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Abstract

Using 136 United States macroeconomic indicators from 1973 to 2017, and a factor augmented vector autoregression (FAVAR) framework with sign restrictions, we investigate the effects of three structural macroeconomic shocks - monetary, demand, and supply – on the labour market outcomes of black and white Americans. Our results indicate that adverse macroeconomic shocks have differential effects on labour market outcomes for blacks and whites, hurting blacks disproportionately relative to whites. Black Americans appear to be significantly more sensitive to macroeconomic shocks than white Americans. Evidence from our FAVAR model, which uses information on contractionary initiatives by the Federal Reserve, indicates that the employment-population ratio among black Americans falls close to twice as much as that among white Americans, primarily due to an increase in their unemployment rate and not a decline in labour force participation rate. Policymakers should take account of these heterogeneous effects across racial groups when implementing disinflationary guiding policy.

JEL-Codes: C320, E240, E320, E520, J100, J150.

Keywords: macroeconomic shocks, monetary policy, business cycles, labour market, unemployment, racial inequality, FAVAR, sign restrictions.

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I. Introduction

Inequality in the United States continues to be a focal point of policy makers and social scientists alike. One area of inequality is the difference in labour market outcomes for black and white Americans. It is well known that black workers often face lower wages and higher unemployment than white workers, and there exists a large literature which attempts to better understand racial labour market differences over time and across business cycles; see for example Queneau and Sen (2012), Hoynes, Miller, and Schaller (2012), Cajner et al. (2017), and Borowczyk-Martins, Bradley, and Tarasonis (2018). [1]

This study fits in the macroeconomics literature which examines the relationship between macroeconomic shocks and the labour market. Business cycle fluctuations affect the labour market experience of all racial and demographic groups. The cyclical behaviour of the employment-population ratio and unemployment rate is a prevailing feature of labour markets. While the employment-population ratio and unemployment rate of different racial and demographic groups show similar cyclical pattern, the levels at which they fluctuate and the magnitude of these fluctuations may differ across racial groups, breeding inequality in the labour market. In this paper, we examine whether macroeconomic shocks exacerbate black-white inequality in the labour market via differential effects on the unemployment rate, employment-population ratio, and labour force participation rate. We study three fundamental macroeconomic shocks and potential drivers of business cycles: monetary policy shock, aggregate demand shock, and aggregate supply shock; and examine how they impact the labour market outcomes for blacks and whites in the US.[2] Further, within the labour market, we jointly focus on the unemployment rate, employment population ratio, and labour force participation rate to understand if underlying changes in the labour market are driven by labour demand or labour supply dynamics. Our analysis uses monthly data of 136 macroeconomic time series from 1973 to 2017, and factor augmented vector autoregression (FAVAR) framework of Bernanke, Boivin, and Eliasz (2005) and Stock and Watson (2011). Within this framework, we identify structural shocks using the sign restrictions identification strategy of Peersman (2005) and Uhlig (2005), and estimate the model using Bayesian estimation methods generalized by Rubio-Ramirez, Waggoner, and Zha (2010).

This work expands the existing literature in a number of innovative ways. First, much of this literature has primarily focused on monetary shocks. While we look at monetary policy shocks, we also study the other fundamental macroeconomic shocks and drivers of business cycles, that is, aggregate demand and supply

[1]See Fairlie and Sundstrom (1999) for discussion of the long-standing gap between black and white unemployment rates. In August 2019, the seasonally adjusted unemployment rate for blacks was 5.5%, while for whites was 3.4%, and so a large gap remains even after the significant recent declines in black unemployment rates.

[2]To make these shocks clear, examples of "demand shocks" include unexpected changes in income, wealth or consumer sentiments, while "supply shocks" can include things such as extreme weather shocks, productivity shocks, or oil shocks. Lastly, a "monetary policy shock" occurs when the central bank engages in interest rate or money supply changes that are unexpected.

shocks, in determining if black and white individuals are impacted differently in the labour market from such cyclical shocks.[3] Further, through variance decompositions, we assess the quantitative importance of the above macroeconomic shocks in driving labour market dynamics across the racial groups.

An additional contribution is our use of a factor-augmented vector autoregression (FAVAR) approach which has a number of statistical advantages over traditional VAR approaches seen in this literature. As pointed out in Bernanke, Boivin, and Eliasz (2005), FAVAR models allow for the study of economic concepts such as "economic activity", "price level" or "monetary conditions" that are imperfectly observable, and may not be captured by a single variable as used in a traditional VAR. Many alternative measures of these concepts may be informative, and the FAVAR framework provides one integrated approach for combining multiple data series through factor analysis.[4] Bernanke et al. (2005) further explain that combining multiple data series through factor analysis provides more accurate estimates of economic concepts as opposed to using single data series for each concept, and may better reflect the true information set used by policymakers when making decisions.[5] For instance, monetary policy, in practice can be conventional and/or unconventional. Monetary policy may not be exclusively represented or measured by just the federal funds rate, but rather a whole package of actions by the Fed which may involve many different short-term interest rates, long term interest rates, and monetary aggregates. This is most reflective in the post-recession period (2008-2015), when the federal funds rate hit the zero lower bound and became an ineffective policy tool, in response to which the Fed resorted to unconventional monetary policies and other more quantitative measures of monetary policy tools to exert further influence on the economy. During such regimes of unconventional monetary policy, just using one short term interest rate, that is, the federal funds rate in a VAR may not correctly measure true monetary policy. However instead a "monetary policy factor" estimated from all different short term interest rates, long term interest rates and monetary aggregates, as an indicator of monetary policy in a FAVAR framework will allow for conditioning the

[3]We also consider whether there are labour market differences across gender lines within racial groups with respect to these shocks. However we do not present the analysis or include the discussion in the main text of the current paper in order to save space. Rather we keep the basic discussion to footnotes later in the paper. The extended results and discussion can be made available upon request.

[4]The information from a large number of time series can be coherently summarized by a relatively small number of estimated factors (Bernanke et al., 2005).

[5]A major criticism of traditional VARs is that it can employ a limited number of variables to preserve degrees of freedom. The sparse information set is unlikely to reflect the true information set used by economic agents, financial market participants, policymakers and central bankers who use over hundreds of data series to make decisions. As such one is left with the real concern of model misspecification and biased estimates due to the small number of variables the VAR model can handle (for example see the explanation of "price puzzle" in Sims, 1992). Moreover, to the extent that the true information set is not captured in VAR analysis, the measurement of structural shocks will also get contaminated. Dynamic factor models directly address the primary drawback of traditional VARs, as it is explicitly designed to capture vast amounts of information in a parsimonious way without losing degrees of freedom. Through a FAVAR approach we are able to condition our empirical analysis on a richer information set without abandoning the statistical advantages of traditional low dimensional VARs.

analysis on the true information set, and correctly measuring the monetary policy (capturing both the conventional and unconventional part). This eliminates any model misspecification bias by construction.

Finally, the key step in applying FAVAR methodology to the question at hand lies in identifying the structural shocks correctly. Therefore, a final contribution of our study is the use of the more robust and less restrictive sign restrictions approach to accurately identify structural macroeconomic shocks, when investigating the effects of such shocks on racial labour market differences. We use the sign restrictions approach over traditional Cholesky decomposition (recursive ordering mostly used in the literature) for identification of structural shocks in our study. Canova and Pina (1999) argue that there is not enough theoretical evidence to justify a zero contemporaneous impact of macroeconomic shocks on output (Cholesky decomposition), and such a restriction is also not consistent with a large family of general equilibrium models. The main advantage of the sign restrictions approach is that shocks are identified not based on a zero restriction in the short run or long run (which require strong a priori theoretical assumptions), but based on the direction of their impact on the variables in the system; this by construction eliminates any kind of puzzling impulse responses which are sometimes considered as "identification failures" in the literature (Uhlig, 2005).[6] Peersman (2005) further confirms that if conventional identification strategies (based on Cholesky decomposition) produce impulse responses which are consistent with the sign restrictions, then these responses mostly lie in the tails of the distributions of the set of all impulse responses admitted by sign restrictions. In Section III, we will expound up on the advantages of our econometric model and identification strategy in more detail. It is our understanding that we are the first to use a FAVAR model to examine this research question. By conditioning our analysis on the true information set in an integrated FAVAR framework, and using the more robust sign restrictions identification strategy, we are able to better track the dynamic effects of macroeconomic shocks on labour market conditions.

Previewing our results, we report three principal findings from our empirical study. First, adverse macroeconomic shocks (negative demand shock, negative supply shock, and contractionary monetary policy shock) lead to an increase in the unemployment rate and a decline in the employment population ratio among Americans to a statistically significant and economically meaningful extent. The impact of supply shocks on the labour market appear to be stronger and more permanent compared to that of demand shocks and monetary policy shocks. The labour force participation response is small and statistically insignificant in response to all three macroeconomic shocks. Given the strong response of unemployment, and a lack of response in the labour force participation rate (LFPR) we interpret these as changes to labour

[6]See for example Sims (1992) and Christiano, Eichenbaum, and Evans (1994) for issues related to Cholesky decomposition and "price puzzles".

demand rather than labour supply decisions. We infer that an increase in unemployment, rather than a decrease in the labour force participation rate is contributing to the declining employment population ratio. Second, there appears to be strong heterogeneity in the labour market responses (in particular unemployment rate and employment-population ratio) faced by Americans across racial groups to the adverse macroeconomic shocks. The heterogeneous effects vary systematically across racial groups: the unemployment rate of blacks increases disproportionately, and the employment-population ratio of blacks falls far more than that of whites. We note that the unemployment rate and employment-population ratio of black Americans are more sensitive to macroeconomic shocks than whites. Third, macroeconomic shocks seem to play a non-trivial role in accounting for fluctuations in the unemployment rate and employment-population ratio, indicating that these shocks are important drivers of the labour market. Forecast error variance decompositions suggest that the contribution of macroeconomic shocks to labour market movements of blacks and whites is of the same order of magnitude (15-20%), as the contribution of these shocks to any other macroeconomic factor like GDP or inflation.

Our study holds important policy implications. In particular, we document that contractionary monetary policy shocks exacerbate racial labour market differences, and account for 15-20 percent of the labour market movements for blacks and whites. Following disinflationary policy shocks, unemployment among black Americans rises almost 1.7 times as much as that among white Americans. Our results suggest that policymakers should take account of these unintended heterogeneous effects, when implementing disinflationary guiding policy.

Note that our study does not examine why the black and white unemployment rates and employment population ratio respond differently to exogenous monetary policy shifts and other macroeconomic fluctuations. The literature that compares labour market patterns among whites and non-whites suggests that differences in educational attainment, demographics, location, skills, experience, industrial representation, and racial discrimination may play a role in explaining the differential labour market responses (discussed in literature section below). Future research should examine further, why the labour markets of blacks and whites show different cyclical responses to macroeconomic shocks.

The rest of this paper proceeds as follows. Section II provides an overview of the literature on macroeconomic shocks and inequality, with most of the focus on the labour market. Section III details the data used in this study as well as an explanation of the FAVAR approach. Section IV presents the results and subsequent discussion, while section V concludes.

II. Literature Review

There is growing interest in examining the relationship between macroeconomic shocks and inequality. Recent theoretical work on the topic that demonstrate how shocks can affect inequality include Gornemann et al. (2016), Ahn et al. (2018), Kaplan and Violante (2018), and Auclert (2019). The impact of macroeconomic shocks on inequality has also been empirically validated by a number of studies. For example, Bivens (2015) investigates the impact of Federal Reserve actions during the Great Recession, and finds that monetary expansion strongly reduced inequality. Coibion, Gorodnichenko, Kueng, and Silvia (2017) using micro-level data confirm that monetary policy shocks contributed significantly to historical cyclical variations in inequality in the US. More recently, Furceri, Loungani, and Zdienicka (2018) use a cross-country panel dataset to find that tightening monetary policy increases inequality while, to a lesser extent, monetary easing lowers inequality. Amaral (2017), however, argues that the redistributive impact of monetary policy is small at best.

Keeping our objective in mind, below, we discuss in particular the literature on macroeconomic shocks and racial inequality in the labour market. There is a rich literature on monetary policy shocks and racial labour market differences. In the context of monetary policy shocks, the most straightforward question is whether the levels at which the unemployment rates fluctuate and the amplitude of these cyclical fluctuations are similar across the racial groups or not. In a seminal paper, Abell (1991) documents strong heterogeneity in the labour market responses of racial groups to monetary policy shocks. Thorbecke (2001), using a VAR approach for the period 1973-1996, finds that contractionary monetary policy shocks increase black unemployment rates significantly more than white unemployment rates. The author finds that following disinflationary policy shocks, unemployment among non-whites rises more than twice as much as that among whites. Carpenter and Rodgers (2004) implement VAR and autoregressive distributed lag (ARDL) models using US data from 1973-2002, and find that contractionary monetary policy shocks affect the employment-population ratio of minorities more than it affects that of whites, and that this difference is mostly the result of an increase in unemployment rather than decrease in labour market participation.[7] Zavodny and Zha (2000), using a VAR framework also conclude that exogenous monetary policy shifts have larger effects on the black unemployment rate relative to the overall unemployment rate. The authors however assert that exogenous monetary policy shocks are not a primary driver of the persistent difference between black and overall unemployment rates, which can be primarily attributed to structural factors.

[7]Rodgers (2008) uses similar methodologies in a study on the impact of monetary policy on the duration of unemployment. Although the author finds that the growth of unemployment duration is larger for whites, he finds evidence that African Americans were harmed more severely overall by disinflationary monetary policy.

Relative to monetary policy shocks, the disparate effect of other business cycle shocks (demand and supply shocks) on labour market outcomes across racial groups is relatively understudied in the literature. Clark and Summers (1981) examines the demographic patterns of business cycle fluctuations in the labour market, and finds that the labour market behaviour of non-whites is much more responsive to cyclical conditions than that of whites. Ewing, Levernier, and Malik (2002) using VAR techniques find that macroeconomic output shocks affect the unemployment rates of blacks more persistently and to a greater magnitude than that of whites. More recently, Bredemeier and Winkler (2017) employing a Bayesian VAR examine differences in labour market dynamics across population subgroups, and find that supply shocks are the key drivers of heterogeneity in the labour market.

In sum, the literature confirms the differential impact of macroeconomic shocks across racial and population sub groups in the labour market. A natural question then is "what explains these differential effects?" Blanchard (1995) argues that an adverse demand shock or a monetary contraction has "ladder effects," adversely affecting lower income individuals who are positioned at lower steps of the ladder. Blanchard and Katz (1997) document that unskilled individuals have significantly higher labour supply elasticities relative to skilled individuals, and so a fall in the demand for labour as the economy slows down will impact the overall employment prospects of less-skilled workers significantly more. As a result, the increase in unemployment following contractionary monetary policy shocks is naturally going to be much larger for low-skilled individuals than for high-skilled workers. Since African-American workers have on average less education and skills than whites, the literature suggests that negative shocks will have larger effects on African-American workers relative to whites. Another intuitive explanation for the differential effect could be that different sectors of the economy are over- or under-represented by minorities and therefore sectoral differences in response to these shocks may seem like racial differences. While Bredemeier and Winkler (2017) find evidence that differential industry or occupational responses to macroeconomic shocks drive the differential labour market responses of blacks and whites, Carpenter and Rodgers (2004) do not find much evidence in favor of this explanation.[8] Hoynes et al. (2012) also document that the demographic composition of sectoral employments and difference in hiring rates across age groups can account for significant differences in employment volatilities among population sub groups and minorities.

Our work builds upon the existing literature in several ways. First, we study the impact of three fundamental macroeconomic shocks which are potential drivers of business cycles- aggregate demand, aggregate supply, and monetary policy shocks. Second, we use a more rigorous econometric framework, a FAVAR model,

[8]Bredemeier and Winkler (2017) argue, for example, that dynamics in employment ratios between genders and education groups can be related to the higher likelihood of men and the less educated to work in construction-intense sectors, which are very sensitive to supply shocks.

over traditional VARs to conduct our study. By utilizing a dynamic factor model, we are able to conduct our empirical analysis on the true information set which is more closely followed by economic agents and policymakers. Our FAVAR model summarizes information from over a hundred time series that potentially span the space of structural disturbances and assist in accurate identification of the structural shocks. Third, within this framework we rely on the more robust and less restrictive sign restrictions identification strategy of Uhlig (2005) and Peersman (2005), instead of traditional Cholesky decomposition (recursive ordering which may require stronger a priori theoretical assumptions) to identify the structural shocks. The advantage of the sign restrictions approach is that shocks are identified not based on a zero restriction in the short run or long run, but based on the direction of their impact on the variables in the system. This leads to better identification and measurement of structural shocks (Peersman, 2005). In the next section, we pick up on these advantages in more detail.

In sum, by conditioning our analysis on the true information set in an integrated FAVAR framework, and using the more robust sign restrictions identification strategy, we are able to better track the dynamic effects of exogenous macroeconomic disturbances on labour market conditions. Note that our study does not however examine why the labour market responses of blacks' and whites' are different to the macroeconomic shocks. The literature suggests that differences in educational attainment, skills, experience, industrial representation, and racial discrimination may play a role in explaining differences in labour market responses.

III. Data and Empirical Approach

Empirical Model

The purpose of our study is to examine the impact of macroeconomic shocks on labour market outcomes across racial groups. To achieve our objective, we make use of a Bayesian factor-augmented vector autoregression framework (Bernanke, Boivin, and Eliasz, 2005 and Stock and Watson, 2011). Our primary motivation in using a FAVAR model is its multiple distinctive advantages over traditional low-dimensional VARs. As pointed out in Bernanke, Boivin, and Eliasz (2005), a FAVAR model allows for the study of economic concepts such as "economic activity" or "monetary conditions" that are imperfectly observable, and that may not be captured by a single variable as used in a traditional VAR. For example, "economic activity", "interest rate", and "monetary policy" are concepts that cannot be perfectly measured by any one single macroeconomic indicator (Bernanke, et al., 2005; Forni and Gambetti, 2014; Bahadir and Lastrapes, 2015; Sun and De, 2019). Many different macroeconomic time series may be informative, and FAVAR

models provide an integrated approach for combining multiple time series through factor analysis.[9] Fernald et al. (2014) further argue that estimated latent factors provide for more accurate and consistent measures of economic concepts than any single reported data series. For instance, monetary policy, in practice can be conventional and/or unconventional. Monetary policy may not be exclusively represented or measured by just the federal funds rate, but rather a whole package of actions by the Fed which may involve many different short-term interest rates, long term interest rates, and monetary aggregates. This is most reflective in the post-recession period (2008-2015), when the federal funds rate hit the zero lower bound and became an ineffective policy tool, in response to which the Fed resorted to unconventional monetary policies and other more quantitative measures of monetary policy tools to exert further influence on the economy. During such regimes of unconventional monetary policy, just using one short term interest rate, that is, the federal funds rate as an indicator of monetary policy will not correctly measure the true monetary policy, and potentially bias the results due to model misspecification. However instead a "monetary policy factor" estimated from all different short-term interest rates, long term interest rates, and monetary aggregates as an indicator of monetary policy in the FAVAR framework will allow for the correct measurement of monetary policy (capturing both the conventional and unconventional part), and eliminate any kind of model misspecification bias. The richer information set in the FAVAR model more closely reflects the true information set used by private businesses, and public policy makers, and assists in correct measurement of structural shocks.[10] We therefore make use of the more recent FAVAR framework over a standard VAR framework for our study, allowing us to conduct our analysis on a much larger and richer information set than a traditional VAR would allow. Below we explain our model.

Let X_t be a n-order vector stochastic process for a set of "informational macroeconomic observables", and F_t be a q- order vector of "common latent factors". The informational observables primarily assist in extracting common latent factors. Λ is the $n \times q$ matrix of "factor loadings". Given a time series realization of X_t and the observable subset of Y_t, we estimate the following dynamic common factor model of Bernanke et al. (2005), and Stock and Watson (2011), in Equations (1) and (2). The FAVAR model in state-space form is given by the following:

$$X_t = \Lambda F_t + \upsilon_t \tag{1}$$

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = B(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{ft} \\ \epsilon_{yt} \end{bmatrix} \tag{2}$$

[9]Broad macroeconomic concepts can be estimated as latent factors from a large number of related macroeconomic indicators, and augmented into a standard VAR making it a "factor-augmented" VAR. Doing so will allow us to condition our empirical analysis on a richer information set without abandoning the statistical advantages of traditional low-dimension VARs. For more details, refer to Bernanke et al. (2005) and Stock and Watson (2011).
[10]See footnote 4.

Eq. (2) can be more compactly written as:

$$Z_t = B(L)Z_{t-1} + \epsilon_{zt} \quad (3)$$

where, Z_t follows the linear dynamic process:

$$Z_t = B_1 Z_{t-1} + B_2 Z_{t-2} \ldots + B_p Z_{t-p} + \epsilon_{zt} \quad (4)$$

Z_t is an $m \times 1$ vector of information at date $t = 1, \ldots\ldots, T$, B_i are coefficient matrices of dimension $m \times m$ and ϵ_{zt} is the one-step ahead forecast error with variance-covariance matrix Σ. The system in Eq. (3) is the reduced form from a dynamic structural model. Our objective is identifying how variables in the system Z_t respond to aggregate macroeconomic structural shocks. The structural counterpart of Eq. (3) in moving average form is given by:

$$Z_t = (I - B_z L)^{-1} D_z u_{zt} \quad (5)$$

$$Z_t = (D_0 + D_1 L + D_2 L^2 + \cdots) u_{zt} \quad (6)$$

where, u_{zt} is a vector of macroeconomic structural shocks, and $E(u_{zt} u_{zt}')$ is normalized to be the identity matrix. The mapping from the reduced form to the structural form entails restrictions only on the covariance structure:

$$\Sigma = E(\epsilon_{zt} \epsilon_{zt}') = D_z E(u_{zt} u_{zt}') D_z' = D_z D_z' \quad (7)$$

Once we identify the $m \times m$ matrix D_z using this mapping (Equation 7), we obtain the dynamic multipliers of interest from Equation (2) using Equations (3-6). Note that we need not fully identify D_z, because we are solely interested in three structural macroeconomic disturbances spanning the economy: aggregate demand shock, aggregate supply shock, and monetary policy shock. We therefore need to impose identifying restrictions only to columns of matrix D_z that correspond to the above three structural shocks.[11]

Data and Model Specification

Our dataset consists of 136 macroeconomic monthly time series for the U.S. economy, with complete coverage from 1973:01 to 2017:04. We obtain the data from the St. Louis Federal Reserve Economics Data (FRED), International Financial Statistics (IFS), Bureau of Labour Statistics (BLS), and Institute for Supply Management (ISM), and seasonally adjust them prior to use. We take first differences of the logarithm of the variables to induce stationarity, except for those reported in percent form, which we use directly.[12] We provide a detailed description of the data (factors and observables) and their transformation, as well as construction of the latent factors and their loadings, in the Appendix. Appendix figures A1-A3 present

[11]There are *m* fundamental innovations which are mutually independent and normalized to be of variance 1: they can therefore be written as a vector u_t of size *m x 1* with $E[u_t u_t'] = I_m$

[12]We follow Bernanke et al. (2005) for choice of series and their transformations. See Appendix.

summary labour market behaviour of blacks and whites over the sample period. We note, in particular, that the unemployment rate of blacks was significantly higher than whites, while the employment to population ratio of blacks was significantly lower than whites over our study period.

We estimate the model using the two-step principal component approach (Bernanke et al., 2005; Stock and Watson, 2011; Bahadir and Lastrapes, 2015; De and Sun, 2019 among others use this same approach) in which the factors are estimated by principal components prior to estimation of the FAVAR. The first step is to extract the common latent factors (F_t). The observable subset X_t in Eq. (1) consists of monthly time series of 118 macroeconomic variables over the sample period.[13] We partition X_t into four subsets of similar economic concepts: economic activity, price level, interest rate, and money supply, and extract a static factor from each of the four subsets: $\hat{F}_{st}, s \in (1,4)$. For each subset s, we estimate $\hat{F}_{st}$ as the first principal component of X_{st}: $\hat{F}_{st} = \left(\frac{1}{n}\right) \widehat{\Lambda}_s{}' X_{st}$, where $\widehat{\Lambda}_s$ contains the eigenvectors of X_{st}, normalized so that $\left(\frac{1}{n}\right) \Lambda_s' \Lambda_s = I$. Thus $\{\hat{F}_{1t}, \hat{F}_{2t}, \hat{F}_{3t}, \hat{F}_{4t}\}$ are the estimated common latent factors that serve as a proxy respectively for economic activity, price level, interest rate, and money supply in the United States. The "economic activity" factor is loaded with 74 indicators broadly reflecting overall macroeconomic outlook-industrial production, employment, income, labour earnings, capacity utilization, consumption, business and residential investment, manufacturing, consumer and business sentiment, crude oil price, current account and overall trade activities in the U.S. The "price" factor is loaded with 28 different consumer and producer prices as well as import and export prices. The "interest rate" factor is loaded with 8 treasury interest rates of different maturities as well as the bank prime loan rate. The "money supply" factor is loaded with 8 measures of monetary aggregates. The four estimated factors: economic activity, price level, interest rate, and money supply comprise the macroeconomic sub-system. The macro subsystem measures the overall macroeconomic conditions and the health of the U.S. economy, and assists in identifying the structural macroeconomic shocks. We augment the standard VAR in Eq. (2) with the above estimated latent factors, thus making it a factor-augmented VAR (FAVAR).

The observable subset Y_t in Eq. (2) includes labour market measures of two racial groups: whites and blacks and the variables of primary interest to us. We estimate models separately for unemployment, employment-population, and labour force participation. This leads to three labour market model specifications for the racial groups. Each FAVAR, $[Z_t]'$ in Eq. (3) includes the four latent factors (the economic activity factor, price factor, interest rate factor, and money supply factor) in $[F_t]'$: $[\hat{F}_{1t}, \hat{F}_{2t}, \hat{F}_{3t}, \hat{F}_{4t}]'$ comprising the

[13]The remaining 18 variables comprise of different labour market measures of the racial groups, and are used as observables in our FAVAR.

macroeconomic subsystem, and the following pair of labour market observables of whites and blacks in $[Y_t]'$, $[Y_{1t}, Y_{2t}]'$: A) unemployment rate of whites and blacks, B) employment-population ratio of whites and blacks, C) labour force participation rate of whites and blacks. We estimate the three FAVAR models separately for each shock under investigation.[14]

Identification of Structural Shocks

We use the sign restriction strategy of Peersman (2005) and Uhlig (2005) to identify structural shocks in our work, as opposed to the traditional Cholesky decomposition. Many studies in the literature identify monetary policy shocks using zero restrictions in the short run and long run. However, there is disagreement regarding the use of such identification strategies. Faust and Leeper (1997) show that substantial distortions in the estimations are possible due to measurement errors when using zero restrictions in the long run. As well, Canova and Pina (1999) argue that there is not enough theoretical evidence to justify a zero contemporaneous impact of shocks on output, and such a restriction is also not consistent with a large family of general equilibrium models. To overcome these shortcomings, Canova and De Nicolo (2002), Uhlig (2005), Peersman (2005), Farrant and Peersman (2006), Scholl and Uhlig (2008), Peersman and Straub (2009), Mountford and Uhlig (2009), Abdallah and Lastrapes (2013), and De and Sun (2019) among others use sign restrictions for identification of structural shocks. The advantage of the sign restrictions approach is that shocks are identified not based on a zero restriction in the short run or long run, but based on the direction of their impact on the variables in the system; this eliminates the need for strong a priori theoretical assumptions. Further, because shocks are identified based upon the direction of their impact, sign restrictions can eliminate any kind of puzzling impulse responses (which are considered failures in identification) by construction (Uhlig, 2005).[15] Peersman (2005) confirms that if conventional identification strategies (Cholesky decomposition) produce impulse responses which are consistent with the sign restrictions, then these responses mostly lie in the tails of the distributions of the set of all impulse responses admitted by the sign restrictions. We therefore use the more robust and less restrictive sign restrictions approach to identify the structural shocks.

Table 1 summarizes the sign restrictions used to identify the structural shocks in our model. We adopt the sign restrictions of Peersman (2005) and Uhlig (2005). These widely accepted restrictions are based on standard IS-LM and AD-AS models, which remain at the core of macroeconomics. In addition, the

[14]Further, we also disaggregate the racial groups by gender, and estimate separate FAVAR models for the race-gender effect. The results are available upon request.
[15]Refer to Sims (1992) and Christiano, Eichenbaum, and Evans (1994) for issues related to Cholesky decomposition and price puzzles.

restrictions are widely accepted in the theoretical literature, and are consistent with most dynamic general equilibrium models (Peersman, 2005).[16] After a negative demand shock, the response of output and price is not positive, and there is not an immediate increase in the interest rate. Following, an adverse supply shock, output does not increase, and prices and interest rates do not fall over a selected horizon. Finally, we identify a contractionary monetary policy shock as one that does not lead to an increase in economic activity, price level and nominal money, or a decrease in the interest rate over a selected horizon (Uhlig, 2005). It is important to note here that no restrictions are imposed on the labour market measures of whites and blacks in our study, here we are agnostic about the variables under investigation.

Table 1 summarizes the sign restrictions used to identify the structural shocks in our model.

Table 1: Sign Restrictions

Factors/Observables → Structural Shocks ↓	Economic Activity (Estimated Latent Factor)	Price Level (Estimated Latent Factor)	Interest Rate (Estimated Latent Factor)	Money Supply (Estimated Latent Factor)	Labour Market Measure Whites (Observable)	Labour Market Measure Blacks (Observable)
Aggregate Demand	≤	≤	≤	?	?	?
Aggregate Supply	≤	≥	≥	?	?	?
Monetary Policy	≤	≤	≥	≤	?	?

Note: This table summarizes the sign restrictions to identify exogenous negative innovations to aggregate supply, aggregate demand, and monetary policy in the United States. We adopt the sign restrictions of Peersman (2005) and Uhlig (2005) to identify these structural macroeconomic shocks.[17] No restrictions are imposed on the labour market measures of whites and blacks. We are agnostic about the labour market response of the racial groups under investigation.

Estimation

We fit the FAVAR in Equations (3-4) with seven lags in first differences of the logarithm of the variables except those reported in percentages, which we use directly (for example the interest rate, unemployment rate, employment population ratio, LFPR; see the Appendix for data descriptions and transformations).[18] We also add a constant and a time trend to Equations (3-4).[19] The time period over which we impose sign restrictions to identify the structural shocks is k = 2 months, including the impact period of the shock. We

[16]These effects are consistent with a leftward shift of the aggregate spending or IS curve (for adverse demand shock); LRAS curve (for adverse supply shock); and the LM curve (for contractionary monetary policy shock) respectively.
[17]Because the oil price shock can be considered as a supply shock, the signs of normalized responses of output, prices and the interest rate are the same as a supply shock (Peersman, 2005). We do not study an oil price shock separately.
[18]We use the AIC to choose the optimal lag length in our model.
[19]This is standard in the literature, we add a time trend to ensure trend stationarity.

use Bayesian methods to estimate the posterior densities of the parameters, conditional on observing the sample data, for the baseline model and alternatives to check for robustness of different model specification. None of the results discussed in section IV are sensitive to increasing the common lag in the VAR to twelve lags or to assuming the sign-restriction horizon as 3-6 months.

We estimate the posterior density using the sign restriction approach of Uhlig (2005 Appendix B, pp 409-417) as formalized by Rubio-Ramirez, Waggoner, and Zha (2010). We observe in particular that B and Σ are directly identified from estimation of the parameters in Equation (4) using OLS. We assume a Gaussian likelihood function and a standard diffuse (Jeffrey's) prior on the reduced form parameters B and Σ, which denotes that the joint posterior density of the parameters is of the Normal-Wishart form (Uhlig 2005, pp. 409-410):[20]

$$\Sigma^{-1} \sim W\left[\left(T\hat{\Sigma}^{-1}\right), T\right] \tag{8}$$

$$(B|\Sigma) \sim N\left[\hat{B},\ \Sigma \otimes \hat{\Omega}\right] \tag{9}$$

where T is the time series sample, $\hat{B}$ and $\hat{\Sigma}$ are the OLS estimates of the dynamic factor model with observable factors, and $\hat{\Omega} = \frac{1}{T}\sum_{t=1}^{T} Z_{t-1}\, Z'_{t-1}$. The algorithm entails the following steps (Rubio-Ramirez, Waggoner, and Zha, 2010; Abdallah and Lastrapes, 2013):

1. Estimate $\hat{B}$ and $\hat{\Sigma}$ from Equation (4) by OLS. OLS is efficient given the restrictions of the model.
2. Draw $\bar{B}$ and $\bar{\Sigma}$ from the posterior distribution given by Equations (8-9) and conditional on the OLS estimates from step 1.
3. Using the values from this draw, impose the sign restrictions of Peersman (2005) and Uhlig (2005) summarized in Table 1 to identify the structural shocks:
    a. Draw a $m \times m$ matrix M, element by element, from a standard normal density, and use its "Q-R" factorization to set $M = QR$, where Q is an orthogonal matrix ($QQ' = I$) and R is normalized to have positive diagonal elements.
    b. Set $D_z = \tilde{D}Q$ which from Equation (5) implies values for $\bar{D}_k$ over the selected horizon $k = 0, 1, 2$, where $\tilde{D}$ denotes the lower-triangular Cholesky factor of Σ.
    c. If the $\bar{D}_k$ estimates do not satisfy the sign restrictions for the structural shocks over the chosen horizon k, return to substep 3(a), draw a new value of Q, and continue until the draw of Q yields responses which satisfy the sign-restrictions.

[20]See Uhlig (1994) for a detailed discussion on the properties of Normal-Wishart distribution.

d. If $\overline{D}_k$ estimates satisfy the sign restrictions, compute and save the corresponding impulse response coefficients relating to the variables in Z_t. Then return to step 2 and draw a new set of reduced form parameters.

4. Iterate on steps 2 through 3(d) until 20,000 draws from the posterior distribution of the dynamic responses of all the variables to the four structural shocks (that satisfy the conditions of step 3(d)) are produced.

We report the median as well as the 16% and 84% quantiles for the sample of impulse responses. We report the forecast error variance decompositions to assess the quantitative importance of each shock in explaining labour market dynamics.

IV. Results

IV. I. The effects of macroeconomic shocks on racial labour market differences

In this section we explain the effects of macroeconomic shocks on labour market outcomes for blacks and whites. Figures 1-6 report the impulse responses of the macroeconomic factors (economic activity, price level, interest rate, and money supply), and labour market measures of blacks and whites (unemployment rate, employment-population ratio, and labour force participation rate) to the three structural shocks: demand, supply, and monetary policy. They comprise our main results.

Aggregate Demand Shock

We first consider the effects of an adverse demand shock on labour market outcomes for blacks and whites. The results are reported in Figures 1 and 2. Figure 1 presents the full set of impulse responses from the FAVAR for the three labour market model specifications: (A) unemployment rate, (B) employment-population ratio, (C) labour force participation rate, of blacks and whites respectively to a negative demand shock.[21] The responses of the macroeconomic subsystem (economic activity, price level, interest rate, and money supply) to a one standard deviation negative demand shock is similar in all three model specifications (Figures 1A-1C). In response to a negative demand shock, economic activity, prices, and interest rates fall, lending justification to our identification scheme (discussed earlier in Table 1). In response to a one standard deviation negative aggregate demand shock, economic activity declines by 0.80 percent (at its lowest point) over a two-month horizon before increasing and reaching its long run normal level. Further, prices fall by 0.60 percent on impact and remain permanently low at -1.10 percent. The adverse demand shock prompts an expansionary monetary policy in the form of lower interest rates and higher money supply. The response of economic activity, prices, interest rates, and money supply are

[21] See the methods section for details on model specifications and estimation.

consistent with what we would expect of a negative aggregate demand shock, and suggest that our demand shock has been plausibly identified.

<Figure 1 >

The main focus of our paper is the labour market responses of blacks and whites to this shock. In Figure 1A, we note that the unemployment rate of both blacks and whites increase in response to the negative demand shock, however the magnitude of the impact differs across the two racial groups. While the unemployment rate of whites increases by only 0.12 percentage points, the unemployment rate of blacks increases by as much as 0.19 percentage points over a 5 to 10-month horizon before approaching their original levels. We note that an adverse demand shock has significant distributional effects, hurting blacks disproportionately relative to the whites.

Blacks are harmed more by a negative demand shock than whites; however, to get a complete picture of the labour market we must also consider the behaviour of the employment-population ratio and labour force participation rates of black and white Americans in response to the adverse demand shock. In Figure 1B, we note that the employment-population ratio of both blacks and whites fall in response to the adverse demand shock. However, the fall is larger in magnitude for blacks compared to whites. While the employment-population ratio of blacks falls by about 0.12 percentage points, that of whites falls by 0.09 percentage points over a 5 to 10-month horizon before approaching their original levels. The fall in employment-population ratio overall is persistent and statistically significant for both racial groups. Lastly, when considering the response of the labour force participation rate, we find in Figure 1C that there is little response of the labour force participation rate to the adverse demand shock.

Black Americans appear to experience larger declines in their employment-population ratio, and also larger increases in their unemployment rates than white Americans as a result of negative demand shocks. A natural question then is whether these differential responses are truly (statistically and economically) different. To assess this, we turn to Figure 2. Figure 2 presents a summary comparison of the labour market responses of blacks and whites (estimated from the FAVAR in Figure 1) to the negative demand shock, that is, it shows us the labour market responses of blacks *relative* to whites.

<Figure 2 Here>

Figure 2A left panel compares the unemployment responses of blacks and whites, while the right panel reports the unemployment response of blacks minus whites with 16% and 84% confidence intervals. We note that the unemployment response of black minus white is strongly significant with a peak differential response of 0.07 percentage points over a 5 to 10-month horizon. Figure 2B (right panel) reports the

differential responses of employment-population to the adverse demand shock with 16% and 84% confidence intervals. We note strong heterogeneity in responses of the employment-population ratio across blacks and whites to the adverse demand shock, however the heterogeneous responses does not appear to be statistically significant. Lastly, when considering the response of the labour force participation rate we, again, find in Figure 2C that there no statistical difference between black and white labour force participation rates in response to the negative aggregate demand shock.

Summarizing these results, we find that a negative aggregate demand shock lowers the employment-population ratio, increases the unemployment rate, and has little effect on the labour force participation rate. The lack of response from the labour force participation rate coupled with the strong response from the unemployment rate and employment-population ratio suggests the labour market affects are being driven by changes in labour demand rather than labour supply (as labour force participation really does not respond much to the shock). We infer from our results that an increase in unemployment rather than decrease in labour force participation rate contributes more to the declining employment population ratio. Further, the adverse demand shock has significant differential effects across the two racial groups. Blacks appear to be more sensitive, especially in terms of the unemployment rate, than whites to this type of shock.[22]

Aggregate Supply Shock

Next we discuss the effects of an adverse supply shock on labour market outcomes of blacks and whites. The results are reported in Figures 3 and 4. Figure 3 presents the full set of impulse responses from the FAVAR for the three labour market model specifications (of blacks and whites) to a negative supply shock.[23] The responses of the macroeconomic subsystem to a one standard deviation negative supply shock is similar in all three model specifications (Figures 3A-3C). In response to a one standard deviation adverse supply shock, economic activity declines and bottoms out at -0.75 percent over a 15-month horizon before starting to rise slowly. The price level increases permanently to 1.20 percent in the long run. In response to the adverse supply shock, the interest rate increases reaching a peak of 0.28 percentage points, and money supply declines by about 0.60 percent (at its minimum) over a 0 to 5-month horizon, indicating dominance of disinflationary monetary policy. The response of economic activity, prices, interest rates, and the money

[22]Though not reported to save space, we also estimate results where the racial results are further split by gender. In the case of a negative aggregate demand shock, we see that the unemployment rate for black men are more sensitive than white men, however there is no difference for white and black women. For the employment-population ratio, it is at times marginally more sensitive for black men than white men, but again black and white women appear to be impacted similarly, and these results also hold when considering the labour force participation rate. These results are available upon request.

[23] See the methods section for details on model specifications and estimation.

supply, to the negative aggregate supply shock is consistent with standard macroeconomic theory and sign restrictions identification strategy employed in this paper (see Table 1), suggesting that the supply shock has been correctly identified.

<Figure 3 Here>

While Figures 3A-3C presents the full set of impulse responses from the FAVAR, Figure 4 focuses only on the differential labour market responses of blacks and whites to the adverse supply shock (estimated from the FAVAR in Figure 3).

<Figure 4 Here>

Turning to the labour market of blacks and whites, we note that a negative aggregate supply shock leads to a significant increase in the unemployment rate of black as well as white Americans, with larger effects on blacks relative to whites. This is evident from Figure 4. Figure 4A left panel plots the unemployment responses of blacks relative to whites, while the right panel plots the unemployment responses of blacks minus whites with reported confidence interval bands. We note that there is significant heterogeneity in the unemployment responses of blacks and whites. While the unemployment rate of blacks increases by as much as 0.25 percentage points, that of whites increases by only 0.10 percentage points over a 30 to 35-month horizon. Further, the unemployment response of black minus white is strongly significant with a peak differential response of 0.15 percentage points over a 30 to 35-month horizon.

Next we study the behaviour of the employment-population ratio. In Figure 4B, we observe that the employment-population ratios of black and white Americans fall in response to the adverse supply shock. There appears to be strong heterogeneity in responses of the employment population ratio as well. The black employment-population ratio records a much larger decline than the white employment-population ratio, by as much as 0.16 percentage points compared to just 0.10 percentage points for whites over a 30 to 35-month horizon. The differential impact of the negative supply shock on the employment-population ratio of blacks and whites is statistically significant (see Figure 4B, right panel). Lastly, we study the response of the labour force participation rate of blacks and whites to the adverse supply shock (see Figure 4C). We note that there is little response of the LFPR and no significant difference between the black and white samples.

In sum, we find the employment-population ratio declining with the unemployment rate rising and little change in the labour force participation rate, in response to a negative supply shock. Adverse supply shocks lower the employment-population ratio by acting primarily through the demand channel, that is, by raising the unemployment rate and not reducing the labour force participation rate. Our results provide supporting

evidence that the effect on labour market outcomes is primarily a result of the demand for labour and not supply of labour. Further, adverse supply shocks have significant long run differential effects on the labour market outcomes of blacks and whites, hurting blacks disproportionately relative to whites; these differential effects appear to be stronger and more permanent compared to those found for adverse demand shocks, discussed previously.[24]

Monetary Policy Shock

Perhaps of most interest are the results for a contractionary monetary policy shock. There is a rich literature on monetary policy shocks and their differential effects across blacks and whites in the labour market, which enables us to compare our findings with the benchmark findings from the literature.

<Figure 5 Here>

Figure 5 and 6 presents the impulse responses for a contractionary monetary policy shock. Again, figure 5 presents the full set of impulse responses from the FAVAR for the three labour market model specifications (of blacks and whites) to a contractionary monetary policy shock .[25] The responses of the macroeconomic subsystem to a one standard deviation contractionary monetary policy shock is similar in all three model specifications (Figures 5A-5C). A one standard deviation contractionary monetary policy shock leads to an increase in interest rate by 0.20 percentage points and decline in money supply by 0.35 percent on impact. In response to a one standard deviation contractionary monetary policy shock, economic activity falls and reaches a minimum of 0.60 percent over 0 to 5-month horizon before slowly returning to its original long run level. The price level in the economy declines permanently by 0.50 percent. The impulse responses of interest rates, nominal money, economic activity, and price series, discussed above, lend validity to the identification scheme employed in this research (sign-restriction), suggesting reliability in the results for all other series.

While Figures 5A-5C presents the full set of impulse responses from the FAVAR, Figure 6 focuses only on the differential labour market responses of blacks and whites to the contractionary monetary policy shock (estimated from the FAVAR in Figure 5).

Figure 6A left panel plots the unemployment responses of blacks relative to whites, while the right panel plots the unemployment responses of blacks minus whites with the reported confidence bands. In response

[24]When considering racial differences along gender lines, in the case of the unemployment rate response and employment-population ratio response, black men are more affected than white men, and black women are more affected than white women, while no significant differences exist in the case of the labour force participation rate. These results can be made available upon request.

[25] See the methods section for details on model specifications and estimation.

to a contractionary monetary policy shock, the unemployment rate of blacks and whites increase, but that of blacks increase disproportionately more than that of whites. While the unemployment rate of whites increase by 0.13 percentage points, that of blacks increase by 0.23 percentage points (almost 1.7 times more) over a 15 to 20-month horizon. Further, we note that this differential impact of blacks and whites in response to policy shocks is statistically and economically significant, with a peak differential response of 0.10 percentage points over a 15 to 20-month horizon.[26] Consistent with Thorbecke (2001), Carpenter and Rodgers (2004), and Zavodny and Zha (2000) we find that contractionary monetary policy shocks have significant heterogeneous effects on the unemployment rate of blacks and whites, with larger effects on blacks relative to the whites. We confirm that the increase in unemployment following monetary contraction is much larger for black Americans than for white Americans.

<Figure 6 Here>

Figure 6B-6C presents the responses of the employment population ratio and labour force participation rates of blacks and whites respectively to a contractionary monetary policy shock. Again, we observe that the employment-population ratio falls across both racial groups, exhibiting a similar pattern: the employment population ratio of blacks falls more relative to the whites. Following contractionary monetary policy, the employment population ratio among blacks falls close to twice (0.20 percentage points) as much as that among whites (0.10 percentage points) over a 15 to 20-month horizon. This differential impact of contractionary monetary policy is statistically and economically significant (see Figure 6B, right panel). The labour force participation response to policy shocks is small, and statistically insignificant (see Figure 6C). This indicates that contractionary monetary policy lowers the employment population ratio primarily by raising the unemployment rate and not by reducing the labour force participation rate. An increase in interest rates slows down the economy and lessens overall aggregate labour demand; this leads to a decline in the probability of employment for any given individual increasing unemployment (consistent with Carpenter and Rodgers, 2004).

Overall, we find strong evidence for differential effects of contractionary monetary policy shocks on labour market outcomes for blacks and whites. The heterogeneous effects of the policy shocks vary systematically across racial groups: the unemployment rate of blacks' increase disproportionately, and the employment-population ratio of blacks' fall far more than for whites. We note that the sensitivity of unemployment rate

[26]When considering racial differences along gender lines, in the case of the unemployment rate response and employment-population ratio response, black men are more affected than white men, and black women are more affected than white women. For the labour force participation rate there is no difference between black and white men though black women are more negatively affected than white women. These results can be made available upon request.

and employment-population ratio of black Americans is much higher than that of white Americans to policy shocks.

IV. II. How important is the contribution of macroeconomic shocks to labour market movements of Blacks and Whites?

In this section, we consider the extent to which macroeconomic shocks can account for labour market dynamics in the U.S. That is, whereas the previous section focuses on characterizing whether macroeconomic shocks affect the labour market outcomes of the racial groups, we now turn to the question of assessing the quantitative importance of this relationship.

Variance decompositions report what fraction of the movement in the variables can be accounted for by the structural shocks. If a shock explains a large fraction of the variation in a reported variable, then the shock is an important driver of movements in the variable. This measure provides one metric of the extent to which demand, supply, and monetary policy shocks are quantitatively important in driving labour market dynamics.

Aggregate Demand Shock

We first consider the share of the variance in labour market outcomes accounted for by aggregate demand shocks over our sample period. Estimates from the variance decompositions of aggregate demand shocks are presented in Figure 7 for the macroeconomic factors and labour market observables of blacks and whites.

<Figure 7 Here>

We find that aggregate demand shocks account for 15-17% of the variation in the unemployment rate, and 10-15% of the variation in the employment-population ratio of blacks and whites over the medium to long run, indicating that these shocks play a non-trivial role in accounting for cyclical labour market dynamics. On the other hand, they account for only 2% of the movement in the labour force participation rate for both white and black workers. Our results suggest that demand shocks explain a considerable fraction of variation in the unemployment rates and the employment-population ratio of blacks and whites, while very little for labour force participation rate of the racial groups, indicating that these shocks are important drivers of labour demand for blacks and whites (as opposed to labour supply).

Aggregate Supply Shock

Next, we discuss the share of the variance in labour market outcomes explained by aggregate supply shocks. Estimates from the variance decompositions of aggregate supply shocks are presented in Figure 8 for the macroeconomic factors and labour market observables of blacks and whites.

<Figure 8 Here>

Similar to demand shocks, supply shocks also explain a significant fraction of the variation (15-20 percent) in unemployment rates and employment-population ratio of blacks and whites, while very little (only 2 to 3 percent) of the variation in labour force participation rate, again indicating that these shocks are important drivers of labour demand.

Monetary Policy Shock

Finally, we turn to assessing the quantitative importance of monetary policy shocks in explaining cyclical labour market dynamics. Estimates from the variance decompositions of monetary policy shocks are presented in Figure 9 for the macroeconomic factors and labour market observables of blacks and whites.

<Figure 9 Here>

The results confirm the importance of monetary policy shocks in explaining fluctuations in the labour market outcomes of blacks and whites. Monetary policy shocks explain 15-20 percent of the variation in the unemployment rates and employment population ratio of blacks and whites over the medium to long run, suggestive of evidence that these shocks are important drivers of labour market movements across both racial groups. Monetary policy shocks appear to play a non-trivial role in accounting for fluctuations in the unemployment rate and employment population ratio of blacks and whites. The forecast error variance decompositions show that the contribution of monetary policy shocks to fluctuations in the unemployment rate and employment population ratio of blacks and whites is of the same order of magnitude as the contribution of these shocks to other macroeconomic factors like economic activity and inflation, indicating that these shocks are important and should be taken into account when implementing disinflationary guiding policy. Further, the policy shocks explain only 2-3 percent of the movement in the labour force participation rate, suggestive of evidence that monetary policy shocks are more dominant drivers of labour demand (as opposed to labour supply).

V. Conclusion

The income gap between black and white Americans has been consistent and growing over the last four decades. As stated by Hoover et. al (p. 587, 2015) “No economy will reach the frontier of its productivity

without full engagement of all of its citizens and the persistence of this income gap suggests that a sizeable proportion has not been fully engaged in the economy." In that regard, one of the key ways to help in closing that gap is through employment opportunities. In this paper, we attempt to answer an important question in the literature of macroeconomics-labour markets-racial inequality: how do macroeconomic shocks affect the labour market outcomes across racial groups? We study three fundamental macroeconomic shocks and potential drivers of business cycles: monetary policy shock, aggregate demand shock, and aggregate supply shock, and examine how they impact the labour market outcomes of blacks and whites in the US. We utilize a factor augmented vector autoregression framework to conduct our analysis. Within this framework, we uniquely identify structural shocks using sign restrictions approach of Peersman (2005) and Uhlig (2005).

We document three principal findings from our study. First, adverse macroeconomic shocks (negative demand shock, negative supply shock, and contractionary monetary policy shock) lead to an increase in the unemployment rate and a decline in the employment population ratio among Americans to a statistically significant and economically meaningful extent. The impact of supply shocks on the labour market appear to be stronger and more permanent compared to that of demand shocks and monetary policy shocks. The labour force participation response is small and statistically insignificant in response to all three macroeconomic shocks. Given the strong response of unemployment, and a lack of response in the labour force participation rate we interpret these as changes to labour demand rather than labour supply decisions. Second, there appears to be strong heterogeneity in the labour market responses (unemployment rate and employment-population ratio) faced by Americans across different racial groups to the adverse macroeconomic shocks. The heterogeneous effects vary systematically across racial groups: the unemployment rate of blacks increases disproportionately, and the employment-population ratio of blacks falls far more than that of whites. Black Americans appear to be significantly more sensitive to macroeconomic shocks than white Americans. Third, macroeconomic shocks seem to play a non-trivial role in accounting for fluctuations in the unemployment rate and employment-population ratio, which is further suggestive of evidence that these shocks are important drivers of labour market movements (particularly labour demand) across blacks and whites.

Our study holds important policy implications. We document that contractionary monetary policy shocks exacerbate racial labour market differences, and account for 15-20 percent of the labour market movements for blacks and whites. In particular, we find that contractionary monetary policy shocks reduce the employment-population ratio among black Americans close to twice as much as that among white Americans, primarily due to an increase in their unemployment and not a decline in labour force participation. Policymakers should take account these heterogeneous effects across racial groups when implementing disinflationary guiding policy. In 1970, blacks made up 11.2 percent of the American

population. By 2010 that number had grown to approximately 13.6 percent. Policy makers should be cognizant of the impact of exogenous monetary policy shifts and macroeconomic disturbances on individual groups in the economy, given the ever-increasing importance this group will play in the economic fortunes of the US in the future.

We note in closing a limitation of our research and provide suggestions for future exploration. Our study does not examine why the black and white unemployment rates, and employment population ratio respond differently to exogenous monetary policy shifts and other macroeconomic fluctuations. The literature that compares labour market patterns among whites and non-whites suggests that differences in educational attainment, skills, industrial representation, and racial discrimination may play a role in explaining the differential labour market responses. Future research should examine further, why labour market of blacks and whites show different cyclical responses to macroeconomic shocks.

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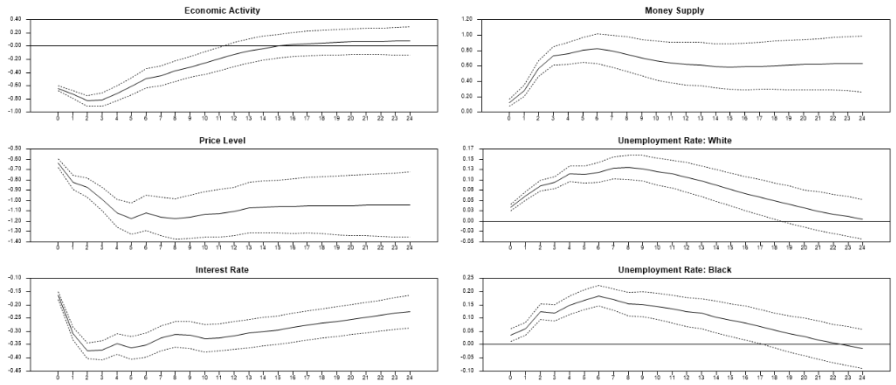
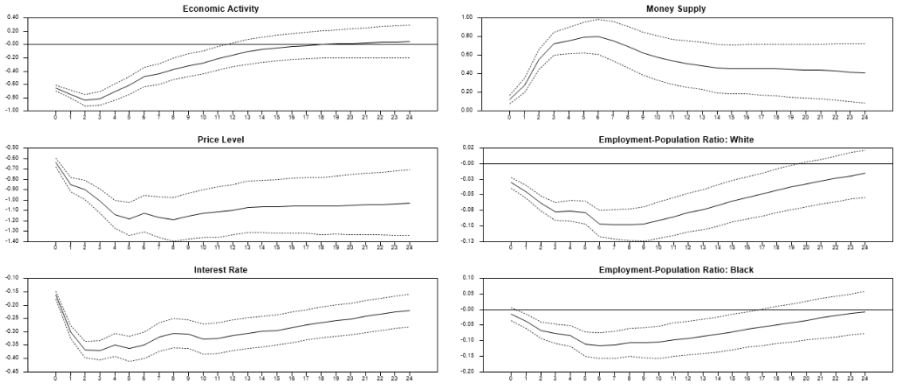
Figure 1. Impulse Responses of Blacks and Whites to an Adverse Demand Shock

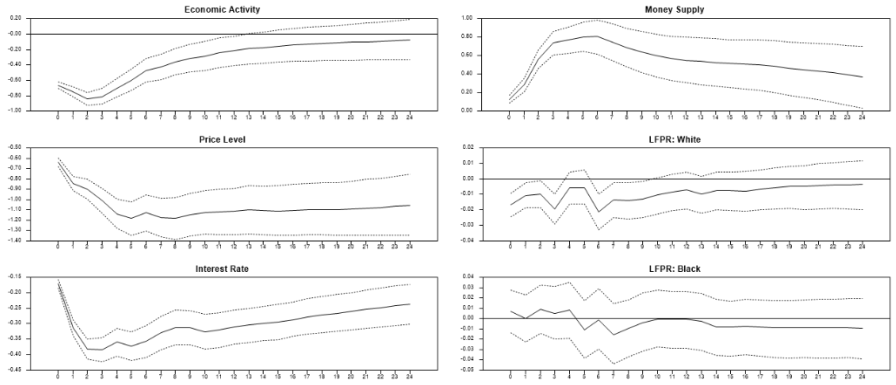
A. Unemployment Rate



B. Employment-Population Ratio



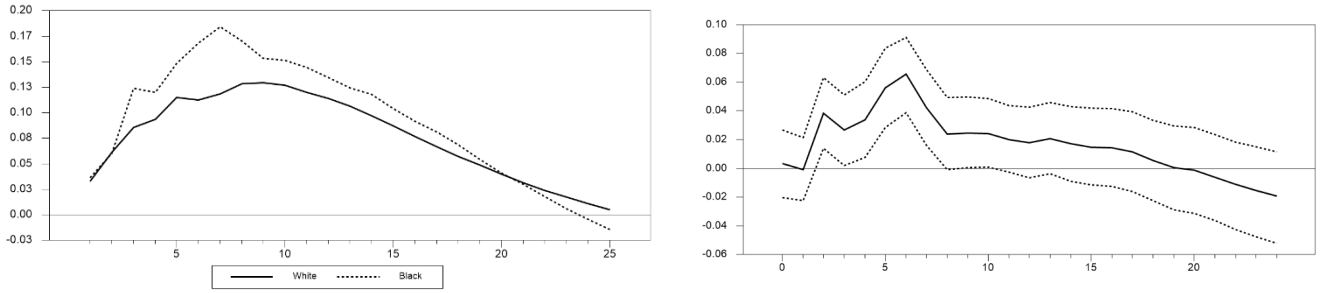
C. Labour Force Participation Rate (LFPR)



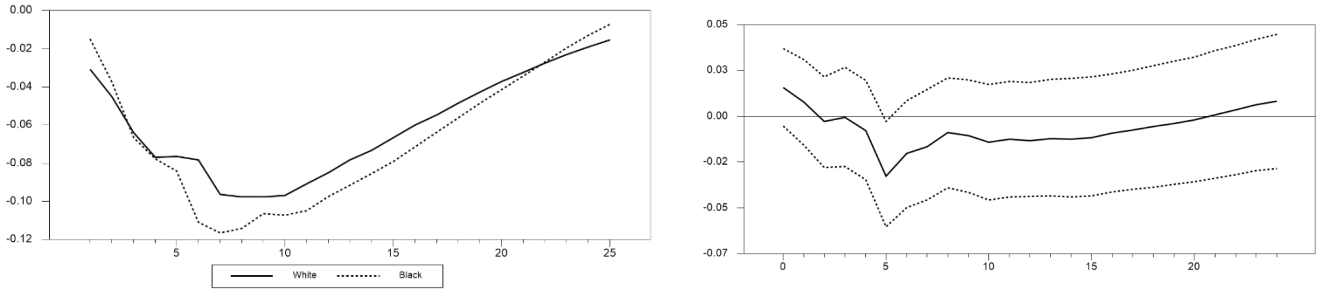
Note: The above figure presents impulse responses to a one standard deviation adverse demand shock using sign restrictions approach. The three lines are the 16%, median, and 84% quantile of the posterior distribution.

Figure 2. Responses of Blacks *Relative* to Whites to an Adverse Demand Shock

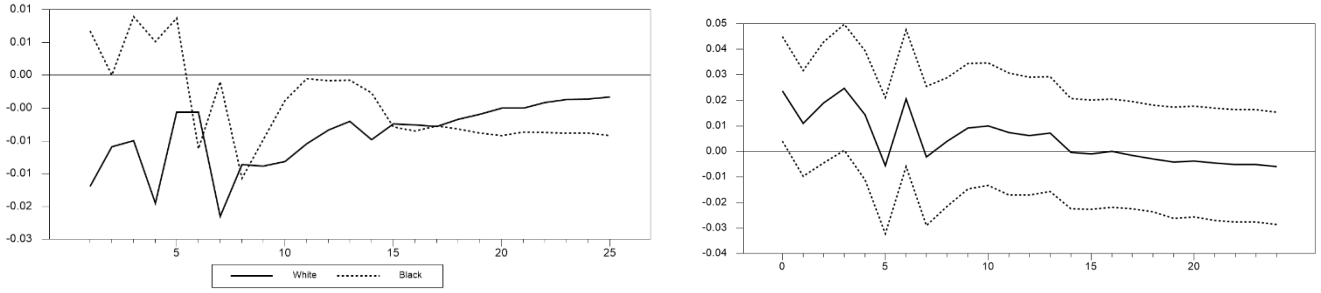
A. Unemployment Rate



B. Employment-Population Ratio



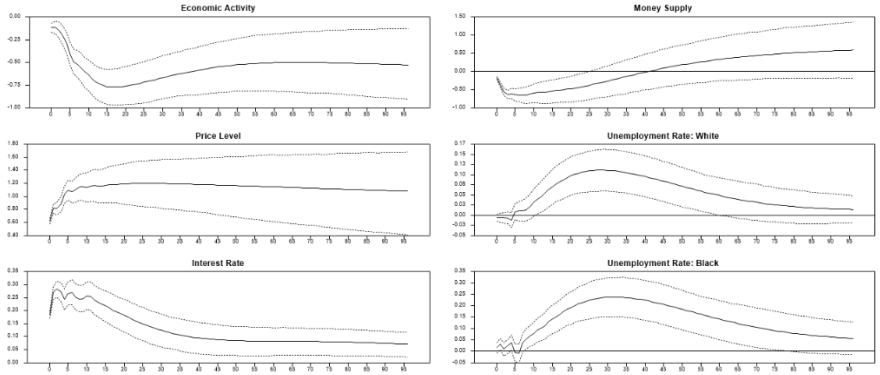
C. Labour Force Participation Rate (LFPR)



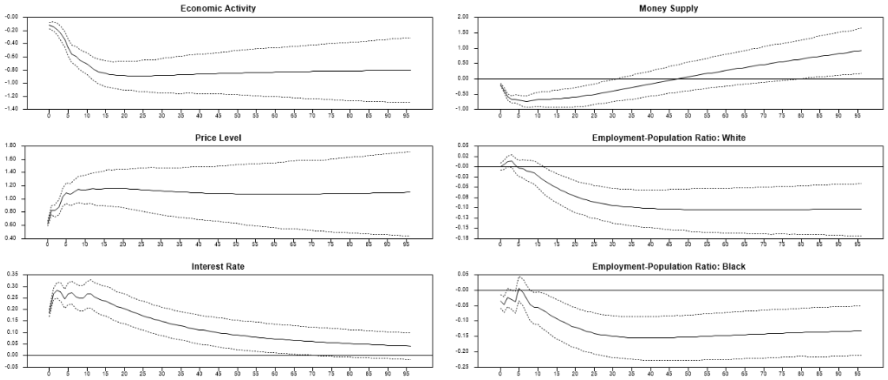
Note: This figure presents the differential labour market responses of blacks and whites to the negative demand shock (estimated from the FAVAR in Figure 1). The left panel in each row compares the labour market responses of blacks and whites, while the right panel reports the labour market response of black minus white with confidence intervals.

Figure 3. Impulse Responses of Blacks and Whites to an Adverse Supply Shock

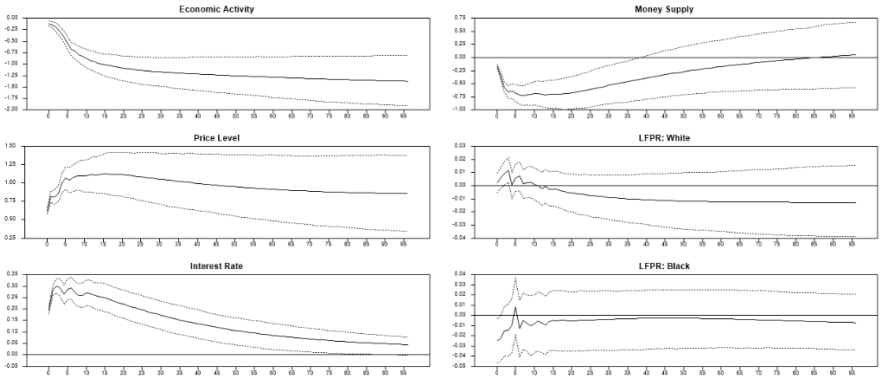
A. Unemployment Rate



B. Employment-Population Ratio



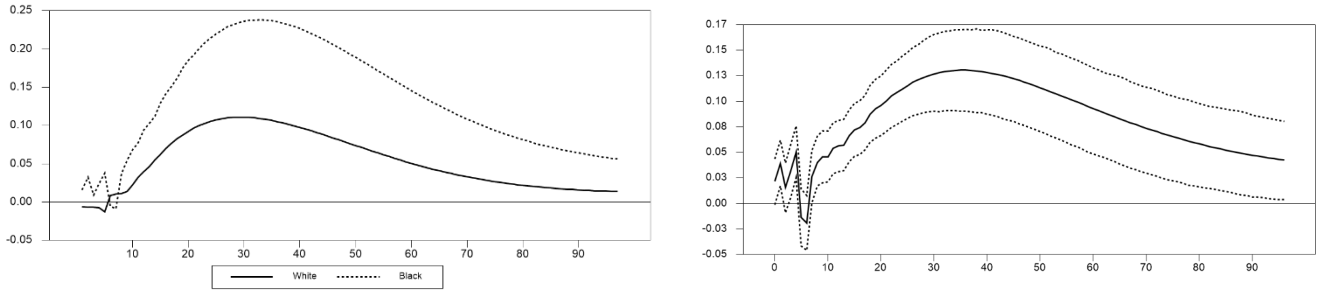
C. Labour Force Participation Rate (LFPR)



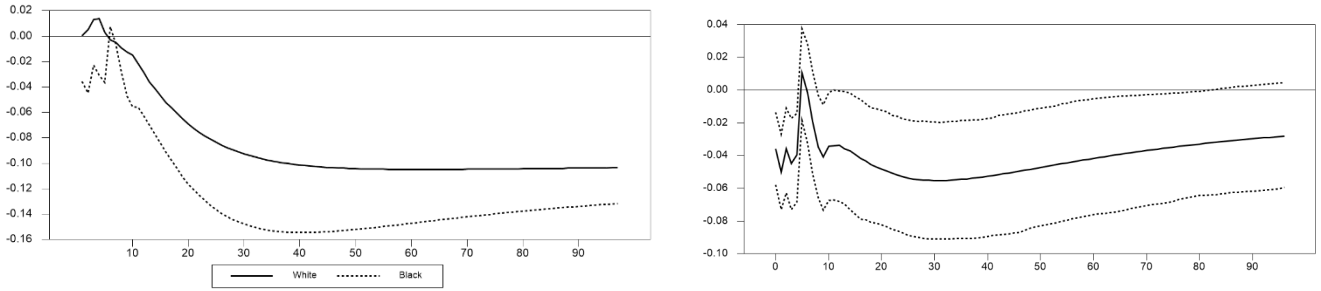
Note: The above figure presents impulse responses to a one standard deviation adverse supply shock using sign restrictions approach. The three lines are the 16%, median, and 84% quantile of the posterior distribution.

Figure 4. Responses of Blacks *Relative* to Whites to an Adverse Supply Shock

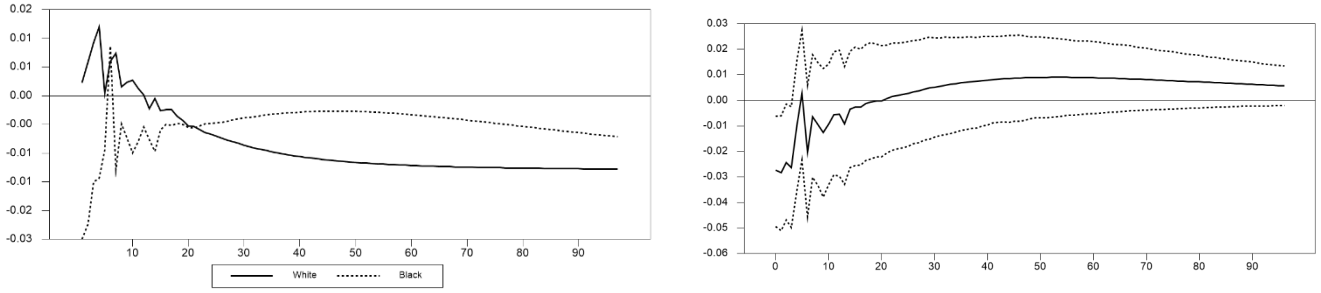
A. Unemployment Rate



B. Employment-Population Ratio



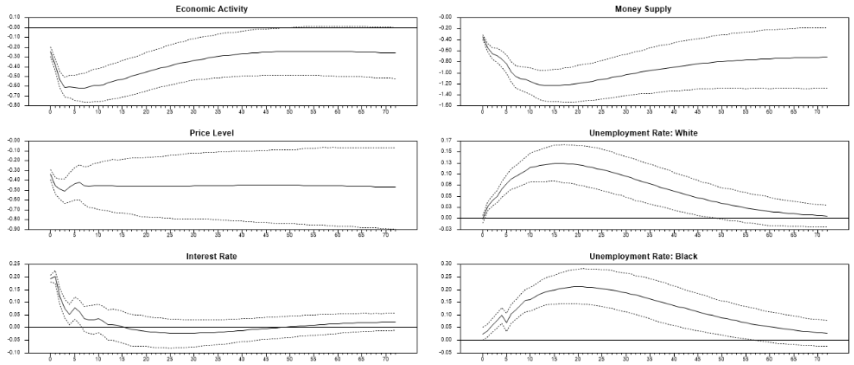
C. Labour Force Participation Rate (LFPR)



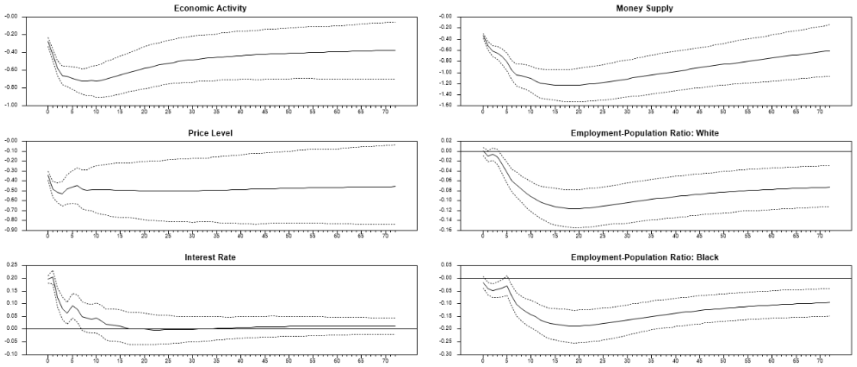
Note: This figure presents the differential labour market responses of blacks and whites to the negative supply shock (estimated from the FAVAR in Figure 3). The left panel in each row compares the labour market responses of blacks and whites, while the right panel reports the labour market response of black minus white with confidence intervals.

Figure 5. Impulse Responses of Blacks and Whites to a Contractionary Monetary Policy Shock

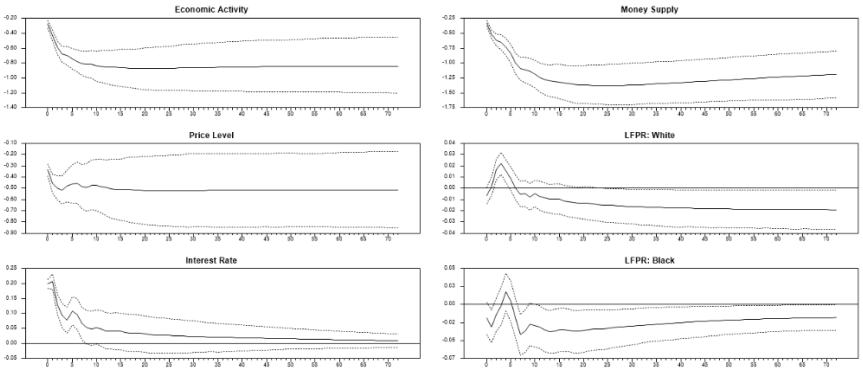
A. Unemployment Rate



B. Employment-Population Ratio



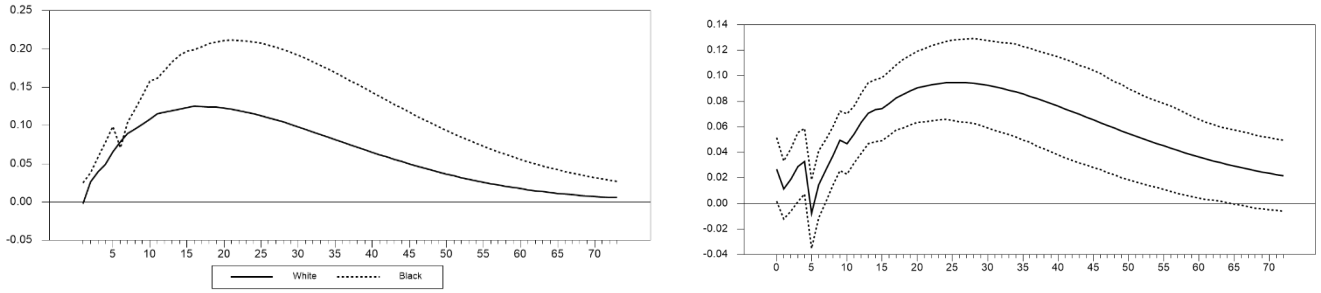
C. Labour Force Participation Rate (LFPR)



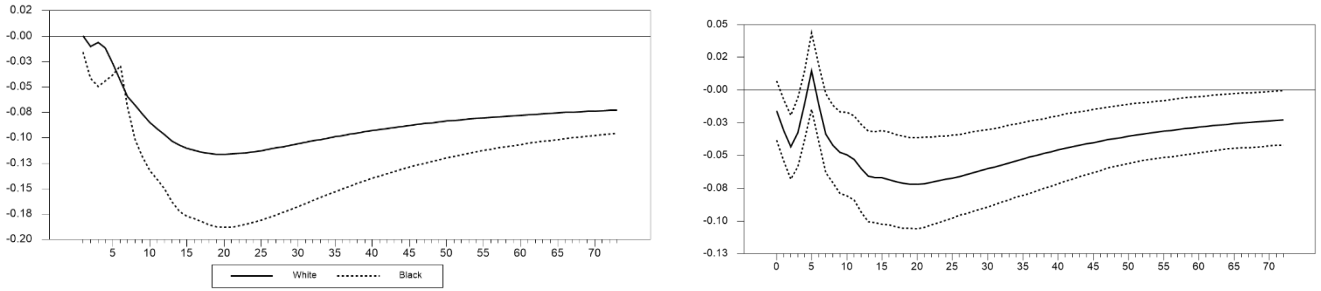
Note: The above figure presents impulse responses to a one standard deviation contractionary monetary policy shock using sign restrictions approach. The three lines are the 16%, median, and 84% quantile of the posterior distribution.

Figure 6. Responses of Blacks *Relative* to Whites to a Contractionary Monetary Policy Shock

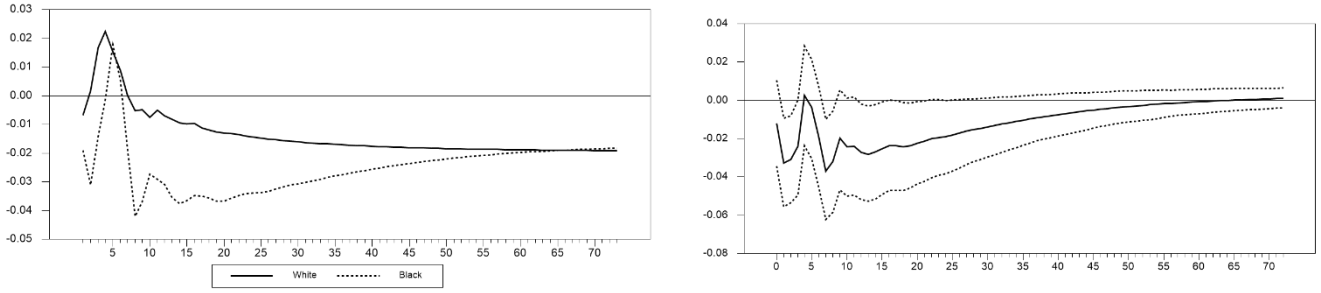
A. Unemployment Rate



B. Employment-Population Ratio



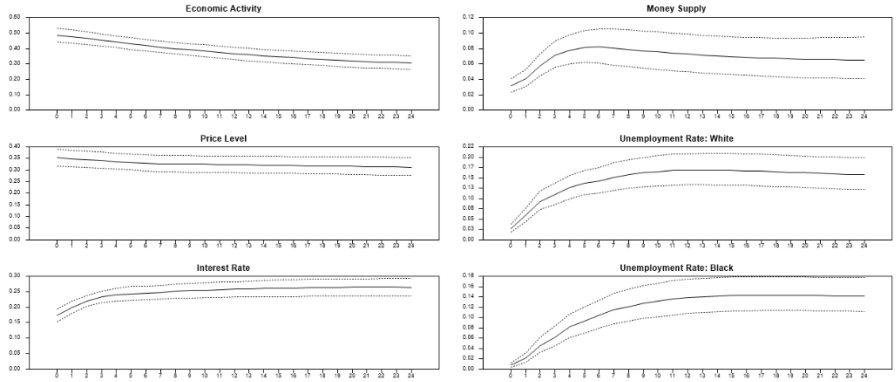
C. Labour Force Participation Rate (LFPR)



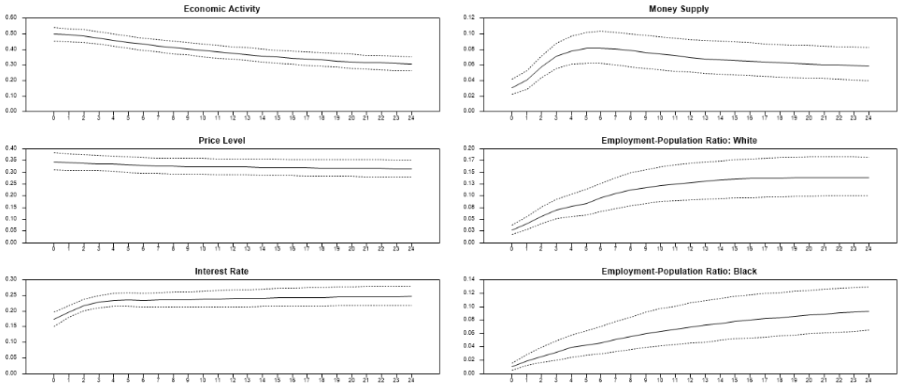
Note: This figure presents the differential labour market responses of blacks and whites to the contractionary monetary policy shock (estimated from the FAVAR in Figure 5). The left panel compares the labour market responses of blacks and whites, while the right panel reports the labour market response of black minus white with confidence intervals.

Figure 7. Fraction of Forecast Error Variance Explained by a Demand Shock

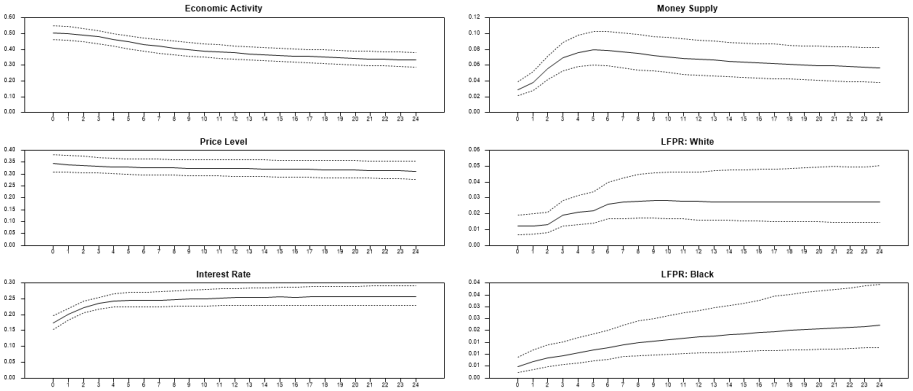
A. Unemployment Rate



B. Employment-Population Ratio



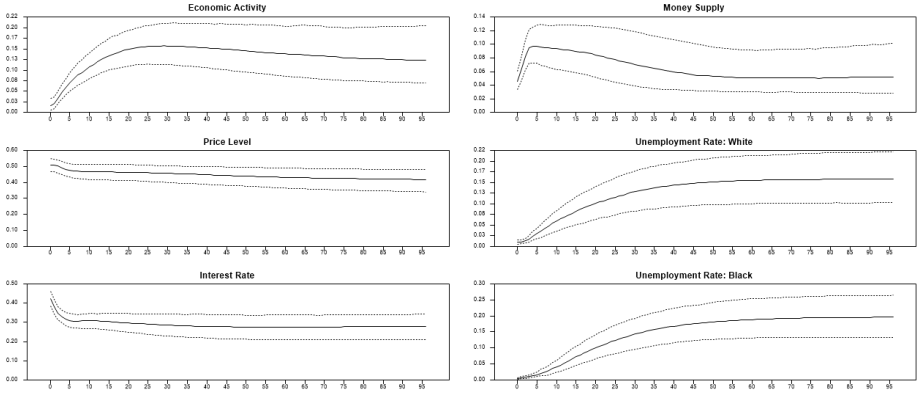
C. Labour Force Participation Rate (LFPR)



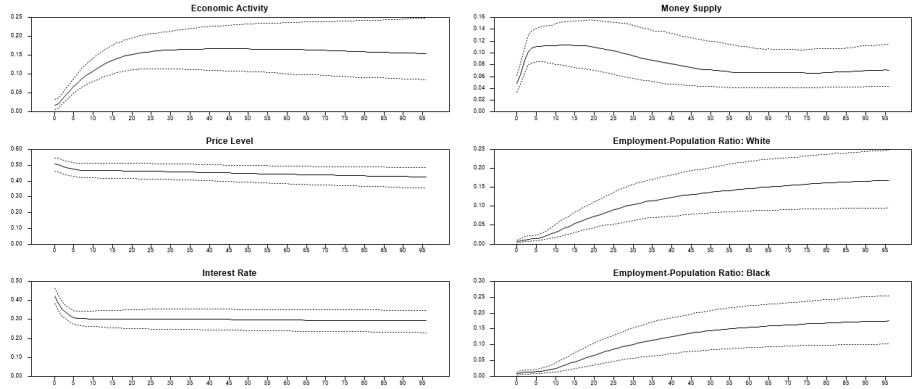
Note: These plots show the fraction of the variance of the k-step ahead forecast revision explained by demand shocks, using sign restriction approach. The three lines are 16% quantile, the median and the 16% quantile of the posterior distribution.

Figure 8. Fraction of Forecast Error Variance Explained by a Supply Shock

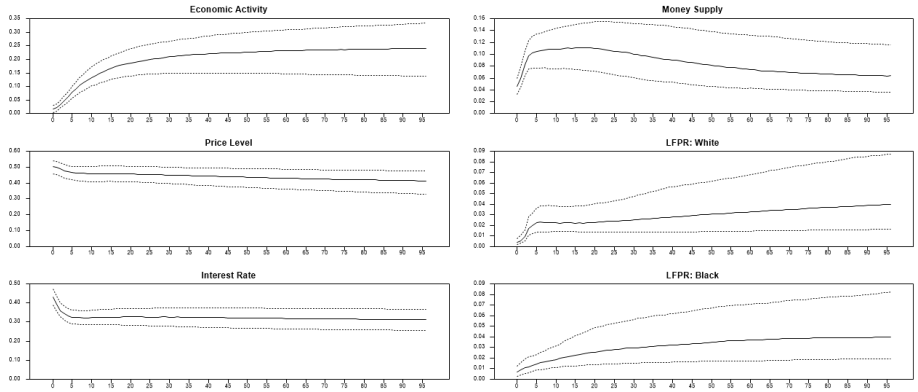
A. Unemployment Rate



B. Employment-Population Ratio



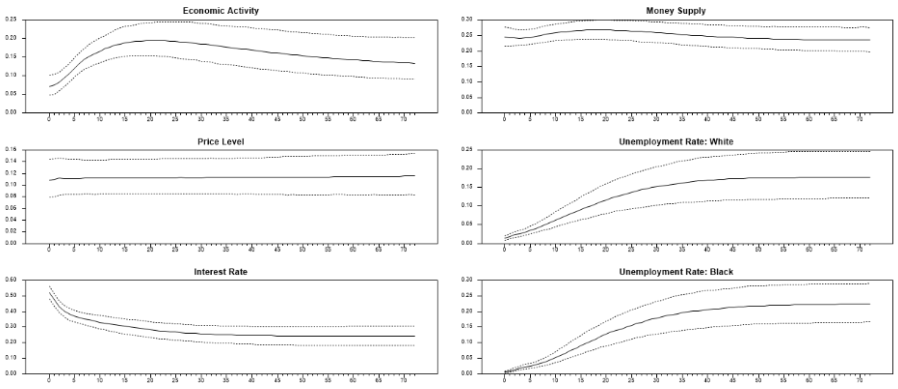
C. Labour Force Participation Rate (LFPR)



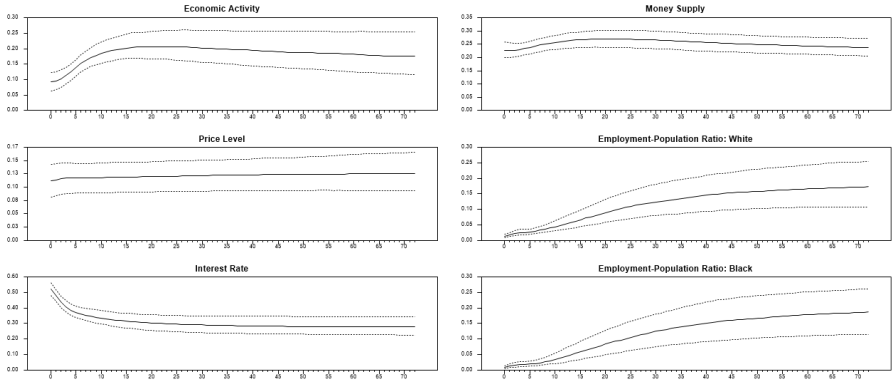
Note: These plots show the fraction of the variance of the k-step ahead forecast revision explained by supply shocks, using sign restriction approach. The three lines are 16% quantile, the median and the 16% quantile of the posterior distribution.

Figure 9. Fraction of Forecast Error Variance Explained by a Monetary Policy Shock

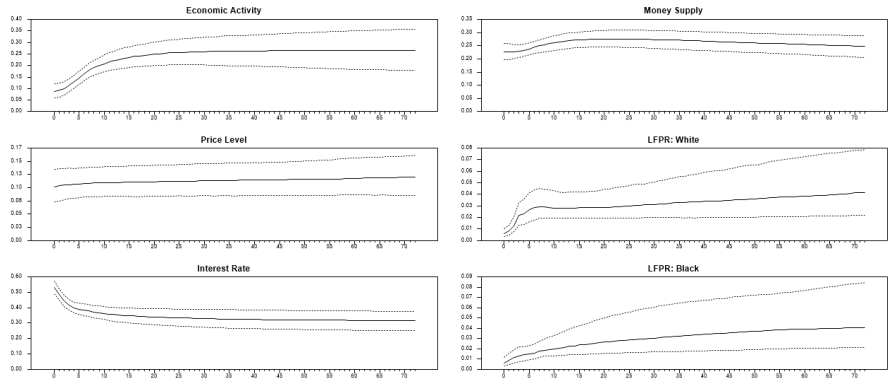
A. Unemployment Rate



B. Employment-Population Ratio



C. Labour Force Participation Rate (LFPR)



Note: These plots show the fraction of the variance of the k-step ahead forecast revision explained by monetary policy shocks, using sign restriction approach. The three lines are 16% quantile, the median and the 16% quantile of the posterior distribution.

APPENDIX

Data Description

Our dataset consists of 136 macroeconomic time series for the U.S. economy with complete monthly coverage from 1973:01 to 2017:04. Our data sources are the following: Federal Reserve Economic Database (FRED) of the St. Louis Fed, IMFs International Financial Statistics, Bureau of Labour Statistics, and Institute of Supply Management. In the table below, we provide the data description along with their transformation code. The transformation code 1 indicates no transformation, and 2 indicates first differences of logarithm (following Bernanke et al., 2005). All variables have been seasonally adjusted prior to use.

Economic Activity Factor and Factor Loadings

No.	Variables Constructing the Economic Activity Factor	Transformation Code	Description	Factor Loading (λ)
1	INDPRO	2	Industrial Production Index, Index 2012=100, SA	0.1796
2	IPFINAL	2	Industrial Production: Final Products (Market Group), Index 2012=100, SA	0.1808
3	IPCONGD	2	Industrial Production: Consumer Goods, Index 2012=100, SA	0.1873
4	IPDCONGD	2	Industrial Production: Durable Consumer Goods, Index 2012=100, SA	0.1837
5	IPNCONGD	2	Industrial Production: Nondurable Consumer Goods, Index 2012=100, SA	0.1888
6	IPMAT	2	Industrial Production: Materials, Index 2012=100, SA	0.1766
7	IPDMAT	2	Industrial Production: Durable Materials, Index 2012=100, SA	0.1643
8	IPNMAT	2	Industrial Production: Nondurable Materials, Index 2012=100, SA	0.1914
9	IPMANSICS	2	Industrial Production: Manufacturing (SIC), Index 2012=100, SA	0.1791
10	IPBUSEQ	2	Industrial Production: Business Equipment, Index 2012=100, SA	0.1648
11	IPB53820S	2	Industrial Production: Non-energy materials for intermediate goods producers, Index 2012=100, SA	0.1885
12	IPB562A3CS	2	Industrial Production: Primary and semifinished processing, Index 2012=100, SA	0.1800
13	IPDMAN	2	Industrial Production: Durable Manufacturing (NAICS), Index 2012=100, SA	0.1683
14	IPNMAN	2	Industrial Production: Nondurable Manufacturing (NAICS), Index 2012=100, SA	0.1895
15	IPMINE	2	Industrial Production: Mining, Index 2012=100, SA	0.1900

16	IPG22111S	2	Industrial Production: Utilities: Electric power generation, Index 2012=100, SA	0.1814
17	CAPUTLGMFNS	1	Capacity Utilization: Nondurable manufacturing, Percent of Capacity, SA	3.3646
18	CAPUTLGMFDS	1	Capacity Utilization: Durable manufacturing, Percent of Capacity, SA	3.2316
19	CUMFNS	1	Capacity Utilization: Manufacturing (SIC), Percent of Capacity, SA	3.2918
20	ISMMANPMI	1	ISM Manufacturing: PMI Composite Index, SA (in percent)	2.2053
21	ISMMANPROD	1	ISM Manufacturing: Production Index, SA (in percent)	2.3180
22	ISMMANNEWORDERS	1	ISM Manufacturing: New Order Index, SA (in percent)	2.3115
23	ISMMANEMPL	1	ISM Manufacturing: Employment Index, SA (in percent)	2.0659
24	ISMMANDELIV	1	ISM Manufacturing: Supplies Delivery Index, SA (in percent)	2.2538
25	ISMMANINVENT	1	ISM Manufacturing: Inventories Index, SA (in percent)	1.9561
26	RPI	2	Real Personal Income, Billions of Chained 2012 Dollars, SAAR	0.3809
27	W875RX1	2	Real personal income excluding current transfer receipts, Billions of Chained 2012 Dollars, SAAR	0.3747
28	DPCERA3M086SBEA	2	Real Personal Consumption Expenditures, Index 2012=100, SA	0.1732
29	DDURRA3M086SBEA	2	Real personal consumption expenditures: Durable goods (chain-type quantity index), Index 2012=100, SA	0.1586
30	DNDGRA3M086SBEA	2	Real personal consumption expenditures: Nondurable goods (chain-type quantity index), Index 2012=100, SA	0.1785
31	DSERRA3M086SBEA	2	Real Personal Consumption Expenditures: Services, Index 2012=100, SA	0.1741
32	DPCCRA3M086SBEA	2	Real Personal Consumption Expenditures Excluding Food and Energy, Index 2012=100, SA	0.1710
33	CSCICP03USM665S	2	Consumer Opinion Surveys: Confidence Indicators: Composite Indicators: OECD Indicator for the United States, Normalised (Normal=100), SA	0.1932
34	CE16OV	2	Civilian Employment Level, Thousands of Persons, SA	0.4909
35	LNS12035019	2	Employment Level: Nonagricultural Industries, Thousands of Persons, SA	0.4898
36	LNS12034560	2	Employment Level: Agriculture and Related Industries, Thousands of Persons, SA	0.3340
37	UNRATE	1	Civilian Unemployment Rate, Percent, SA	-0.2666

38	UEMPMEAN	2	Average (Mean) Duration of Unemployment, Weeks, SA	-0.1192
39	UEMPLT5	2	Number of Civilians Unemployed for Less Than 5 Weeks, Thousands of Persons, SA	-0.3342
40	UEMP5TO14	2	Number of Civilians Unemployed for 5 to 14 Weeks, Thousands of Persons, SA	-0.3255
41	UEMP15OV	2	Number of Civilians Unemployed for 15 Weeks and Over, Thousands of Persons, SA	-0.3284
42	UEMP15T26	2	Number of Civilians Unemployed for 15 to 26 Weeks, Thousands of Persons, SA	-0.2942
43	UEMP27OV	2	Number of Civilians Unemployed for 27 Weeks and Over, Thousands of Persons, SA	-0.3027
44	CES0500000001	2	All Employees: Total Private, Thousands of Persons, SA	0.4800
45	CES0000000001	2	All Employees: Total Nonfarm, Thousands of Persons, SA	0.4878
46	CES0600000001	2	All Employees: Goods-producing, Thousands of Persons, SA	0.4201
47	CES1000000001	2	All Employees: Mining and Logging, Thousands of Persons, SA	0.2783
48	CES2000000001	2	All Employees: Construction, Thousands of Persons, SA	0.3604
49	CES3000000001	2	All Employees: Manufactoring, Thousands of Persons, SA	0.4060
50	CES3100000001	2	All Employees: Durable Goods, Thousands of Persons, SA	0.3858
51	CES3200000001	2	All Employees: Nondurable Goods, Thousands of Persons, SA	0.3657
52	CES0700000001	2	All Employees: Service Providing, Thousands of Persons, SA	0.4781
53	CES4000000001	2	All Employees: Trade, Transportation, and Utilities, Thousands of Persons, SA	0.4200
54	CES4142000001	2	All Employees: Wholesale Trade, Thousands of Persons, SA	0.3583
55	CES4200000001	2	All Employees: Retail Trade, Thousands of Persons, SA	0.3970
56	CES5500000001	2	All Employees: Financial Activities, Thousands of Persons, SA	0.3685
57	CES8000000001	2	All Employees: Other Services, Thousands of Persons, SA	0.3487
58	CES9000000001	2	All Employees: Government, Thousands of Persons, SA	0.4131
59	CIVPART	2	Civilian Labour Force Participation Rate, Percent, SA	2.7222
60	UNEMPLOY	2	Unemployment Level, Thousands of Persons, SA	-0.3768
61	AWHMAN	2	Average Weekly Hours of Production and Nonsupervisory Employees: Manufacturing, Hours, SA	0.1557

62	AWOTMAN	2	Average Weekly Overtime Hours of Production and Nonsupervisory Employees: Manufacturing, Hours, SA	0.0565
63	CES2000000032	2	Average Hourly Earnings of Production and Nonsupervisory Employees: Construction, 1982-84 Dollars, SA	0.1000
64	CES3000000032	2	Average Hourly Earnings of Production and Nonsupervisory Employees: Manufactoring, 1982-84 Dollars, SA	0.0903
65	CES0500000032	2	Average Hourly Earnings of Production and Nonsupervisory Employees: Total Private, 1982-84 Dollars, SA	0.0894
66	CES0600000032	2	Average Hourly Earnings of Production and Nonsupervisory Employees: Goods-producing, 1982-84 Dollars, SA	0.0932
67	CES0800000032	2	Average Hourly Earnings of Production and Nonsupervisory Employees: Private Service-providing, 1982-84 Dollars, SA	0.0879
68	HOUST	2	Housing Starts: Total: New Privately Owned Housing Units Started, Thousands of Units, SAAR	0.3025
69	HOUSTMW	2	Housing Starts in Midwest Census Region, Thousands of Units, SAAR	0.2317
70	HOUSTNE	2	Housing Starts in Northeast Census Region, Thousands of Units, SAAR	0.2089
71	HOUSTS	2	Housing Starts in South Census Region, Thousands of Units, SAAR	0.2695
72	HOUSTW	2	Housing Starts in West Census Region, Thousands of Units, SAAR	0.2429
73	PERMIT	2	Housing Starts in West Census Region, Thousands of Units, SAAR	0.3012
74	WTISPLC	2	Spot Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma, Dollars per Barrel, NSA	0.1401

Price Factor and Factor Loadings

No.	Variables Constructing the Price Factor	Transformation Code	Description	Factor Loading (ζ)
1	WPS141	2	Producer Price Index by Commodity for Transportation Equipment: Motor Vehicles and Equipment, Index 1982=100, SA	0.9939
2	WPSFD4111	2	Producer Price Index by Commodity for Final Demand: Finished Consumer Foods, Index 1982=100, SA	1.0199
3	WPSFD49207	2	Producer Price Index by Commodity for Final Demand: Finished Goods, Index 1982=100, SA	1.0119
4	WPSID62	2	Producer Price Index by Commodity for Intermediate Demand by Commodity Type:	1.0092

			Unprocessed Goods for Intermediate Demand, Index 1982=100, SA	
5	WPSID61	2	Producer Price Index by Commodity for Intermediate Demand by Commodity Type: Processed Goods for Intermediate Demand, Index 1982=100, SA	1.0075
6	WPSID69111	2	Producer Price Index by Commodity for Intermediate Demand by Commodity Type: Processed Materials Less Foods and Feed, Index 1982=100, SA	1.0072
7	WPSID69211	2	Producer Price Index by Commodity for Intermediate Demand by Commodity Type: Unprocessed Materials Less Agricultural Products, Index 1982=100, SA	1.0040
8	PPIACO	2	Producer Price Index for All Commodities, Index 1982=100, NSA	1.0102
9	PPIACO	2	Producer Price Index for All Commodities, Index 1982=100, NSA	1.0102
10	CPIAPPSL	2	Consumer Price Index for All Urban Consumers: Apparel, Index 1982-1984=100, SA	0.9911
11	CPITRNSL	2	Consumer Price Index for All Urban Consumers: Transportation, Index 1982-1984=100, SA	1.0187
12	CPIMEDSL	2	Consumer Price Index for All Urban Consumers: Medical Care, Index 1982-1984=100, SA	1.1026
13	CUSR0000SAC	2	Consumer Price Index for All Urban Consumers: Commodities, Index 1982-1984=100, SA	1.0145
14	CUSR0000SAD	2	Consumer Price Index for All Urban Consumers: Durables, Index 1982-1984=100, SA	0.9740
15	CUSR0000SAS	2	Consumer Price Index for All Urban Consumers: Durables, Index 1982-1984=100, SA	1.0564
16	CPIULFSL	2	Consumer Price Index for All Urban Consumers: All Items Less Food, Index 1982-1984=100, SA	1.0373
17	CUSR0000SA0L2	2	Consumer Price Index for All Urban Consumers: All items less shelter, Index 1982-1984=100, SA	1.0328
18	CPILFESL	2	Consumer Price Index for All Urban Consumers: All Items Less Food and Energy, Index 1982-1984=100, SA	1.0432
19	CUSR0000SA0L5	2	Consumer Price Index for All Urban Consumers: All Items Less	1.0333

			Medical Care, Index 1982-1984=100, SA	
20	CPIENGSL	2	Consumer Price Index for All Urban Consumers: Energy, Index 1982-1984=100, SA	1.0002
21	CPILEGSL	2	Consumer Price Index for All Urban Consumers: All Items Less Energy, Index 1982-1984=100, SA	1.0424
22	CPIUFDSL	2	Consumer Price Index for All Urban Consumers: Food, Index 1982-1984=100, SA	1.0398
23	PXPIX	2	Export Price Index: All Commodities, Index, NSA	0.9094
24	PMPIX	2	Import Price Index: All Commodities, Index, NSA	0.8962
25	SP500REALPRICEMONTH	2	S&P 500 Real Price by Month, Index, NSA	1.3122
26	FPEIX	2	Financial Market Prices, Equities, Index, Index, NSA	0.7799
27	FPEPAMEXIX	2	Financial Market Prices, Equities, Primary Market Instruments, American Exchange, Index, Index, NSA	0.7262
28	FPEPNASIX	2	Financial Market Prices, Equities, Primary Market Instruments, NASDAQ, Index, Index, NSA	0.7535

Interest Rate Factor and Factor Loadings

No.	Variables Constructing the Interest Rate Factor	Transformation Code	Description	Factor Loading (η)
1	FEDFUNDS	1	Effective Federal Funds Rate, Percent, NSA	0.9683
2	TB3MS	1	3-Month Treasury Bill: Secondary Market Rate, Percent, NSA	0.8636
3	TB6MS	1	6-Month Treasury Bill: Secondary Market Rate, Percent, NSA	0.8784
4	GS1	1	1-Year Treasury Constant Maturity Rate, Percent, NSA	0.9487
5	GS3	1	3-Year Treasury Constant Maturity Rate, Percent, NSA	0.9935
6	GS5	1	5-Year Treasury Constant Maturity Rate, Percent, NSA	1.0173
7	GS10	1	10-Year Treasury Constant Maturity Rate, Percent, NSA	1.0448

8	MPRIME	1	Bank Prime Loan Rate, Percent, NSA	1.2375

Money Supply Factor and Factor Loadings

No.	Variables Constructing the Money Supply Factor	Transformation Code	Description	Factor Loading (γ)
1	M1SL	2	M1 Money Stock, Billions of Dollars, SA	0.9645
2	M2SL	2	M2 Money Stock, Billions of Dollars, SA	1.1607
3	NOM1M2	2	Non-M1 Components of M2, Billions of Dollars, SA	1.1205
4	M2MSL	2	M2 Less Small Time Deposits, Billions of Dollars, SA	1.1211
5	AMBSLREAL	2	Real St. Louis Adjusted Monetary Base, Billions of 1982-84 Dollars, SA	0.8259
6	BUSLOANS	2	Commercial and Industrial Loans, All Commercial Banks, Billions of U.S. Dollars, SA	0.9187
7	CONSUMER	2	Consumer Loans at All Commercial Banks, Billions of U.S. Dollars, SA	0.8522
8	TOTALSL	2	Total Consumer Credit Owned and Securitized, Outstanding, SA	0.9786

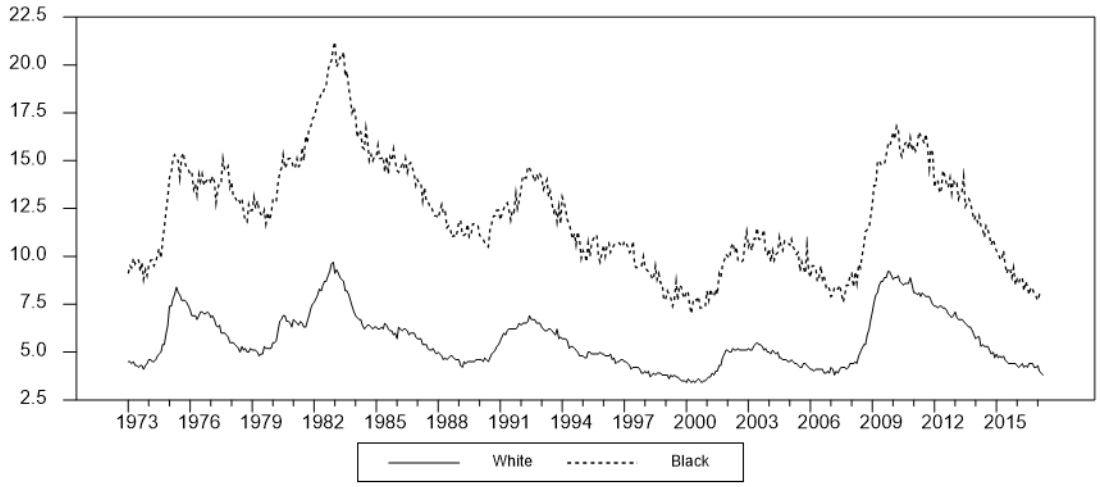
Observable Labour Market Variables

No.	Observables	Transformation Code	Description
1	UNEMRATEwhite	1	Unemployment Rate (U3) of Whites, SA
2	UNEMRATEblack	1	Unemployment Rate (U3) of Blacks, SA
3	EPRwhite	1	Employment Population Ratio of Whites, SA
4	EPRblack	1	Employment Population Ratio of Blacks, SA
5	LFPRwhite	1	Labour Force Participation Rate of Whites, SA

6	LFPRblack	1	Labour Force Participation Rate of Blacks, SA
7	UNEMRATEwhitemen	1	Unemployment Rate (U3) of White Males, SA
8	UNEMRATEwhitewomen	1	Unemployment Rate (U3) of White Females, SA
9	UNEMRATEblackmen	1	Unemployment Rate (U3) of Black Males, SA
10	UNEMRATEblackwomen	1	Unemployment Rate (U3) of Black Females, SA
11	EPRwhitemen	1	Employment Population Ratio of White Males, SA
12	EPRwhitewomen	1	Employment Population Ratio of White Females, SA
13	EPRblackmen	1	Employment Population Ratio of Black Males, SA
14	EPRblackwomen	1	Employment Population Ratio of Black Females, SA
15	LFPRwhitemen	1	Labour Force Participation Rate of White Males, SA
16	LFPRwhitewomen	1	Labour Force Participation Rate of White Females, SA
17	LFPRblackmen	1	Labour Force Participation Rate of Black Males, SA
18	LFPRblackwomen	1	Labour Force Participation Rate of Black Females, SA

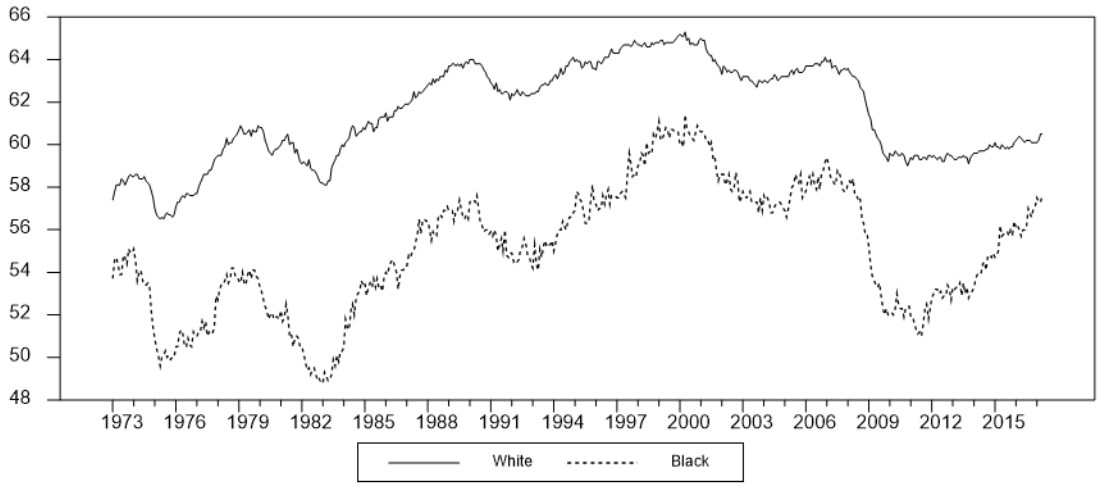
Data Sources: Federal Reserve Economic Database (FRED) of the St. Louis Fed, IMFs International Financial Statistics, Bureau of Labour Statistics, and Institute of Supply Management.

Figure A1. Unemployment Rate of Whites and Blacks, 1973-2017



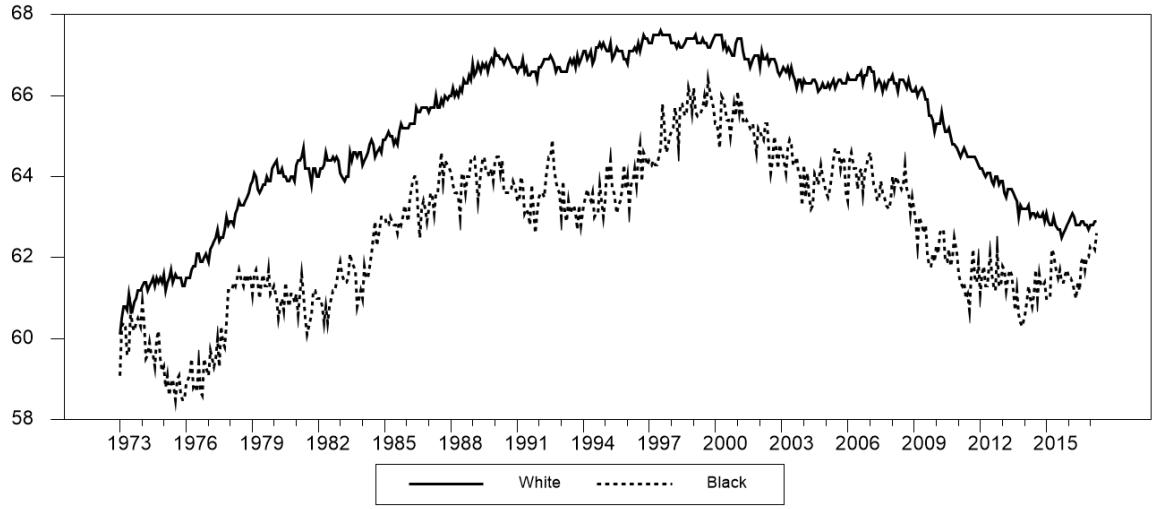
Note: Figure A1 plots the movement in unemployment rate of white and black Americans over the sample period, 1973-2017

Figure A2. Employment Population Ratio of Whites and Blacks, 1973-2017



Note: Figure A2 plots the movement in employment-population ratio of white and black Americans over the sample period, 1973-2017

Figure A3. Labour Force Participation Rates of Whites and Blacks, 1973-2017



Note: Figure A3 plots the movement in labour force participation rate of white and black Americans over the sample period, 1973-2017