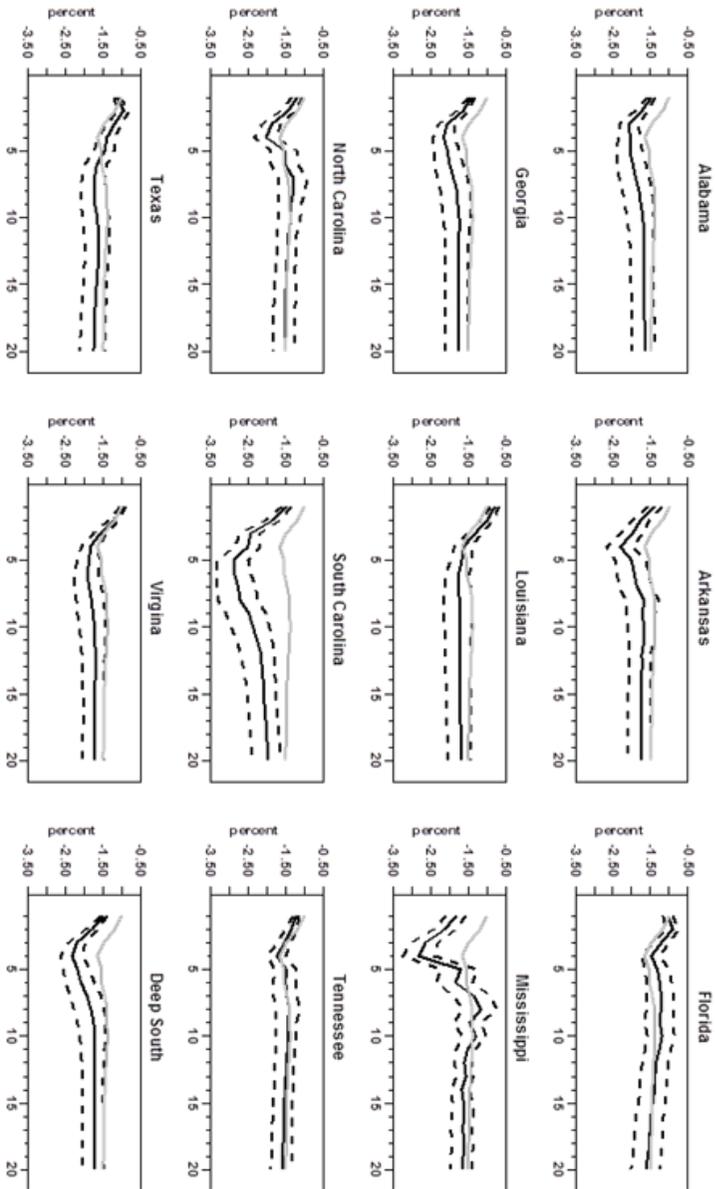
Empirical Results

Panel A of Figure 4 reports for the eleven Southern states, the Deep South, and the United States the estimated personal income IRFs from a negative 100 basis point monetary policy shock to nominal income for the convergence period of 1948:Q1 – 1979:Q4. For each region, the solid black line shows the point estimate for the IRF and the dashed black lines show a simulated standard error band. The gray line, which is reproduced in every state graph, shows the point-estimate IRF for the United States for the sake of comparison.

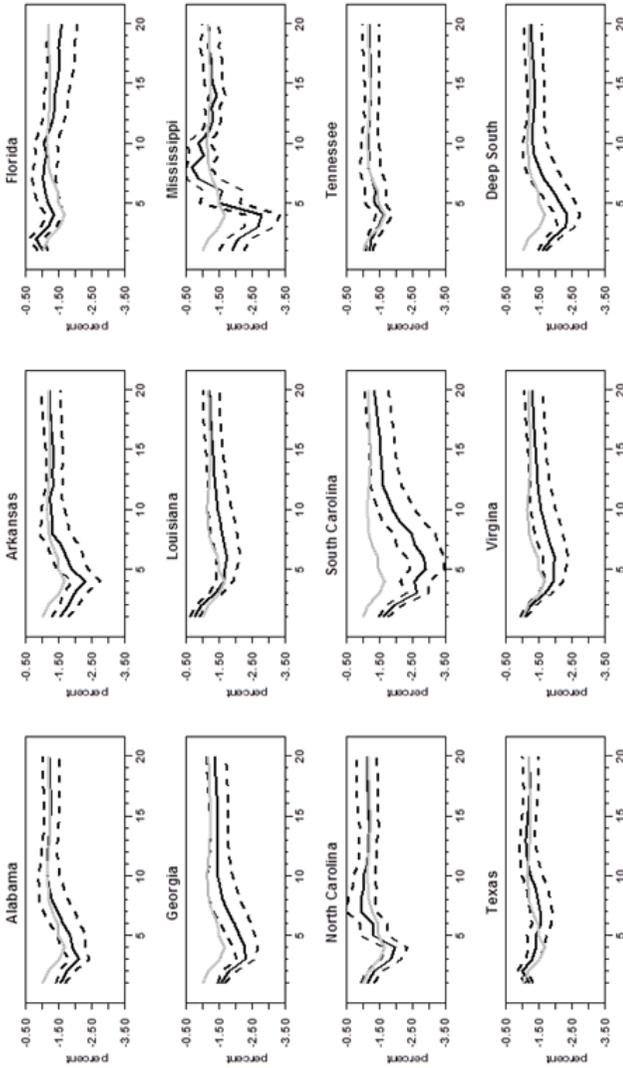
Several patterns emerge from Figure 4. First, a negative monetary policy shock creates a downturn in nominal income for all regions during the convergence period. The impact of the shock bottoms out by 5 quarters in most states. Second, the declines for the Deep South states of Alabama, Arkansas, Georgia, Mississippi, and South Carolina all are significantly different than the nation upon impact. Nominal income in these states drop anywhere from 0.39 to 0.82 percent in the first quarter and all remain significantly different than the national response for at least a year. The biggest relative declines occur in Mississippi and South Carolina which respectively fall below the national IRF at 1.15 percent points three quarters out and 1.35 percentage points five quarters out. Third, the states outside the Deep South experience a smaller relative decline in nominal income. North Carolina and Tennessee experience a significantly different decline, but the difference is small and does not last long. The peripheral states of Florida, Louisiana, Texas, and Virginia do not experience any significantly different responses upon impact.²⁴ After impact, Florida and Texas actually experience less of a decline than the nation. These results, then, indicate that the Deep South states are those that experienced the greatest asymmetric responses to US monetary policy.

²⁴ Virginia does, however, have significantly lower response after the first year.

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Panel A: 1948:Q1-1979:Q4, Quarters After Shock; — State/Region IRF — USA IRF



Panel B: 1948:Q1-1967:Q4, Quarters After Shock; — State/Region IRF ——— USA IRF

Figure 4

Nominal Income Response to Negative 1Percent Monetary Policy Shock

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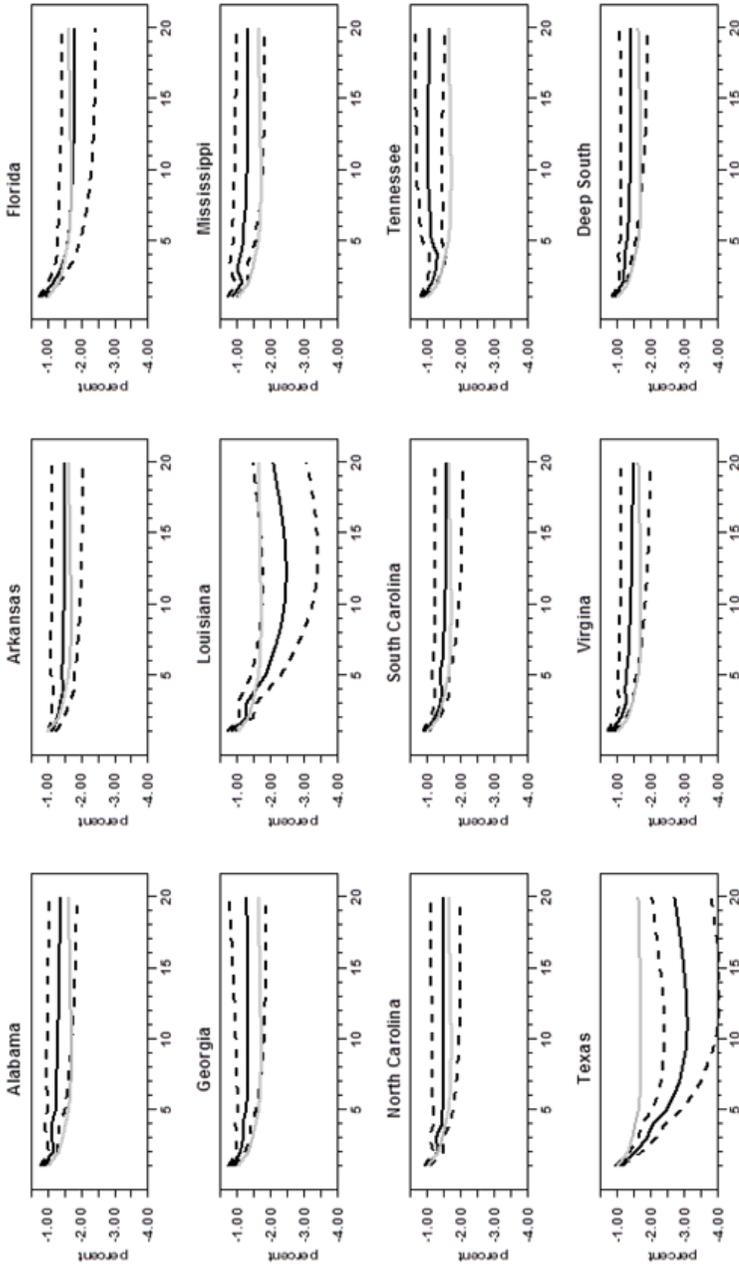
The bottom-right graph in panel A of Figure 4 underscores this last point. It shows that the response of the Deep South as a whole to the monetary policy shock remains significantly different than the nation's response 15 quarters out. During the first two years of this period it is on average 0.57 percentage points lower than the nation's response.

As a robustness check, Panel B of Figure 4 shows the IRFs for the model estimated over 1948:Q1 – 1967:Q4. It is possible that some of the states may have converged before 1980 and consequently a shorter sample period like this might better reflect how they responded to monetary policy shocks while converging. Also, this sample avoids most of the “Great Inflation” period when inflation expectations and nominal spending growth become unmoored.²⁵ Though shorter, this twenty-year period should also be long enough to capture most of the dynamics. The IRFs from this shorter sample show largely the same patterns as those from the full convergence-period sample. The Deep South states are the most adversely affected by the negative monetary policy shock and the periphery tends to do better. So the findings from the full sample appear robust.

Figure 5 provides the IRFs from the monetary policy in the post-convergence period. Panel A shows the results for the full sample period of 1980:Q1 – 2007:Q4. The differences between this figure and Figure 4 are stark. In most cases, the Southern states now experience a smaller decline than the nation in response to a 100 basis point monetary policy shock. For Alabama, Georgia, Mississippi, Tennessee, and Virginia these smaller declines are also significantly different at times. The Deep South as a whole does significantly better for seven quarters. Only Texas and Louisiana do worse.

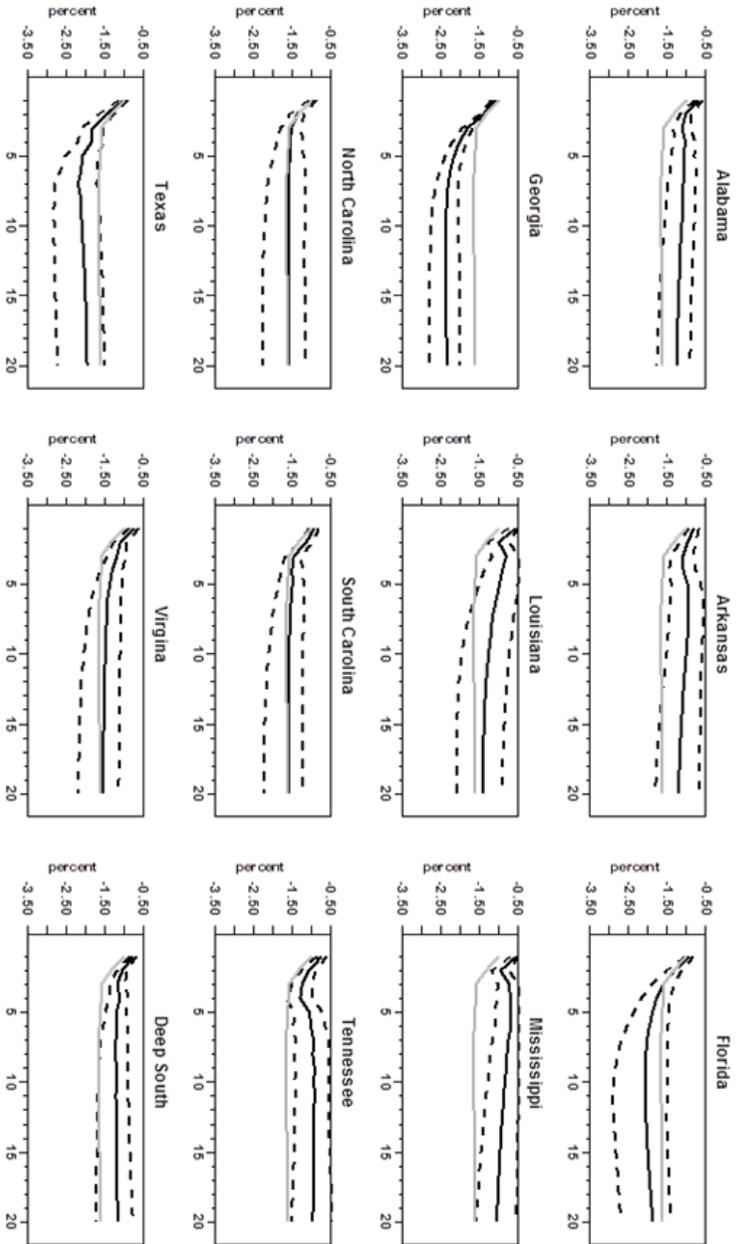
Panel B of Figure 5 shows the IRFs for the model estimated over the subsample period of 1988:Q1 – 2007:Q4. As before, this twenty-year period should be long enough to capture the dynamics in the data, but also avoid the structural change in US monetary policy that occurred in the

²⁵ See Michael Bordo and Athanasios Orphanides (2013) for a recent and comprehensive look at the Great Inflation.



Panel A: 1980:Q1-2007:Q4, Quarters After Shock; ——— State/Region IRF; - - - - State IRF; Region IRF

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Panel B: 1988:Q1-2007:Q4, Quarters After Shock; ——— State/Region IRF ——— USA IRF
Figure 5
 Nominal Income Response to Negative 1Percent Monetary Policy Shock

early 1980s under Federal Reserve Chairman Paul Volker. It is well documented that there was a permanent shift in US monetary policy during this time that led to the Federal Reserve taking its price stability mandate more seriously (Taylor 1999; Clarida et al. 2000; Boivin and Giannoni 2006). Though there is some debate as to when this shift actually occurred, all studies indicate it was completed well before 1988, so the shortened sample avoids it. The IRFs from this shortened sample generally corroborate the findings from the longer sample. Almost all state IRFs are either no worse or significantly better than the national response. Even Texas now is not significantly different than the nation while Louisiana does better. Overall, then, the subsample suggests the full sample IRFs are robust.²⁶

One way to summarize the findings that emerge from Figures 4 and 5 is to subtract the average IRF over the first year for a state from the average IRF over the first year for the nation. Figure 6 does this for both the convergence and post-convergence periods. The figure succinctly shows that, relative to the rest of the nation, the South—particularly the Deep South—tended to be more adversely affected by negative monetary policy shocks before convergence, but afterwards it tended to do better. This stark change in nominal income responses naturally begs the question why? The next section explores this question.

Accounting for the South's Changing Response to Monetary Policy Shocks

So how does one account for the observed change in the response of the Southern economies to the monetary policy shocks? The previous section's use of sub-samples suggests the answer is not a change in the systematic conduct of monetary policy. A more likely answer is the dramatic structural change that occurred in the South. As noted earlier, the South went from being a relatively closed and predominantly agricultural economy to one that was more open and diversified.

²⁶ The only big difference is Georgia which does significantly worse. It is not clear why this change occurred.

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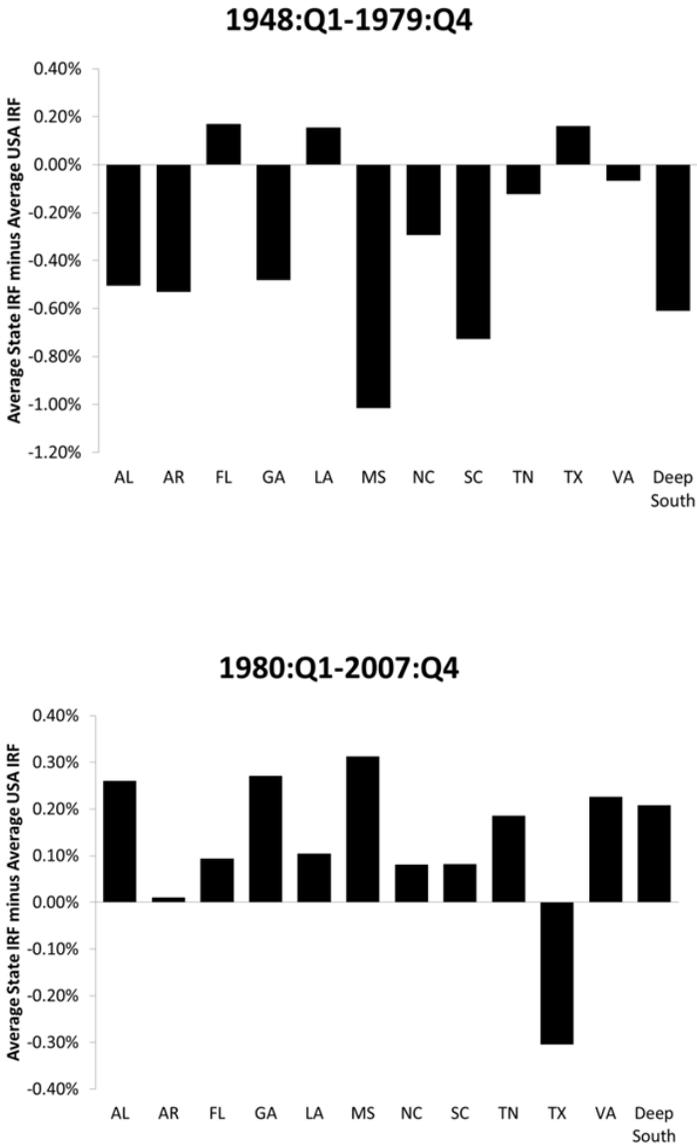


Figure 6
Average IRF Differences Over First Four Quarters

The reduction in the volatility of industry portfolios for the Southern states seen in Table 1 offers support for this view. If this increased diversification and development of state economies in the South were important contributors to the changing response to monetary policy shocks, then the reduction in the volatility of industry portfolios in Southern states should be tied to the size of the IRFs.

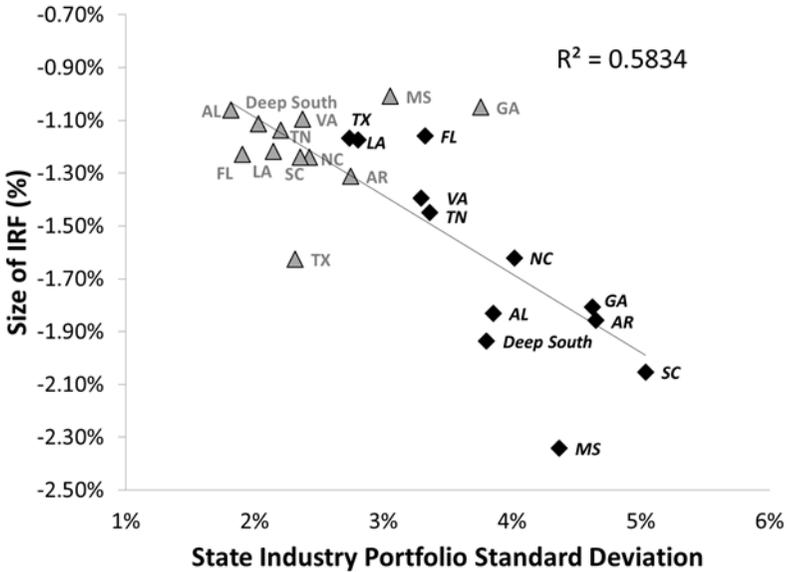


Figure 7
Explaining IRF Variation by Industry Diversification

Note: Average IRFs and industry portfolio standard deviations are drawn from both the convergence and post-convergence periods. The former are denoted by black symbols while the latter use gray symbols.

Figure 7 shows that this relationship does in fact hold. It plots for each Southern state the size of the average IRF over the first year against the volatility of state industry portfolios for both the convergence and post-convergence periods. Recall that the lower the volatility, the more diversified is the state economy. This scatterplot shows that when state

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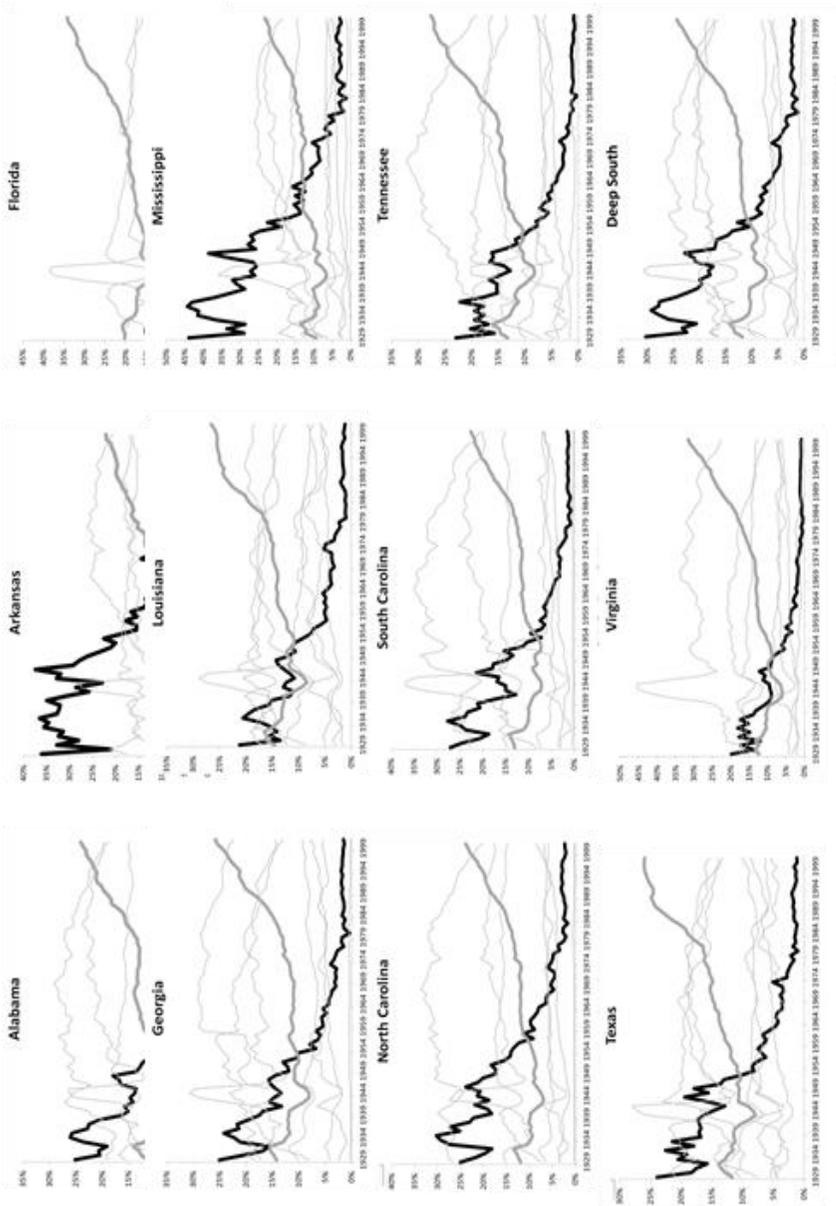
economies were less diversified, as in the convergence period, the declines in nominal incomes from a monetary policy shock were larger. The figure indicates that 58 percent of the variation in the IRFs can be explained by variation in the economic diversification of the Southern states. That sizable amount lends support to the notion that changes in the structure of an economy will affect in a meaningful way the impact of monetary policy.

This finding can be further unpacked by examining the actual industry structure in each state and observing how it changed over time. Figure 8 does this by plotting the annual SIC industry share for the years 1929-2001.²⁷ Like Figure 2, industry shares are calculated here by taking annual personal income earned from each of the 10 SIC industries plus farming as a percent of total state income for each year. As in Figure 2, the farming and agriculture shares are combined into one industry share as are the wholesale and retail trade shares for a total of nine industry shares.²⁸ The SIC data end in 2001 and thus industry shares are calculated only through 2001. After that time NAIC industry shares are available, but differences in how industries are measured prevent a consistent industry share to be calculated thereafter.

Since there are nine industry shares, Figure 8 highlights the two industries for each state that had the largest persistent change while putting in the background the other industries for comparison. In each state, the two industries with the biggest change are farming and agriculture and Services. In most cases farming and agriculture is the largest industry at the start of the sample and becomes one of the smallest at the end, a persistent decline almost matched by the persistent rise of the service sector. This suggests that increased diversification and development of the South may be in part due to the retrenchment of Farming and Agriculture and the growth of the Service sector.

²⁷ Quarterly state data only begin in 1948 whereas annual data begin in 1929.

²⁸ Farming and agricultural are combined because of the similarities while the wholesale and retail trade are combined since they are only reported separately beginning in 1958.



Farming & Agriculture Services

Figure 8

Changing Industry Shares

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To test this implication the average industry shares for each state for both the convergence and post-convergence periods are regressed against the average IRFs used in Figure 7. This gives a total of 24 observations which does not afford many degrees of freedom. Consequently, standard errors in the regressions are calculated by doing 500 bootstrap replications. Also, the FIRE sector is combined with the Service sector to save degrees of freedom and because the former is also a Service sector.

Columns one through eight in Table 3 report the results from individually regressing each industry share on the average IRFs. These columns show that four industries are significantly related to the change in the IRFs: Farming and Agriculture, Services and FIRE, Manufacturing, and Transportation and Public Utilities. The industry with the largest coefficient and most variation explained is Farming and Agriculture. The estimate shows that a 1-percentage point decline in the Farming and Agriculture share leads to a 0.07 percentage point reduction in the size of the IRF. It also can explain 56 percent of the variation in the IRFs. The next biggest contributor is the Service and FIRE. A 1-percentage point increase in its share leads to a roughly 0.04 percentage point fall in the size of the IRF. It can explain almost 40 percent of the IRF variation. The other two significant sectors explain far less variation. This finding is consistent with the observations from Figure 8 that Farming and Agriculture and the Service sector were those that saw the largest persistent change in industry shares.

Columns nine through eleven runs multivariate regressions using the industries found significant in the first eight columns. Here Farming and Agriculture is run in every regression along with one of the other significant industries. Column nine regresses Farming and Agriculture and the Service and FIRE sector and shows the latter is no longer significant. This finding might reflect that much of the decline in the Farming and Agriculture share was picked up by service sector. The same outcome, however, holds in column ten for the Manufacturing share. It no longer is significant and it is not clear why. Finally, column 11 shows that the Transportation and Public Utilities share remains significant and slightly increases the amount of explained variation in the IRFs to 65 percent.

Table 3
Explaining the IRFs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Constant	-1.0771 (0.000)	-2.254 (0.000)	-1.729 (0.000)	-1.458 (0.000)	-0.8960 (0.000)	-2.429 (0.000)	-1.333 (0.004)	-1.784 (0.000)	-1.426 (0.000)	-0.794 (0.000)	-1.840 (0.000)
Farming and Agriculture Share	-0.0703 (0.000)								-0.0564 (0.008)	-0.0654 (0.000)	
Service and FIRE Share		0.0384 (0.000)							0.0130 (0.391)		
Construction Share			0.0477 (0.517)								
Mining Share				0.0218 (0.521)							
Manufacturing Share					-0.0244 (0.007)					-0.0142 (0.137)	
Transportation and Utilities Share						0.1391 (0.018)					0.1023 (0.021)
Wholesale and Retail Trade							-0.0051 (0.845)				
Government								0.0189 (0.278)			
Number of Observations	24	24	24	24	24	24	24	24	24	24	24
Bootstrap Replications	500	500	500	500	500	500	500	500	500	500	500
R ²	0.560	0.398	0.015	0.013	0.147	0.173	0.002	0.035	0.583	0.607	0.651
Adjusted R ²	0.540	0.371	-0.030	-0.032	0.108	0.135	-0.044	-0.009	0.543	0.569	0.618

Notes: Dependent variable: average size of IRFs over first four quarters. P-values in parenthesis

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Collectively, these regression results suggest that the biggest change in industry that contributed to the reduction of the asymmetric effect of monetary policy shocks on the South was the reduction of the Farming and Agriculture industry. This begs the question as to why the change in this industry seems to have mattered so much.

One potential answer is that Farming and Agriculture was the key industry that kept the South's portfolio of industries from being diversified in a manner similar to the rest of the country prior to convergence. As seen in Figure 2, Farming and Agriculture was about 25 percent of South's portfolio compared to about 9 percent for the other regions. For the Deep South it was even more pronounced at 30 percent and in the case of Mississippi it was 45 percent, as seen in Figure 8. Regressing the volatility of state industry portfolios against the Farming and Agriculture share creates an R^2 of 61 percent suggesting that it was, in fact, the large Farming and Agriculture industry share that kept the South's portfolio less diversified.

Additionally, Farming and Agriculture during the late 1800s and early 1900s was in transition becoming more capital intensive and large scale in operation. This meant farmers who wanted to stay competitive had to take on more debt to finance capital and land expenditures. Farming and Agriculture, in short, became a highly-leveraged industry and therefore relatively more susceptible to economic shocks, including those from monetary policy.

Therefore, given the comparatively large share of Farming and Agriculture in the South's portfolio of industries, this region was almost bound to be more adversely affected by negative monetary policy shocks. Having a more diversified portfolio after 1980 made this less of a problem for the South.

Conclusion

The great economic convergence of the American South that began in the early 1940s and ended around 1980 is one of the more interesting developments in twentieth century US economic history. This transformation of the South's economy raises the question of whether the impact of US monetary policy shocks upon the South changed during and

after this transformation. This article addressed this question by examining the impact of negative monetary policy shocks on nominal income in the 11 Southern states and the Deep South as a region during the convergence and post-convergence periods. This article finds that the responses of nominal income in most of these regions to monetary policy shocks goes from being more adversely affected than the nation during the convergence period to being affected about the same or less adversely during the post-convergence period. Further analysis of these responses showed that about two-thirds of this change can be attributed to the changing composition of industry in the South as its economy was transformed. The large reduction in the Farming and Agriculture share of the economy appears to have been especially important. Structural changes in the economy, then, do seem to be important in explaining changes in the propagation of monetary policy shocks.

While the American South is an obvious choice for exploring the impact of structural change on the impact of monetary policy, it would be interesting to extend this line of research to other parts of the United States to gain further insights into the consequences of structural change for regional economies.

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