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ORIGINAL ARTICLE

The Differential Impact of Monetary Policy on Blacks and Whites since the Great Recession

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Abstract

This paper studies the differential impact of monetary policy on labor market responses for blacks and whites since the start of the Great Recession. We estimate and quantify these differences using a somewhat unconventional approach to identifying an expansionary monetary policy shock. At the long horizon, we find that black employment is more sensitive to changes in monetary policy than that of whites. However, at the short horizon, black employment falls, whereas white employment immediately increases. Owing to such disparities, one might expect the central bank to be deeply engaged in understanding the causal mechanisms at play. Moreover, our findings raise concern that recent monetary policy tightening may adversely affect blacks disproportionately to whites.

Keywords Monetary policy · Labor market · Sign restrictions

JEL classification E52 · J23 · J08

Introduction

Recent unemployment figures reflect robust economic growth since the financial crisis of 2008; however, the current national unemployment rate of 4.1% camouflages major labor market differences across demographic groups. For example, the black unemployment rate was 4% higher than the white unemployment rate in October 2017. Such disparity is consistent with existing research, which shows a historic 2-to-1 ratio of black-to-white unemployment rates.[1] Similarly, labor force participation rates and employment-population ratios among whites and blacks vary considerably. Unfortunately, these differences are not new and have persisted for nearly 70 years. Furthermore, differences in education or experience are unable to explain racial inconsistencies in employment. For instance, Betsey (1978) shows a significant portion of the black-white unemployment gap remains unexplained after taking education, previous training, and other demographic variables into consideration. Even more compelling, Ritter and Taylor (2011) show black individuals experience substantially higher lifetime unemployment than white individuals with similar levels of premarket skills.

Given the implications for economic growth, one might expect a heightened focus by macroeconomic policymakers on such discrepancies in employment. To the extent, these discrepancies reflect differences in income and wealth across race, and disadvantaged individuals will underinvest in human capital, which has adverse consequences for potential output. Furthermore, relatively low levels of labor force participation and employment among blacks represent an important and untapped source of slack in the economy. Bringing discouraged workers back into the labor force not only has positive effects on economic growth but provides these individuals with a sense of economic security and self-worth. For these reasons, a strong argument can be made for macroeconomic policies targeting labor market disparities.

[1] For example, Fairlie and Sundstrom (1997), who examine trends in unemployment among black and white men from 1880 to 1990, document the persistence of the unemployment gap and offered up potential explanations.

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The Federal Open Market Committee (FOMC) is charged with achieving maximum employment but does not have a fixed numerical goal for employment because it acknowledges there are other nonmonetary factors that influence labor market dynamics. Ignoring non-wage factors that influence labor supply and demand, we ask the question, how has monetary policy impacted labor market disparities since the Great Recession? Owing to the "zero lower bound" and massive amounts of excess reserves in the banking system, Fed policy entered a "new" era which started December 2008. To assess the impact of monetary policy, in this new era, we focus our study on the post Great Recession period (2009–2017). We find it reasonable to believe the monetary transmission mechanism evolved following the financial crisis.

While this paper adds to a growing list of research devoted to studying employment disparities across demographic groups, relatively few papers have analyzed the link between monetary policy and racial differences in employment.[2] Most recently, using recursive vector autoregression (VAR) analysis, Carpenter and Rodgers (2004) finds African American unemployment rates are more sensitive to changes in monetary policy than white unemployment rates. They attribute the higher sensitivity to a higher likelihood of being employed in industries that are more sensitive to monetary policy. Similarly, Thorbecke (2001) finds that a contractionary monetary policy shock, as measured by an increase in the federal funds rate, raises African American and Hispanic unemployment rates by 50 to 90% more than whites.

In contrast to the aforementioned studies, which use recursive identification, we estimate the differential labor market responses between blacks and whites to monetary policy shocks using a relatively new method for identifying shocks. To clarify, we explicitly impose sign restrictions on the impulse response vectors. In doing so, we make the a priori theorizing embedded in the recursive approach explicit by assuming the federal funds rate is non-increasing, and output, prices, non-borrowed reserves, and total reserves are non-decreasing (which allows for a zero response). We remain agnostic about the variable of interest, which is the employment-population ratio or the unemployment rate.

We find that at the long horizon—2 years after the shock—the black employment-population ratio is more sensitive to changes in monetary policy than that of whites. At the short end, the black employment-population ratio falls (by 0.08%) following an expansionary monetary policy shock; at the same time, white employment increases. It is important to point out the fall in black employment is somewhat puzzling and not reported in previous studies. We speculate the fall in black employment is due to a discouragement effect of displaced black workers exiting the labor force, following an expansionary monetary policy shock. Recall, the black-white skills gap is large and stubbornly persistent.[3] Consequently, employers' decision to "up-skill" jobs—require higher skill levels for a given job—disproportionately affects black workers, who might exit the labor market due to discouragement. In support of our hypothesis, a new study shows that abundant labor induced firms to up-skill jobs following the Great Recession.[4]

Separate estimates are reported for black and white unemployment rate responses. Congruent with employment-population ratio estimates, the white unemployment rate quickly declines following a positive monetary shock. On the contrary, the black unemployment rate temporarily increases, which is consistent with the discouragement effect highlighted above.

Certainly, open market operations are not well suited to address labor market disparities; however, understanding and identifying these disparities are important for achieving the Federal Reserve's goal of high employment and economic growth.

The remainder of the paper is as follows. The "Data and Trends" section describes the data used for analysis. The "Methodology" section describes the methodology and identification strategy. The "Results" section contains our results. The "Robustness" section explains our robustness checks. Concluding remarks are provided in the "Conclusion" section.

Data and Trends

The data series used in this study span from June 2009 to October 2017. Again, we chose this time period to capture changes in the monetary policy landscape resulting from the recession. The consumer price index less energy and food (CPI) and the producer price index for all commodities come from the US Bureau of Labor Statistics (BLS). Non-borrowed reserves and total reserves are published by the Board of Governors of the Federal Reserve System. The US Bureau of Economic Analysis does not produce gross domestic product data at the monthly frequency. As a result, we use data on real gross domestic product published by Macroeconomic Advisers. Economic theory and existing research provide justification for use of each

[2] There is a large empirical literature that studies demographic differences in employment. For example, Shulman (1991) focuses on black-white differences in the unemployment rate. Korenman and Okun (1989) examine gender differences in cyclical unemployment. In related work, Clark and Summers (1981) study cyclical employment fluctuations across race and age.

[3] See, for example, Heckman and Rubinstein (2001) and Fryer and Levitt (2013).

[4] Hershbein and Kahn (2017) point out that skill requirements on job postings in different metropolitan statistical areas change depending on how hard their labor market was hit by the Great Recession. They also find that these differences are persistent and most pronounced in routine-cognitive occupations.

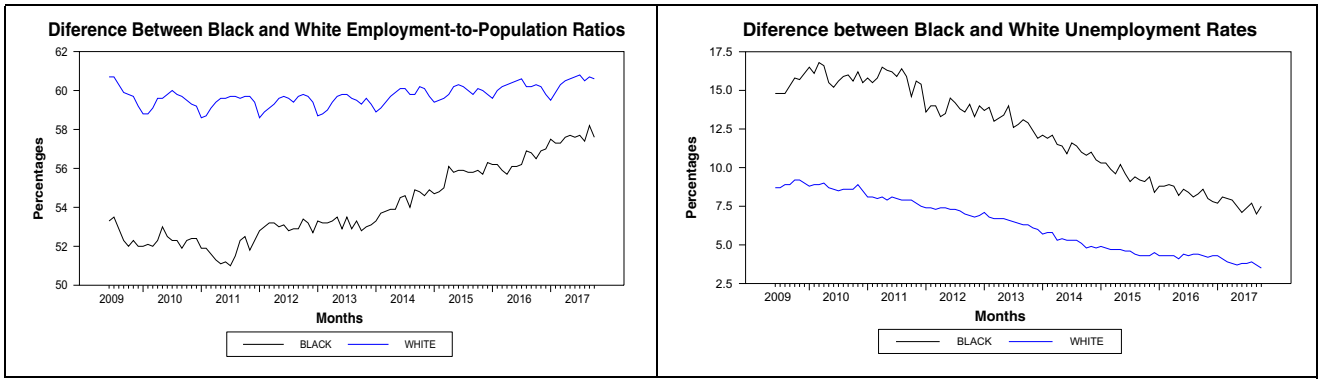


Fig. 1 Trends in employment

macroeconomic variable listed above to identify a monetary policy shock.[5]

In December 2008, the effective federal funds rate reached the "zero lower bound," where it remained through 2015. In response, researchers turned to shadow rate models to estimate the effective federal funds rate.[6] As a proxy for the effective federal funds rate, we use the Wu and Xia (2016) shadow federal funds rate data, which is used along with other macroeconomic variables to identify a monetary policy shock. Each variable, except the shadow federal funds rate, enters the system in log form, which allows changes to be interpreted as percentage changes. Despite unit root test results (located in the Appendix), we do not first difference the variables. Instead, variables enter the system in levels, which provides a basis for comparing our results to others in the literature.[7]

Our focus is on employment; however, there is no clear measure that captures the overall health of the labor market and so we look at two different measures: the unemployment rate and the employment-population ratio. Given the unemployment rate underestimates actual labor market conditions and is more affected by short-term fluctuations in labor market behavior, our primary variable of interest is the employment-population ratio, but including the unemployment rate captures, to some extent, the robustness of our findings. Both measures of the labor market come from the Bureau of Labor Statistics. Moreover, we disaggregate both measures by race, age, and sex.

According to Fig. 1, from 2009 to 2017, employment and unemployment rates for blacks and whites follow a similar trend; employment has trended upward and unemployment has trended downward over this time period. Despite the black-white gap in employment narrowing as the economic recovery unfolded, labor market trends clearly display a disparity in employment between blacks and whites. In particular, black employment is that of whites.

Methodology

In the spirit of Uhlig (2005), and following the work of Ume (2018), sign restrictions are used to impose the needed structure on the VAR model. The structural VAR model is represented by the following notation:

$$BY_t = A(L)Y_{t-1} + \varepsilon_t, \ \varepsilon_t \sim N(0, \Sigma_\varepsilon). \quad (1)$$

B contains the coefficients reflecting the relationship between each endogenous variable, $A(L) = A_1\ L + ... + A_P L$ is the lag polynomial, and ε_t is the *nx1* vector of structural shocks.

We estimate separate VARs for whites and blacks, which lead to four model specifications, each including one of the following employment variables: (1) black employment-population ratio, (2) white employment-population ratio, (3) black unemployment rate, or (4) white unemployment rate. In addition to a single employment variable, each VAR specification contains the following macroeconomic variables: real GDP, CPI, the shadow federal funds rate, the commodity price index, total reserves, and non-borrowed reserves. Hence, the VAR system contains seven variables.

Using OLS, the model must be estimated in its reduced form, which has the following representation:

$$Y_t = \Pi(L)Y_{t-1} + e_t, e_t \sim N(0, \Sigma_e) \quad (2)$$

$$\Pi(L) = B^{-1}A(L). \quad (3)$$

Using the residual values from OLS along with knowing the relationship between the structural shocks and the VAR errors, $e_t = B^{-1}{}_t$, matrix B^{-1} can be estimated by decomposing the variance covariance matrix as such:

$$\Sigma_e = B^{-1}\left[\varepsilon_t \varepsilon_t{}'\right] B^{-1'} = B^{-1}B^{-1'}. \quad (4)$$

[5] The variable choices are motivated by arguments in Eichenbaum (1992), Christiano and Eichenbaum (1992), Bernanke and Blinder (1992), and Strongin (1995).
[6] See, for example, Bullard (2012), Krippner (2013), and Wu and Xia (2016).
[7] See, for example, Uhlig (2005); Thorbecke (2001); and Christiano et al. (1999).

Table 1 VAR sign restrictions on macroeconomic variables

	Real GDP	Cons. price index	Comm. price index	Shadow fed funds	Nonborr. reserves	Total reserves
Response to monetary policy shock	+	+	+	–	+	+

Note: Restrictions are not imposed on labor market variables, which are the employment-population ratio or the unemployment rate

To identify a monetary policy shock, restrictions are imposed on the impulse responses of certain variables. Dissimilar to recursive identification, this approach makes a priori theorizing explicit which ensures the results are consistent with economic theory. For instance, an expansionary monetary policy shock is identified when the responses of prices, output, non-borrowed reserves, and total reserves are non-increasing and the response of the shadow federal funds rate is non-decreasing.

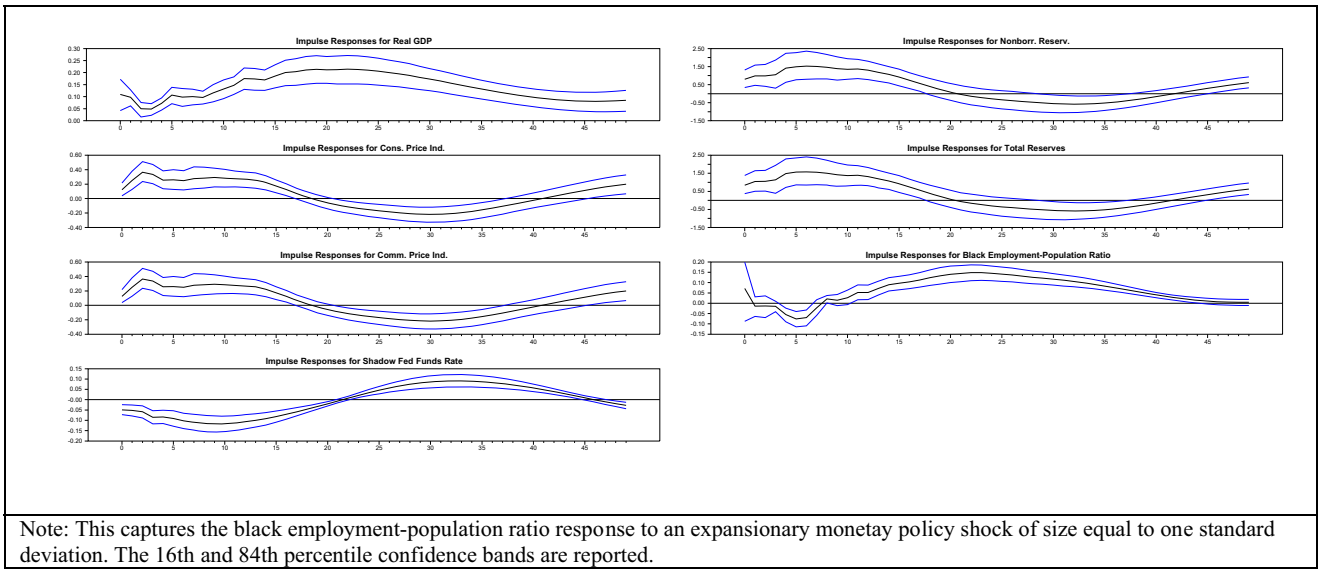
Furthermore, existing research provides justification for such restrictions. According to Strongin (1995), accommodative monetary policy leads to permanent and significant increases in prices and a decline in interest rates. Findings from Sims (1992) and Bernanke and Blinder (1992) suggest that output and money rises in response to an expansionary monetary policy disturbance. Likewise, Christiano et al. (1999) results suggest increases in non-borrowed reserves and total reserves are associated with expansionary monetary policy shocks.

The sign restrictions are summarized in Table 1.

Relevant literature lacks an empirically grounded method for determining the proper restriction horizon; therefore, similar to Uhlig (2005), we determine the horizon selection to be five periods (months). After calculating impulse responses, we check if the responses of the variables to the shock have the correct sign for the appropriate length of time. If so, the responses are kept; otherwise, they are discarded. Using the kept responses, we then minimize a distance criterion from the median impulse responses. Finally, we present the set of impulse responses that are closest to the median responses as possible, along with the 84th and 16th percentile confidence bands. This median target method for model identification was put forth by Fry and Pagan (2011).

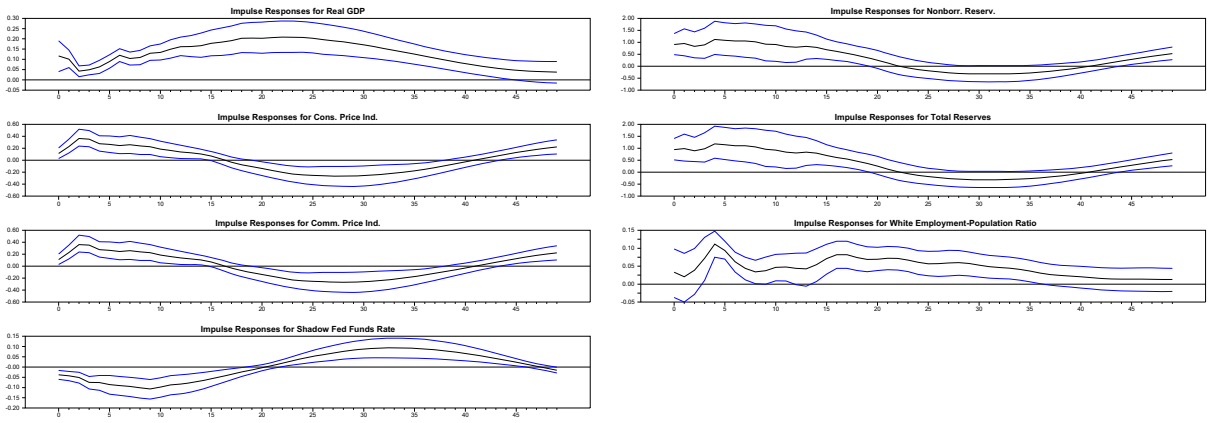
Results

Again, we generate four sets of impulse responses, each containing one employment measure (the employment-population ratio or the unemployment rate) for whites or blacks along with six other macroeconomic variables used to identify the monetary policy shock. The main results are displayed in Figs. 2, 3, 4, and 5; Figs. 2 and 3 present employment-population ratio responses for blacks and whites



Note: This captures the black employment-population ratio response to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported.

Fig. 2 Black employment-population ratio responses. Note: This captures the black employment-population ratio response to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported



Note: This captures the white employment-population ratio response to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported.

Fig. 3 White employment-population ratio responses. Note: This captures the white employment-population ratio response to an expansionary monetary policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported

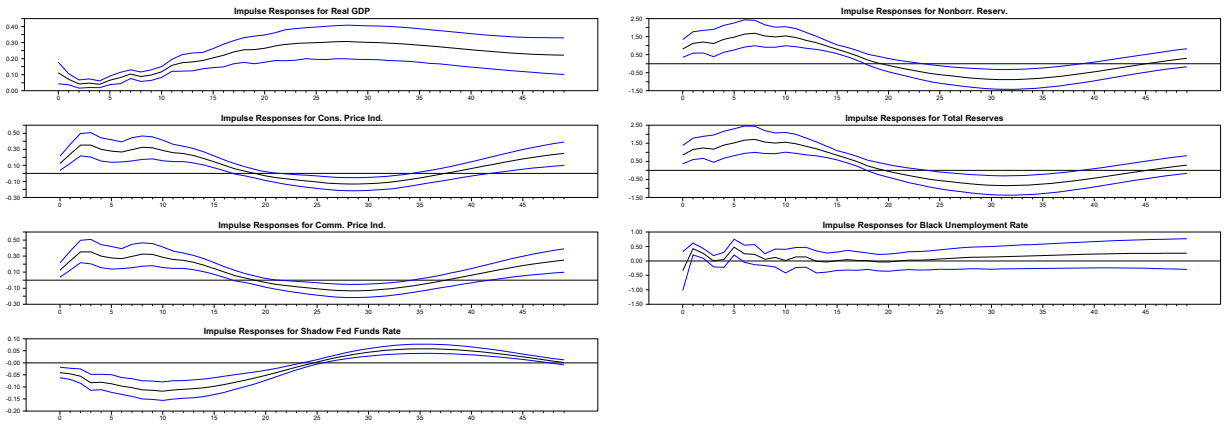
and Figs. 4 and 5 present unemployment rate responses for blacks and whites.

Employment-Population Ratio

As seen in Figs. 2 and 3, the white employment-population ratio response is positive and more immediate than that of blacks. Roughly 5 months after a one-standard deviation expansionary monetary policy shock, the black employment-population ratio falls by 0.08%. Comparatively, the white employment-population ratio increases by 0.11% 4 months after the shock. These results suggest that initially displaced white workers re-enter the labor force while displaced black workers exit.

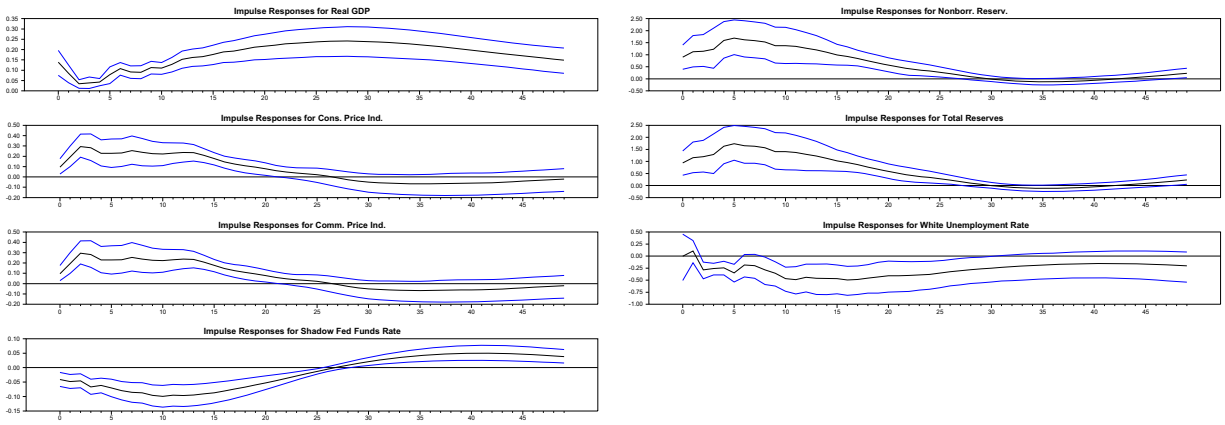
Although white employment initially outpaces black employment following a shock, gains in black employment become most pronounced 2 years after the shock, with the employment-population ratio rising by 0.15%. Over the same time horizon, the white employment-population ratio grows by only 0.06%. Consistent with existing studies, we find black labor market responses since the end of the Great Recession are far more sensitive to monetary policy shocks than their white counterparts.

Figures 2 and 3 also display impulse responses to a one standard deviation expansionary monetary policy shock for



Note: This captures the black unemployment rate response to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported.

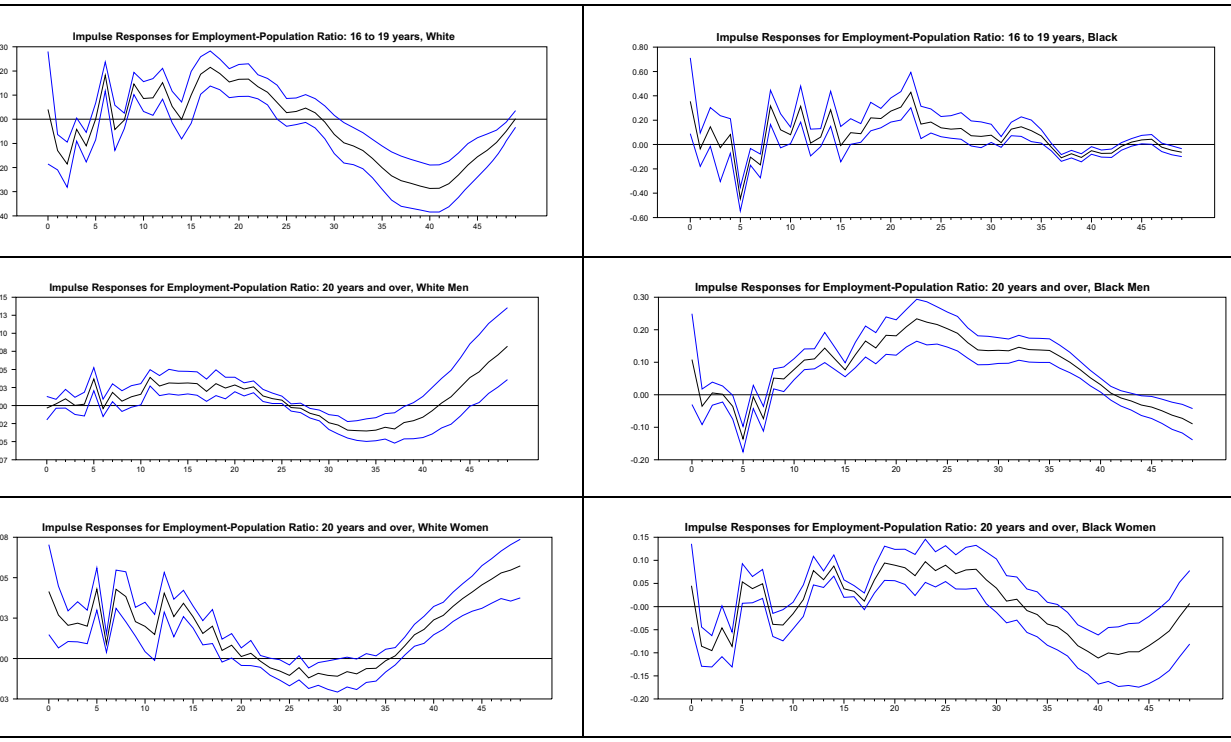
Fig. 4 Black unemployment rate responses. Note: This captures the black unemployment rate response to an expansionary monetary policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported



Note: This captures the white unemployment rate response to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported.

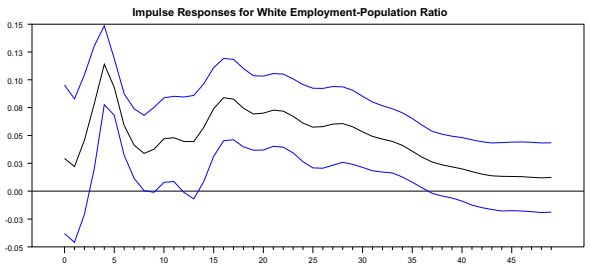
Fig. 5 White unemployment rate responses. Note: This captures the white unemployment rate response to an expansionary monetary policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported

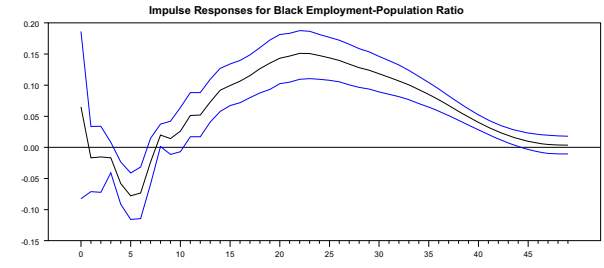
the other macroeconomic variables in the system. Except slight differences in magnitudes, economic variables respond similar across specifications, and all six variables respond immediately. According to the black employment-population ratio specification, real GDP rises by as much as 0.21%, the consumer and commodity price indexes rise by as much 0.33% then gradually decline, and the shadow federal funds rate remains negative for 20 months before it reverses course. Reserves (total and non-borrowed) respond immediately to the monetary policy shock and rise by as much as 1.6%. The positive movement in reserves help rule out the possibility of a negative money demand shock driving the economic



Note: Impulse responses of the employment-population ratio by race, age, and sex, to an expansionary monetay policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported.

Fig. 6 Employment-population ratio responses by age and sex. Note: Impulse responses of the employment-population ratio by race, age, and sex, to an expansionary monetary policy shock of size equal to one standard deviation. The 16th and 84th percentile confidence bands are reported





Note: Impulse responses of the employment-population ratio to an expansionary monetay policy shock of size equal to one standard deviation and a restriction horizon k = 8.

Fig. 7 Employment-population ratio responses with longer restriction horizons. Note: Impulse responses of the employment-population ratio to an expansionary monetary policy shock of size equal to one standard deviation and a restriction horizon $k = 8$

expansion. Note that the forecast error variance decompositions for Figs. 2 and 3 are in the Appendix.

Unemployment Rate

According to Fig. 4, the impact of an expansionary monetary policy shock on the black unemployment rate is largely insignificant; however, contrary to expectations, there is a brief positive jump 1 month after the shock. The response of the unemployment rate for whites (in Fig. 5) conforms to expectations, in that it declines following the shock. Specifically, 4 months after the shock, the white unemployment rate experiences a 0.35 percentage change and later declines by as much as 0.5 percentage.

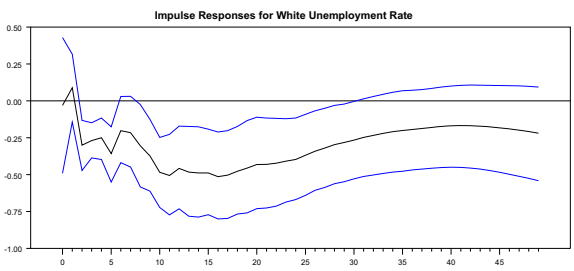
As the results indicate, blacks and whites faced a different labor market demand following the Great Recession. Hence, the heterogeneous responses to monetary policy over this time period. Initially, white employment increases and black employment declines in response to an expansionary monetary policy shock. However, after 2 years, black employment responds positively to the shock and its response is larger than that of whites. This heterogeneity in labor market response leads us to further disaggregate employment-population responses by age and sex in attempt to gain a deeper understanding of the potential breakdown in the monetary policy transmission channel.

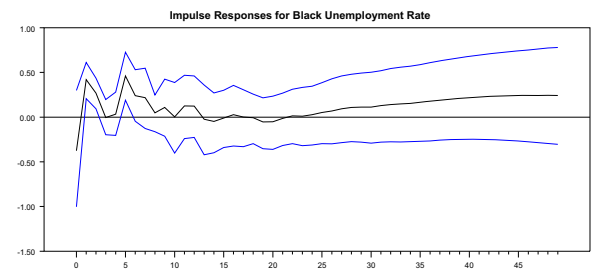
Employment-Population Ratio by Age Groups

Ideally, we would like to focus on the prime-age (25–54) employment-population ratio, which is a better measure of labor market health; however, this data is not available at the monthly frequency. So, we estimate separate VARs for teenagers (16 to 19 years old) and adults (20 years and over); we then break out the adults by sex. Not only are teenager less-skilled (educated), but they face a different trade-off between working and studying. For these reasons, it is important we separate teenagers and adults.

Responses for Teenagers

As the top row of Fig. 6 shows, employment falls for white and black teenagers shortly after the monetary policy shock, but it eventually rises and peaks 17 and 22 months, respectively. Moreover, at its peak, the teenage black employment-population ratio is 0.2% higher than its white counterpart. As it relates to the initial decline for both groups, one can imagine





Note: Impulse responses of the unemployment rate to an expansionary monetay policy shock of size equal to one standard deviation and a restriction horizon k = 8.

Fig. 8 Unemployment rate responses to with longer restriction horizons. Note: Impulse responses of the unemployment rate to an expansionary monetary policy shock of size equal to one standard deviation and a restriction horizon k = 8

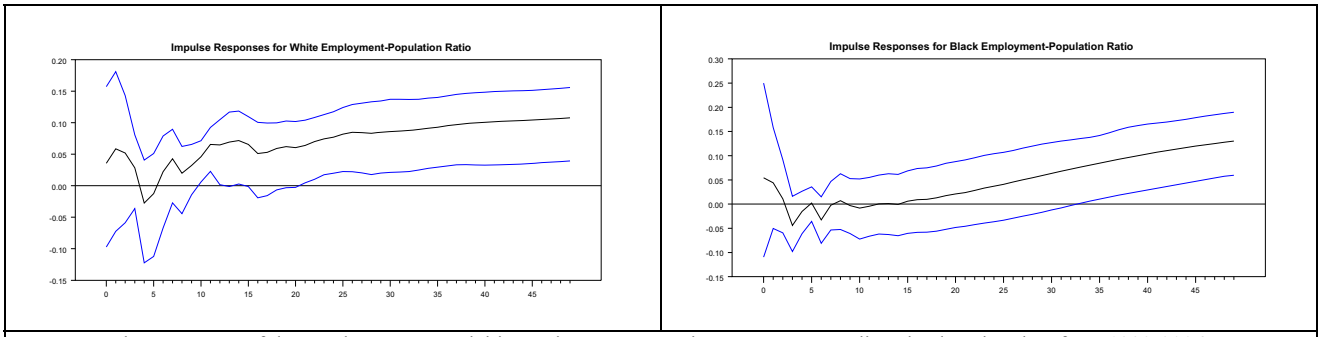


Fig. 9 Employment-population ratio responses pre-Great Recession (1992–2006). Note: Impulse responses of the employment-population ratio to an expansionary monetary policy shock, using data from 1992 to 2006

employers replacing part-time teenage workers with full-time adult workers when the economy starts to improve.

Responses for Adults

The employment-population ratio for adult white men does not respond initially but raises temporarily by 0.04% 5 months after the shock. In contrast, the employment response of adult black men illustrates a decline in employment 5 months after the shock, but employment rises for this group by as much as 0.2% after 22 months.

Employment responses for males and females vary significantly. The employment-population ratio for adult white women rises rapidly, peaks at roughly 0.045%, and remains positive for 18 months following the shock. For adult black women, their response function oscillates from negative to positive throughout the first 15 months following the expansionary monetary policy shock.

At the short horizon, it appears black workers (teenagers and adults) exit the labor market following an expansionary monetary policy shock while displaced white workers re-enter the labor market. At the longer end, black entry into the labor market is higher than that of whites. Note that, even if the cumulative change in black employment exceeds that of whites, the initial decline in black employment should be reason for concern among policymakers.

Robustness

To evaluate the robustness of our results, we extend the restriction horizon, analyze the pre-Great Recession period (1992–2006), and generate results using recursive identification.

Alternative Restriction Horizon

Again, a major drawback to using sign restrictions is the ad-hoc horizon selection process. Consequently, some may question the restriction horizon, or degree of structure, we impose. Therefore, as a robustness check, we generate results using a longer restriction horizon of 8 months, which does not alter or change the results in any significant way. As shown in Figs. 7 and 8, the shapes and magnitudes of the impulse response functions are essentially the same as with our benchmark results.

It is possible to impose restrictions on employment variables at certain horizons, but we chose to remain as agnostic as

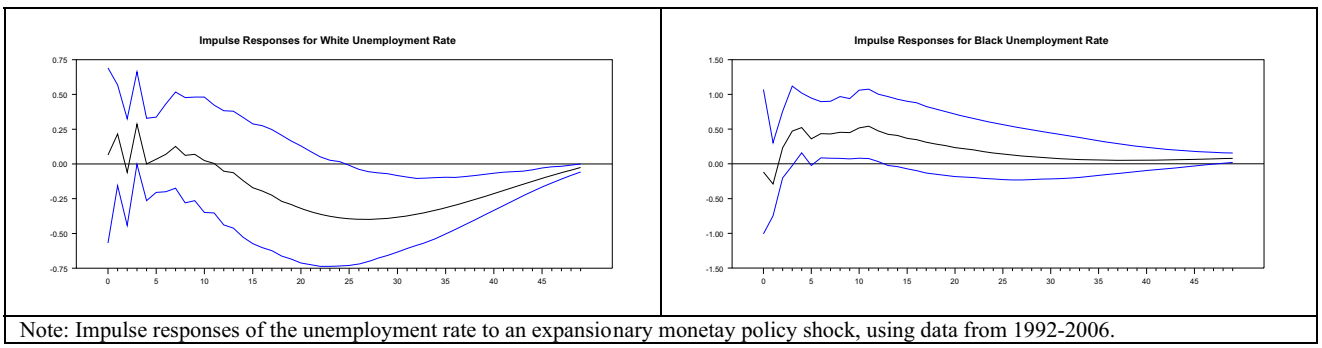


Fig. 10 Unemployment rate responses pre-Great Recession (1992–2006). Note: Impulse responses of the unemployment rate to an expansionary monetary policy shock, using data from 1992 to 2006

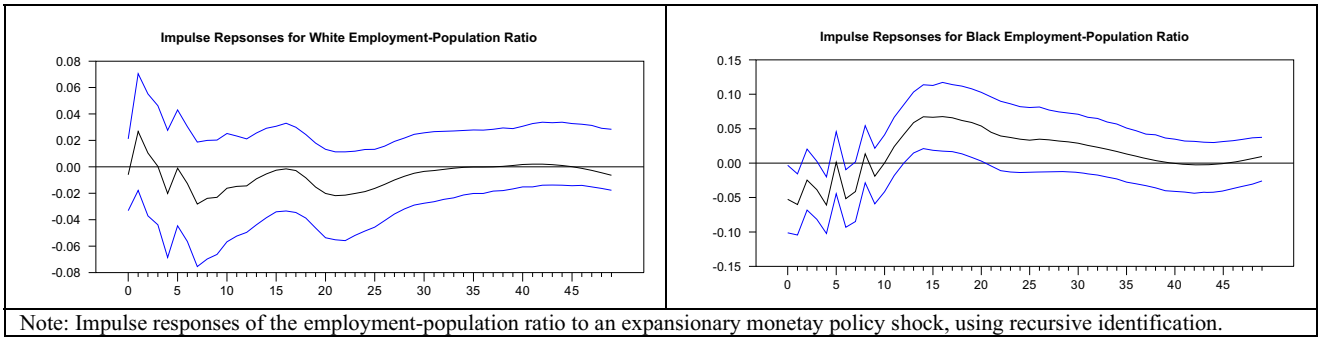


Fig. 11 Employment-population ratio responses from recursive identification. Note: Impulse responses of the employment-population ratio to an expansionary monetary policy shock, using recursive identification

possible about these variables. As with all structural VARs, the researcher must balance having enough restrictions, or structure, to identify the desired behavior and having so many that no shocks actually satisfy them.

Pre-Great Recession Period

As previously stated, the monetary policy landscape shifted in 2008, which explains our focus on the post-Great Recession period. One might expect such a shift to alter monetary policy and labor market dynamics. To confirm whether this is the case or not, we examine the pre-Great Recession impact of monetary policy on employment using a subsample that ranges from 1992 to 2006. Monthly GDP data is not available prior to 1992; therefore, we are unable to use the same sample period as Carpenter and Rodgers (2004) or Thorbecke (2001).

In Figs. 9 and 10, we observe delayed effects on black and white employment, but the immediate impact on both groups is statistically insignificant. More specifically, the black employment-population ratio does not respond until 34 months after the shock occurs. White employment responds slightly sooner. Furthermore, the white unemployment rate exhibits a negative response 27 months after the shock. Consistent with our baseline results, the unemployment rate rises for blacks at the short horizon and displays no effect at the long horizon. Taken together, these results suggest the effects of monetary policy on employment have been more immediate since the Great Recession.

Recursive Identification

Typically, monetary policy shocks are identified by adopting a specific informational ordering of the variables in the VAR system. This approach, known as recursive identification, assumes output and prices are slow-moving variables. Which is to say, they do not respond contemporaneously to the federal funds rate. We use this recursive approach as a robustness check and measure of comparison for our baseline results. Again, the federal funds rate is equal to zero over our sample period; thus, we use the shadow federal funds rate as a proxy.

Figures 11 and 12 reveal similar shapes for the impulse response functions across identification schemes, but magnitudes are smaller under recursive identification. There is largely no statistically significant impact of monetary policy on black and white employment. However, we do observe a brief decline in employment for blacks at 1, 4, and 6 months after the shock, and an increase in black employment 15 months after the shock. In contrast to our main results, the black unemployment rate initially falls—as opposed to rising. In our view, this suggests the identification scheme matters for measuring the impact of monetary policy and more research is needed to verify if this is true for sectors of the economy.

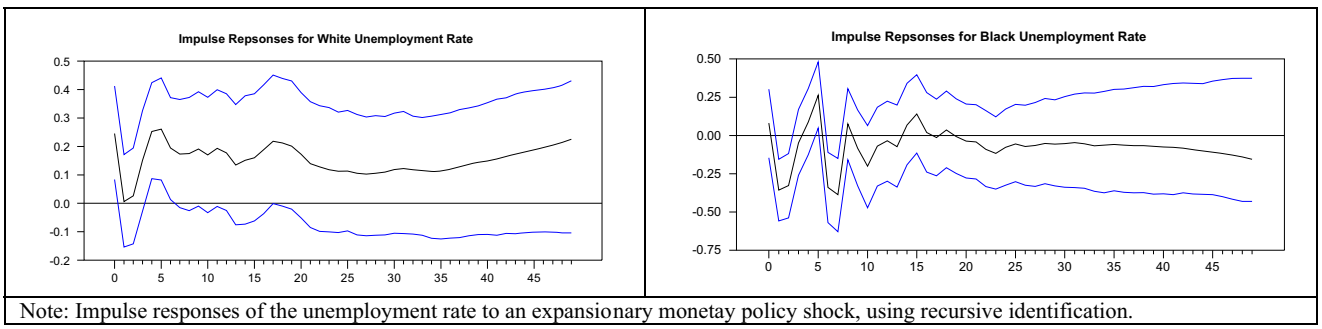


Fig. 12 Unemployment rate responses from recursive identification. Note: Impulse responses of the unemployment rate to an expansionary monetary policy shock, using recursive identification

Conclusion

Given that racial inconsistencies in employment have important implications for economic growth and the extremely accommodative monetary policy measures undertaken by the Fed since the financial crisis, it is natural to ask what impact has monetary policy had on such disparities since the Great Recession? Consistent with the literature, we find that over time black employment is more sensitive to an expansionary monetary policy shock than that of whites, but changes in white employment are more immediate. Interestingly, we find that black employment is not pro-cyclical immediately following an expansionary monetary policy shock and that the black unemployment rate temporarily spikes following the shock. One potential explanation for such findings is that, as firms decide to up-skill jobs in the face of excess labor supply, displaced black workers become discouraged and temporarily exit the labor force. And while the primary policy tool of the Federal Reserve is not well suited to address this issue, other initiatives similar to the Opportunity and Inclusive Growth Institute should be considered.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Appendix 1. Forecast Error Variance Decomposition

Table 2 Forecast error variance decomposition

	Real GDP	CPI	Comm. price ind.	Shadow fed funds	Nonborr. reserves	Total reserves	White employment-pop ratio
1	10.587	10.799	10.799	11.295	17.730	17.632	2.869
2	10.896	10.434	10.434	11.102	16.974	17.050	3.266
3	10.565	10.607	10.607	10.920	15.238	15.564	3.322
4	10.409	10.306	10.306	10.934	14.574	14.945	4.032
5	9.909	10.017	10.017	11.010	13.839	14.241	4.622
6	9.753	9.882	9.882	10.930	13.080	13.466	4.946
7	9.688	9.880	9.880	10.899	12.617	12.965	5.082
8	9.529	9.968	9.968	10.924	12.212	12.535	5.266
9	9.437	10.093	10.093	10.983	11.911	12.209	5.588
10	9.472	10.218	10.218	11.043	11.722	11.992	6.035
11	9.548	10.348	10.348	11.075	11.607	11.852	6.382
12	9.613	10.449	10.449	11.092	11.505	11.732	6.597
13	9.706	10.527	10.527	11.099	11.439	11.652	6.725
14	9.774	10.603	10.603	11.096	11.410	11.611	6.804
15	9.816	10.665	10.665	11.093	11.397	11.590	6.875
16	9.868	10.708	10.708	11.089	11.397	11.584	6.979
17	9.918	10.743	10.743	11.087	11.398	11.581	7.089
18	9.964	10.780	10.780	11.090	11.388	11.570	7.172
19	10.011	10.822	10.822	11.094	11.368	11.548	7.240
20	10.053	10.864	10.864	11.097	11.338	11.516	7.319
21	10.087	10.906	10.906	11.099	11.294	11.471	7.414
22	10.123	10.953	10.953	11.097	11.244	11.419	7.516
23	10.163	11.007	11.007	11.092	11.196	11.369	7.610
24	10.200	11.068	11.068	11.087	11.151	11.321	7.695
25	10.234	11.125	11.125	11.080	11.112	11.280	7.777
26	10.266	11.171	11.171	11.073	11.084	11.250	7.860
27	10.293	11.202	11.202	11.067	11.065	11.228	7.942
28	10.317	11.218	11.218	11.065	11.052	11.213	8.018
29	10.339	11.224	11.224	11.068	11.045	11.204	8.084
30	10.357	11.225	11.225	11.078	11.042	11.199	8.137
31	10.372	11.221	11.221	11.092	11.041	11.197	8.185
32	10.384	11.212	11.212	11.107	11.043	11.197	8.232
33	10.393	11.199	11.199	11.122	11.046	11.200	8.280

Table 2 (continued)

34	10.400	11.181	11.181	11.134	11.051	11.203	8.326
35	10.406	11.159	11.159	11.144	11.056	11.207	8.369
36	10.411	11.134	11.134	11.151	11.062	11.212	8.408
37	10.413	11.105	11.105	11.156	11.069	11.218	8.446
38	10.415	11.071	11.071	11.157	11.078	11.225	8.484
39	10.415	11.033	11.033	11.156	11.087	11.234	8.524
40	10.415	10.989	10.989	11.151	11.098	11.244	8.561
41	10.414	10.942	10.942	11.144	11.110	11.255	8.596
42	10.412	10.893	10.893	11.135	11.122	11.267	8.628
43	10.408	10.844	10.844	11.123	11.135	11.279	8.657
44	10.404	10.796	10.796	11.108	11.148	11.292	8.685
45	10.398	10.750	10.750	11.092	11.162	11.305	8.712
46	10.391	10.706	10.706	11.073	11.176	11.319	8.736
47	10.382	10.667	10.667	11.052	11.191	11.332	8.758
48	10.372	10.633	10.633	11.030	11.205	11.346	8.778
49	10.360	10.603	10.603	11.008	11.218	11.359	8.796
50	10.345	10.580	10.580	10.987	11.232	11.371	8.813
	Real GDP	CPI	Comm. price ind.	Shadow fed funds	Nonborr. reserves	Total reserves	Black employment-pop ratio
1	10.587	10.799	10.799	11.295	17.730	17.632	2.869
2	10.896	10.434	10.434	11.102	16.974	17.050	3.266
3	10.565	10.607	10.607	10.920	15.238	15.564	3.322
4	10.409	10.306	10.306	10.934	14.574	14.945	4.032
5	9.909	10.017	10.017	11.010	13.839	14.241	4.622
6	9.753	9.882	9.882	10.930	13.080	13.466	4.946
7	9.688	9.880	9.880	10.899	12.617	12.965	5.082
8	9.529	9.968	9.968	10.924	12.212	12.535	5.266
9	9.437	10.093	10.093	10.983	11.911	12.209	5.588
10	9.472	10.218	10.218	11.043	11.722	11.992	6.035
11	9.548	10.348	10.348	11.075	11.607	11.852	6.382
12	9.613	10.449	10.449	11.092	11.505	11.732	6.597
13	9.706	10.527	10.527	11.099	11.439	11.652	6.725
14	9.774	10.603	10.603	11.096	11.410	11.611	6.804
15	9.816	10.665	10.665	11.093	11.397	11.590	6.875
16	9.868	10.708	10.708	11.089	11.397	11.584	6.979
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25	10.234	11.125	11.125	11.080	11.112	11.280	7.777
26	10.266	11.171	11.171	11.073	11.084	11.250	7.860
27	10.293	11.202	11.202	11.067	11.065	11.228	7.942
28	10.317	11.218	11.218	11.065	11.052	11.213	8.018
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31	10.372	11.221	11.221	11.092	11.041	11.197	8.185
32	10.384	11.212	11.212	11.107	11.043	11.197	8.232
33	10.393	11.199	11.199	11.122	11.046	11.200	8.280
34	10.400	11.181	11.181	11.134	11.051	11.203	8.326
35	10.406	11.159	11.159	11.144	11.056	11.207	8.369
36	10.411	11.134	11.134	11.151	11.062	11.212	8.408
37	10.413	11.105	11.105	11.156	11.069	11.218	8.446
38	10.415	11.071	11.071	11.157	11.078	11.225	8.484
39	10.415	11.033	11.033	11.156	11.087	11.234	8.524
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44	10.404	10.796	10.796	11.108	11.148	11.292	8.685
45	10.398	10.750	10.750	11.092	11.162	11.305	8.712
46	10.391	10.706	10.706	11.073	11.176	11.319	8.736

Table 2 (continued)

47	10.382	10.667	10.667	11.052	11.191	11.332	8.758
48	10.372	10.633	10.633	11.030	11.205	11.346	8.778
49	10.360	10.603	10.603	11.008	11.218	11.359	8.796
50	10.345	10.580	10.580	10.987	11.232	11.371	8.813

Appendix 2. Cointegration and Unit Root Tests

Table 3 Engle-Granger cointegration tests

	Key variable	
Number of fixed lags	Black emp.-pop. ratio	White emp.-pop. ratio
0	− 5.90***	− 2.78***
1	− 4.51***	− 2.60***
2	− 3.24***	− 2.93 ***
3	− 3.51***	− 3.84***
4	− 3.75***	− 3.79 ***
5	− 3.07***	− 3.53***
6	− 2.96***	− 3.21***

Null hypothesis: no cointegration

Indicators of marginal significance levels: 10%(*); 5% (**); 1% (***)

Table 4 Augmented Dickey-Fuller tests

	Real GDP	CPI	Comm. price ind.	Shadow fed funds	Nonborr. reserves	Total reserves	White employment-pop ratio	Black employment-pop ratio
No trend included	− 0.05	− 2.46	− 2.46	− 1.14	− 2.08	− 1.58	− 3.66***	0.18
Lags	2	1	1	3	1	1	1	1
Trend included	− 2.76*	− 2.53	− 2.53	2.05	− 1.31	− 1.06	− 5.92***	− 2.51
Lags	2	1	1	0	1	1	1	1

Note: Akaike, Bayesian-Schwartz, and Hannan-Quinn information criterion is used to select number of lags for reported statistic. Null hypothesis: has unit root

Indicators of marginal significance levels: 10%(*); 5% (**); 1% (***)

There is evidence of cointegration; however, including many variables in a VAR can lead one to believe variables trend together when they really do not (Enders 2008). We decide against an error correction model in favor of the sign restriction model since it will allow us stronger identification.

Contrary to unit root tests results, we do not first difference the variables in the VAR. Instead, variables enter the system in levels, which provides a basis for comparing our results to others in the literature. Moreover, according to Stock and Watson (2003), researchers can rarely be sure whether a series has a stochastic trend or not, due to the low power associated with most unit root tests.

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