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INCLUSIVE MONETARY POLICY:
HOW TIGHT LABOR MARKETS FACILITATE BROAD-BASED EMPLOYMENT GROWTH

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Inclusive Monetary Policy: How Tight Labor Markets Facilitate Broad-Based Employment Growth
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ABSTRACT

This paper analyzes the heterogeneous effects of monetary policy on workers with differing levels of labor-force attachment. Exploiting variation in labor market tightness across metropolitan areas, we show the employment of populations with lower labor-force attachment—Blacks, high school dropouts, and women—is more responsive to expansionary monetary policy in tighter labor markets. The effect builds up over time and is long-lasting. We replicate these results in a New Keynesian model with heterogeneous workers. In the model, expansionary monetary shocks lead to larger increases in the employment of less attached workers when the central bank follows a more dovish monetary policy and when the Phillips curve is flatter. These findings suggest that a more hawkish monetary policy especially hurts the employment prospects of workers with lower labor force attachment.

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With regard to the employment side of our mandate, our revised statement emphasizes that maximum employment is a broad-based and inclusive goal. This change reflects our appreciation for the benefits of a strong labor market, particularly for many in low- and moderate-income communities.

Jerome Powell, 2020 Jackson Hole Economic Policy Symposium

1 Introduction

Following its 2020 Monetary Policy Review, the Federal Reserve emphasized maximum employment as a "broad-based and inclusive goal". It stressed the importance of "understanding how various communities are experiencing the labor market when assessing the degree to which employment in the economy as a whole is falling short of its maximum level" (Federal Reserve 2020). At the Jackson Hole Economic Policy Symposium, Chairman Powell (2020) underscored the need to sustain a strong labor market to generate employment gains more widely across society. Despite this change in focus, monetary policy's heterogeneous effects on different segments of the labor markets are not well understood. In this paper, we study how labor market strength intermediates the effect of monetary policy across different types of workers and demographic groups.

Our empirical analysis explores monetary policy's heterogeneous employment effects with respect to workers' race, education, and sex. We investigate how expansionary monetary policy promotes employment growth for each group across local labor markets with different tightness. We find that for demographic groups with lower average labor market attachment—Blacks, the least educated, and women—expansionary monetary policy has a larger effect on employment growth in tighter labor markets. Because expansionary monetary policy tightens labor markets (Coibion et al., 2017), this finding implies that sustaining expansionary monetary policy over more extended periods is particularly helpful to these demographic groups.

For each demographic group, we regress employment growth on the interaction between the federal funds rate and local labor market tightness, measured across 895 local labor markets in the U.S. between 1990 and 2019. The local market panel nature of our data allows us to include industry-by-quarter fixed effects, which absorb aggregate demand for a given industry's output and other unobserved, industry-level, temporal variation in employment growth common across locations.[1] All regressions also include industry-by-location fixed ef-

[1] The uninteracted effect of monetary policy on employment growth is not identified in the presence of these time fixed effects, but the differential effect of monetary policy in tight as compared to slack labor markets is identified.

fects to control for time-invariant, location-specific variation in employment growth common to a given industry (driven, for example, by variation in the local supply of human capital or the quality of transportation systems). For a given demographic group, our analysis is therefore identified by comparing how monetary policy affects that group's employment growth in tight as compared to slack labor markets.

Our results show that for demographic groups with low average labor market attachment—Blacks, the least educated, and women—monetary expansions have a larger effect on employment growth in tight labor markets, which we measure using the local market's aggregate prime-age employment-to-population ratio. This effect is economically large. For example, we find that a one standard deviation drop in the federal funds rate increases subsequent two-year Black employment growth by 0.91 percentage points more in tight labor markets (90th percentile) than in slack labor markets (10th percentile). Similarly, for workers who did not complete high school, a one standard deviation drop in the federal funds rate increases employment growth over the subsequent two years by 0.39 percentage points more in tight labor markets than in slack ones. This additional impact of monetary policy in tight labor markets is sizable, corresponding to 9% and 18% of the mean employment growth rates for Blacks and high school non-completers over the sample period, respectively.

Whereas labor market tightness plays an important role in mediating the effect of monetary policy on employment for demographic groups with lower labor market attachment, this effect is muted or non-existent for groups with stronger labor market attachment. For example, the point estimate for White employment growth is less than one-quarter of the estimate for Blacks and not statistically significant. All of the differences in the effect of monetary policy—between Blacks and Whites, between less and more educated, and between women and men—are statistically significant.

The effects on less-attached workers are persistent. We find that monetary policy's incremental effect on less-attached workers' employment growth in tight labor markets peaks 7 to 9 quarters after interest rates decrease. Although monetary policy's incremental effect wanes over time, its cumulative effect is long-lasting. For example, the differential effect of monetary policy on cumulative Black employment growth in tight versus slack labor markets persists even four years after the federal funds rate decreases.

The fixed effects used throughout our analysis flexibly control for aggregate economic conditions that covary with monetary policy, including inflation and the output gap. To alleviate any remaining concerns about the endogeneity of monetary policy, we confirm the robustness of the results to estimating an instrumental variables two-stage least squares (2SLS) regression which, following Kuttner (2001), Gertler and Karadi (2015), Wong (2016), and Gorodnichenko and Weber (2016), exploits high-frequency innovations in the federal funds futures rate around Federal Open Market Committee (FOMC) announcements.

We then present a New Keynesian model with search and matching frictions à la Blanchard and Galí (2010) and two types of workers, closely following Dolado et al. (2021) to analyze how monetary policy affects different parts of the labor market. The model features shocks and frictions of a medium-scale New Keynesian business cycle model (Smets and Wouters, 2007; Christiano et al., 2005) to, first, show that a standard model that matches salient business cycle features can replicate our key empirical result and, second, to conduct counterfactual analysis. In the model, worker types are differentiated by their productivity. We do not model the sources of the variation in productivity, which could include differences in education levels, labor market experience, worker-firm match quality, on-the-job discrimination, workplace harassment, or other factors. In each period, firms post vacancies to hire high- and low-productivity workers, with the labor markets for the two types of workers being segmented. The match probability is a function of labor market tightness.

In line with our empirical results, we show that following a monetary expansion, employment of low-productivity workers increases more strongly in tight as compared to slack labor markets. In contrast to low-productivity workers, the employment impact of high-productivity workers following a monetary expansion does not differ much with respect to labor market tightness. Thus, low-productivity workers particularly benefit from monetary expansions when labor markets are tight, as in these situations, the monetary expansion induces firms to hire relatively more low-skilled workers.

We use the model to analyze two counterfactuals. First, we examine how the slope of the Phillips Curve affects the relationship between labor market tightness, monetary policy, and employment. Evidence from before the onset of the Covid-19 pandemic suggests that the Phillips Curve flattened (see, e.g., Simon et al., 2013; Hall, 2013). Such a change to the slope of the Phillips Curve would naturally reduce inflationary pressure from tight labor markets, altering the tradeoff between output and inflation (Brookings, 2020). As such, a flatter Phillips Curve could allow for less restrictive monetary policy, which enables labor markets to tighten more and increases employment of groups less attached to the labor market.

We study the role of the Phillips Curve slope by varying the degree of price stickiness in the economy. We show that when price stickiness is higher, and thus the Philips curve is flatter, the differential employment effect of a monetary expansion on low-productivity workers in tight versus slack labor markets is larger. Thus, the employment benefit that low-skilled workers obtain from monetary expansions when labor markets are tight are particularly pronounced when the Phillips Curve is flat.

In our second counterfactual, we simulate the effects of the Federal Reserve Board's 2020 policy change, in which, following a policy review, the Federal Reserve reinterpreted its objective to put more weight on full and inclusive employment. To do so, we reduce the weight on the inflation in the central bank's reaction function. With this more dovish rule, we find an even larger impact of labor market tightness in mediating monetary expansions: for low-productivity workers, monetary policy has a larger differential employment effect in tight versus slack labor markets. Thus, low-productivity workers particularly benefit from a more dovish policy, as the central bank can keep interest rates lower for longer, allow labor markets to tighten, and enable them to join the workforce.

Taken together, our theoretical and empirical results both point to the importance of labor market tightness in mediating the impact of monetary policy on workers with low labor force attachment. Monetary expansions boost the employment of these workers the most when labor markets are tight. The results thus suggest that a more dovish monetary policy benefits segments of the labor force that have lower historical employment rates. Of course, optimal policy should consider this benefit of prolonging monetary expansions alongside costs arising from the associated inflationary pressure.

Related Literature. Our paper is the first to study the role of local labor market tightness in transmitting monetary shocks differentially into employment growth. We build on prior work that uses aggregate data to study the effect of monetary policy on wealth and consumption inequality (see, e.g., Romer and Romer, 1999; Zavodny and Zha, 2000; Thorbecke, 2001; Carpenter and Rodgers III, 2004; Coibion et al., 2017). In contemporaneous research, Amberg et al. (2022) and Peydró et al. (2023) use annual registry data from Sweden and Denmark to study the effect of monetary policy on consumption and wealth inequality. Coglianese et al. (2023) use the unexpected interest hike in Sweden in 2010-2011 to show that workers with shorter tenure were more negatively affected than other workers. Moser et al. (2021) use the introduction of negative policy rates in Europe as a negative credit supply shock, resulting in lower wages in Germany. Based on aggregate data, Bartscher et al. (2022) find that expansionary monetary policy increases the employment of black households slightly more than that of white households; see also Nakajima (2023) for a rationalization in a heterogeneous agent New Keynesian (HANK) model. Using time-series methods, Amir-Ahmadi et al. (2022) document substantial heterogeneity across individuals' sensitivity to monetary policy shocks in the U.S. Alves and Violante (2023) embed a frictional model of the labor market in a HANK model, in which the employment of low-skilled workers is more exposed to the business cycle, and confirm the predictions of the model using aggregate U.S. data. We differ from these papers in that we study the role of labor market tightness at the local labor market level as an important mediating factor of monetary policy. Studying a large panel of local labor markets, we show that monetary policy's ability to increase employment varies across workers' labor market attachment and depends on local labor market tightness.

Our theoretical analysis builds on Blanchard and Diamond (1994) and Blanchard (1995), which describe so-called "ranking" effects in labor markets, and the vast New Keynesian literature studying the real effects of monetary policy. Early contributions adding labor markets into the New Keynesian model focus on the size and the persistence of the effects of monetary policy shocks (Walsh, 2003, 2005; Trigari, 2009). More recent research adds various labor market frictions to the baseline model to study normative questions such as how unemployment affects the design of optimal monetary policy.[2] These models do not, however, deal with the heterogeneous effects of monetary policy across worker types. Our model is closest to Dolado et al. (2021), who study the distributional consequences of monetary policy between high-skilled and low-skilled workers. In contrast to their work, our research focuses on the role of labor market tightness in shaping the differential effects of monetary policy. Ravenna and Walsh (2012) model two types of workers competing for identical jobs, with firms screening workers to determine their productivity. They focus on understanding how productivity shocks affect the unemployment-inflation tradeoff through a composition effect of who is unemployed. In contrast, we study the effect of exogenous monetary policy on workers with different skill levels. Ravenna and Walsh (2022) extend their model to study the selection effect of the Covid-19 pandemic. Our analysis is also related to Baek (2021), who extends Christiano et al. (2021) and derives optimal monetary policy in a New Keynesian model with regular and irregular workers without perfect insurance. Finally, there is a recent literature that combines the HANK setups with a search-and-matching labor-market block to study the interaction of monetary policy with endogenous unemployment risk (see, e.g., Challe, 2020; Ravn and Sterk, 2021; Gornemann et al., 2021; Broer et al., 2021).

While we focus on labor market tightness and workers' attachment, monetary policy also has heterogeneous effects through other channels. The growing HANK literature, e.g., analyzes the role of households' financial portfolio liquidity in propagating monetary policy shocks (see, e.g., Auclert, 2019; Kaplan et al., 2018; Auclert et al., 2020; Bayer et al., 2019; Krueger et al., 2016; Bayer et al., 2024).

The remainder of the paper is organized as follows. Section 2 describes the data and empirical analysis. We present the model setup and simulation results in Section 3. Section 4 concludes.

[2]See, e.g, Blanchard and Galí (2010); Faia (2008, 2009); Gertler et al. (2008); Christiano et al. (2010); Christiano et al. (2011); Galí (2011a); Galí (2011b); and Galí et al. (2012).

2 The Heterogeneous Effects of Monetary Policy on Employment Growth

In this section, we show that monetary policy has heterogeneous effects on employment across different demographic groups with varying degrees of labor market attachment. Exploiting cross-sectional variation in labor markets, we examine how local labor market tightness mediates the effect of monetary policy on employment for different demographic groups.

Our empirical design, which exploits the data's panel structure, has a number of advantages. First, given the endogenous nature of monetary policy, it is crucial to control for time-series variation in national economic conditions, which is not possible when using national-level data alone. Second, with panel data, we can control for time-invariant, location-specific factors that can affect the relationship between monetary policy and employment growth. In comparing across demographic groups, we can also control for time-varying, location-specific factors. Finally, using cross-sectional data on local labor markets provides a larger range of observed labor market tightness, which increases the power of our tests.

We document a novel set of facts: employment growth of Blacks, less educated workers, and women is more sensitive to monetary policy in tighter labor markets. For these groups, which are less attached to the labor market, monetary policy expansions are associated with larger increases in employment growth when labor markets are tight as opposed to when they are slack. These effects build over time and last several years. In contrast, for Whites, more educated workers, and men, who, on average, have a stronger labor market attachment, the responsiveness of employment growth to monetary policy is less sensitive to the degree of labor market tightness.

2.1 Data

Our main data source is the United States Census Bureau's Quarterly Workforce Indicators (QWI) program. From QWI, we obtain quarterly local labor market level employment statistics for industry-worker demographics cells. These data, which cover the period Q1 1990 to Q1 2019, are ultimately sourced from a variety of administrative records, including state unemployment insurance systems, the Social Security Administration, and the Internal Revenue Service. The sample includes 895 local labor markets: 380 Metropolitan Statistical Areas and 515 Micropolitan Statistical Areas. For ease of exposition, we refer to these areas using the terms MSA-level and local-level interchangeably, although our analysis includes Micropolitan Statistical Areas as well.

Our analysis focuses on heterogeneity in employment growth within three demographic categories: race, education, and sex. Table 1 lists the groups that we analyze within each category along with their mean employment rate over the sample period. Labor force attachment varies considerably across the demographic groups. The average employment rate is lower for Blacks than for Whites (56.6% and 62.3%), lower for women than for men (55.2% and 68.5%), and increases monotonically with education. All of these differences are highly statistically significant.

[Table 1 about here.]

For each quarter t, we observe the number of individuals belonging to a given demographic group employed in the MSA in a given 2-digit NAICS industry. For each demographic group, MSA, and industry cell, we calculate the employment growth over the subsequent two years, from the beginning of quarter $t+1$ through the end of quarter $t+8$. We analyze employment growth over different horizons, from one to 16 quarters. To be included in the sample, we require an MSA-industry-group-quarter cell to have at least 50 employees. Employment growth is winsorized at its 1% tails.

We measure local labor market tightness using the prime-age employment-to-population ratio. The numerator in this ratio is the number of employees aged 25-54 in the MSA, obtained from QWI.[3] The denominator is the population of MSA residents aged 25-54, obtained from the U.S. Census Bureau Population Estimates Program. We use this measure for local labor market tightness, because data on vacancies are only available for a small number of MSAs. Still, for the 18 MSAs where the vacancy-to-unemployment ratio is available from Q1 2001 onwards from the Job Openings and Labor Turnover Survey (JOLTS), the two measures exhibit a high correlation of 0.66. The measures are also highly correlated at the state and national levels. Using state-level data from JOLTS, which is available from Q1 2000, the average within-state, time-series correlation between the ratios is 0.67. At the national level over our full sample period, the correlation between the prime-age employment-to-population ratio and the ratio of the Barnichon vacancy index to the number of unemployed workers is 0.65. Following logging and HP filtering of the two series, the correlation is 0.9.

Our analysis includes two measures of monetary policy: the federal funds rate and the history of unexpected high-frequency innovations in the federal funds futures. Data on the effective federal funds rate are from Federal Reserve Economic Data (FRED) at the Federal Reserve Bank of St. Louis. We calculate the average rate over a quarter using the four monthly federal funds rates spanning the quarter (i.e., the rates at the beginning of each month and the rate at the end of the quarter). Our data on high-frequency innovations

[3] Because the QWI does not include federal employees, we exclude the District of Columbia from the sample, but this exclusion does not meaningfully affect our results.

in the federal funds futures market around FOMC meetings follows Kuttner (2001), Wong (2016), and Gorodnichenko and Weber (2016).

Let $ff_{t,0}$ denote the rate implied by the current-month federal funds futures on date t and assume that one FOMC meeting takes place during that month. t is the day of the FOMC meeting and D is the number of days in the month. We can then write $ff_{t,0}$ as a weighted average of the prevailing federal funds target rate, r_0, and the expectation of the target rate after the meeting, $\mathbb{E}_t(r_1)$:

$$ff_{t,0} = \frac{t}{D} r_0 + \frac{D-t}{D}\,\mathbb{E}_t(r_1) + \mu_{t,0}, \tag{1}$$

where $\mu_{t,0}$ is a risk premium.[4] Gürkaynak et al. (2007) estimate risk premia of 1 to 3 basis points, and Piazzesi and Swanson (2008) show that they only vary at business-cycle frequencies. We focus on intraday changes to calculate monetary policy surprises and neglect risk premia, as is common in the literature.

We can calculate the surprise component of the announced change in the federal funds rate, v_t, as:

$$v_t = \frac{D}{D-t}(ff_{t+\Delta t^+,0} - ff_{t-\Delta t^-,0}), \tag{2}$$

where t is the time when the FOMC issues an announcement, $ff_{t+\Delta t^+,0}$ is the fed funds futures rate 20 minutes after t and $ff_{t-\Delta t^-,0}$ is the fed funds futures rate 10 minutes before t.[5] The $D/(D-t)$ term adjusts for the fact the federal funds futures settle on the average effective overnight federal funds rate.

When the event day occurs within the last seven days of the month, we follow Gürkaynak et al. (2005) and use the unscaled change in the next-month futures contract. This approach ensures small targeting errors in the federal funds rate by the trading desk at the New York Fed, revisions in expectations of future targeting errors, changes in bid-ask spreads, or other noise, which have only a small effect on the current-month average, are not amplified through multiplication by a large scaling factor. Following convention, we call monetary policy surprises expansionary when the new target rate is lower than predicted by fed funds futures before the FOMC meeting, that is, when v_t is negative; and we call positive v_t contractionary.

In a robustness test, we instrument for the federal funds rate using the running sum

[4] We implicitly assume date t is after the previous FOMC meeting. Meetings are typically around six to eight weeks apart.

[5] We implicitly assume in these calculations that the average effective rate within the month is equal to the federal funds target rate and that only one rate change occurs within the month.

of these high-frequency monetary policy innovations. Whereas each innovation captures a change in the Federal Funds rate, their running sum is akin to the level of the Federal Funds rate. For each quarter t, we sum the innovations that occurred from the start of the sample period through t.

Table 2 shows summary statistics for various variables of interest. The average federal funds rate in the sample is 2.32%, whereas the average employment-to-population ratio is 0.67. The average two-year employment growth rate is 10.0% for Blacks and 6.1% for Whites. Employment growth is also more volatile for Blacks than for Whites (standard deviation of 21.8% as compared to 13.7%), which is consistent with Black employment growth being more cyclical.

[Table 2 about here.]

The average employment growth rate also varies with workers' education and sex. The average two-year employment growth rate is twice as high for workers without a high school degree (2.1%) as for those with a bachelor's degree (1.1%).[6] Average growth rates are more similar for men (7.0%) and women (6.5%).

2.2 Results

For each demographic group g, we run the following OLS regression relating the growth rate of employment to the federal funds rate and local labor market tightness:

$$EmplGrowth_{j,g,m,t} = \beta_1 \times FedFunds_t \times Empl/Pop_{m,t-1} + \beta_2 \times Empl/Pop_{m,t-1} + \theta_{j,m} + \delta_{j,t} + \epsilon_{j,g,m,t}, \quad (3)$$

where $EmplGrowth_{j,g,m,t}$ is the growth rate of employment for demographic group g from the beginning of quarter $t+1$ through the end of quarter $t+8$ in industry j and local labor market m; $FedFunds_t$ is the average federal funds rate during quarter t; and $Empl/Pop_{m,t-1}$ is the prime age employment-to-population ratio in labor market m at the beginning of quarter t. Industry-by-MSA fixed effects, $\theta_{j,m}$, absorb unobserved, time-invariant, location-specific variation in employment growth that is common to a given industry. These fixed effects control for variation in employment growth that is driven by, for example, the local supply of human capital, regulatory environments and legal infrastructure conducive to growth, and transportation systems. Industry-by-quarter fixed effects, $\delta_{j,t}$, absorb unobserved, industry-level, temporal variation in employment growth that is common across locations, including,

[6] In the QWI, education categories are defined for workers aged 25 and older, who have lower average employment growth rates than younger workers.

for example, variation in the aggregate demand for a given industry's products. Throughout the analysis, the standard errors are adjusted for clustering at the local labor market level.

Although the industry-by-quarter fixed effects prevent us from identifying the main effect of monetary policy on employment growth, the MSA-panel nature of our dataset, which includes local labor markets with varying degrees of labor market tightness, enables us to identify the relation between employment growth and the interaction of monetary policy and labor market tightness. For each demographic group, the coefficient of interest, β_1, captures how the sensitivity of employment growth to the federal funds rate varies with local labor market tightness, measured using the employment-to-population ratio. This coefficient is identified by comparing how employment growth for a given industry and locality responds differentially to variation in monetary policy in tight, as compared to slack labor markets.[7]

[Table 3 about here.]

Table 3 presents OLS estimates of equation (3). Each column in Table 3 examines the employment growth of a different demographic group. Panel A of the table examines heterogeneity with respect to workers' race, presenting results for Blacks in column 1 and Whites in column 2. For Blacks, the coefficient on the interaction between the federal funds rate and local labor market tightness, β_1, is negative, sizable, and statistically significant. This coefficient implies that a monetary easing is associated with greater Black employment growth in tight labor markets as compared to in slack ones. To assess the magnitude of this estimate, consider the effect of a one standard deviation (2.25 percentage point) decrease in the federal funds rate. Our estimate implies that, over the subsequent two years, this drop in the federal funds rate is associated with a 0.91 percentage point larger increase in Black employment growth in labor markets at the 90th percentile of employment-to-population (86%) than in labor markets at the 10th percentile of employment-to-population (49%). This additional boost in employment growth in tighter labor markets is sizable, corresponding to 9% of the mean two-year Black employment growth over the sample period.

[Figure 1 about here.]

To illustrate the heterogeneity in monetary policy's effect across labor markets implied by our estimates of equation (3), Figure 1 plots, for a given point in time, predicted Black employment growth across labor markets with different degrees of tightness. Specifically, the figure plots the predicted differential effect of a one standard deviation cut in the federal funds

[7]The industry-by-quarter and industry-by-location fixed effects ensure that this identification is achieved after netting out the average rates of employment growth both in that location-industry over time and in that industry-quarter across locations.

rate on two-year Black employment growth across labor markets in each decile of tightness in the fourth quarter of 2000.[8] We plot the additional employment growth predicted for each decile (based on its mean employment-to-population ratio) relative to that for the lowest decile. The figure shows the substantial heterogeneity across labor markets in the effect of a monetary expansion on subsequent Black employment growth: after a monetary expansion, Black employment grows more rapidly in tighter labor markets. The estimates predict that a one standard deviation drop in the federal funds rate in Q4 of 2000 would have increased subsequent 2-year Black employment growth by a quarter percentage point more in labor markets in the second decile of tightness than in the first. The effect is larger in each incremental decile, with the relative effect being twice as large in the fourth decile than in the second decile, more than three times as large in the seventh decile, and more than five times as large in the tenth decile.

The employment response of Whites, however, differs from that of Blacks. Column 2 of Table 3 reports estimates of equation (3) for Whites. In contrast to Blacks, the β_1 coefficient for Whites is much smaller and not statistically significant. This coefficient implies that White employment growth's sensitivity to the federal funds rate does not depend on the degree of local labor market tightness. The difference in the Black and White coefficient estimates is highly statistically significant ($p < 0.01$).

Panel B of Table 3 presents a similar heterogeneity analysis with respect to educational attainment, reporting results for those who did not complete high school in column 3, high school graduates in column 4, those with some college education in column 5, and bachelor's degree holders in column 6.[9] We find that in response to a monetary easing, the increase in employment growth among workers who did not complete high school is larger when labor markets are tight than when they are slack (column 3). The β_1 coefficient implies that a one standard deviation drop in the federal funds rate is associated with 0.39 percentage point greater two-year employment growth in tight labor markets (90th percentile) than in slack ones (10th percentile). This magnitude is again sizeable and corresponds to approximately 18% of unskilled workers' mean two-year employment growth.

For workers with greater educational attainment, in contrast, the β_1 coefficient estimates are close to zero and not statistically significant (columns 4-6). The point estimates are similar across these three more educated groups, implying that the sensitivity of employment growth to monetary easing is less dependent on the degree of slack in the labor market for workers who completed high school. The coefficient for workers who did not complete high

[8] Figures for other points in time look similar with slight variations arising from the contemporaneous distribution of labor market tightness across deciles.

[9] Data are not available in the QWI to conduct the analysis at the race-by-education level.

school is statistically different from the three remaining coefficient estimates. For example, the p-value of the difference between the coefficients for those who did not complete high school and those with a bachelor's degree is 0.001. The difference between these coefficients for each of the three groups with greater educational attainment is not statistically significant.

Panel C of Table 3 examines employment growth separately among men and women. We again find heterogeneous effects: The point estimates of the interaction coefficient, β_1, is an order of magnitude larger in absolute value for women than for men (-0.26 vs. -0.03). Although neither coefficient is statistically different from zero in this specification, the two coefficients are statistically different from one another (p-value = 0.02).[10]

Although groups less attached to the labor market often have lower employment bases than more attached groups, this difference does not explain the differences in β_1 across the groups. Table 4 repeats the analysis of Table 3 after changing the dependent variables from employment growth rates (i.e., the ratio of the change in group employment to the lagged group employment) to the change in group employment normalized by lagged *total* MSA employment (i.e., across all groups). The results are similar in Table 4 and in Table 3. The results' robustness to this alternative normalization indicates that differences in groups' employment bases do not drive our findings.

[Table 4 about here.]

As our identification strategy exploits cross-sectional variation in labor market tightness, one could be concerned that these local labor markets also differ along other dimensions and it is conceivable that these markets experience different shocks that happen to be correlated with labor market tightness. The analysis presented so far uses industry-by-MSA fixed effects to control for time-invariant, location-specific factors that differ across labor markets as well as industry-by-quarter fixed effects to absorb unobserved, industry-level, temporal variation in employment growth common across locations. As a further robustness test, we also control for MSA-by-quarter fixed effects. In these specifications, we base our inference on variation across individuals in the same labor market at the same time. These specifications alleviate concerns that different markets could be subject to different shocks in a manner that industry-by-quarter fixed effects do not capture.

When including MSA-by-quarter fixed effects in the analysis, the β_1 coefficients for each demographic group are not identified. However, we can identify the *difference* in β_1 coefficients across demographic groups. For example, pooling the data for Whites and Blacks allows us to identify the difference in the β_1 coefficients for these two groups. This difference

[10] As shown below, the β_1 coefficient for women is statistically significant in both reduced form and 2SLS specifications examining the effects of high-frequency monetary shocks.

captures how White and Black employment growth responds differentially to monetary policy across labor markets of varying tightness. More generally, with MSA-by-quarter fixed effects, our inference is based on comparing the employment growth rates of different demographic groups in the same MSA in the same quarter.

[Table 5 about here.]

Table 5 presents the results. For each demographic category – race, education, and sex – the table presents the difference in the β_1 coefficient across the different demographic groups in that category. Panel A reports the federal funds rate-labor market tightness interaction coefficient for Blacks relative to that for Whites, ${\beta_1}^{Blacks} - {\beta_1}^{Whites}$ (Column 1), Panel B presents the interaction coefficients for each education level relative to the coefficient for workers with a bachelors degree (Columns 3-5), and Panel C shows the interaction coefficient for females relative to that for males (Column 9). For comparison, the table also presents the analogous estimates from the baseline regressions without MSA-by-quarter fixed effects reported in Table 3.[11] Table 5 shows that including MSA-by-quarter fixed effects has no noticeable effect on most of the estimates. It moderates the estimate for Blacks relative to Whites, but the estimate remains sizable and highly statistically significant.

Next, we examine the persistence of the differential employment growth in tight versus slack labor markets. To study the short- and long-term dynamic responses of employment growth, we use a rolling window framework. Figure 2 depicts the impact of monetary policy on employment growth over a one-year horizon starting at different time periods following a change in monetary policy. For each time period p, beginning one quarter to 16 quarters out, we estimate the following specification:

$$EmplGrowth^{p}_{j,g,m,t} = \beta_1 \times FedFunds_t \times Empl/Pop_{m,t-1} + \beta_2 \times Empl/Pop_{m,t-1} + \theta_{j,m} + \delta_{j,t} + \epsilon_{j,g,m,t}, \quad (4)$$

where $EmplGrowth^{p}_{j,g,m,t}$ is the growth rate of employment for demographic group g from the beginning of quarter $t+p$ through the end of quarter $t+p+3$ in industry j and local labor market m. All other variables are as in equation (3). Figure 2 plots the β_1 coefficients obtained from these one-year rolling window regressions.

[Figure 2 about here.]

[11]For example, in Table 3, the Black coefficient is -1.09 and the White coefficient is 0.10. The difference between these, -1.19, is reported in Table 5, Column (2).

The figure shows that the effects of monetary policy described in Table 3 have a long-term impact. Panel A, which presents the results by race, indicates that the differential incremental impact of monetary policy on Black employment growth in tight versus slack labor markets reaches a peak starting seven quarters after the monetary policy change. The β_1 coefficient declines in absolute value subsequently and is approximately zero by quarter 15. In contrast, the effect on White employment growth is consistently close to zero across all time periods. Panels B and C show similar results when examining differences by education and sex, respectively. The β_1 coefficient for workers without a high school diploma and for women declines in absolute value beginning in quarter 9.

Although monetary policy's incremental effect on Black, low-education, and female employment growth wanes over time, its cumulative effect is long-lasting. Figure 3 depicts the relation between cumulative employment growth and the interaction of the federal funds rate and labor market tightness. For each demographic group, we re-estimate equation (3) for cumulative employment growth measured over different horizons from one quarter up to 16 quarters. Figure 3 plots the β_1 interaction coefficients obtained from each of these regressions. The eight-quarter estimates are the same as those reported in Table 3. Panel A presents results by race, Panel B by education, and Panel C by sex. In all three cases, the heterogeneity in the cumulative effect is long-lasting. Focusing, for example, on Panel A, the figure shows that the differential effect of monetary policy on cumulative black employment growth in tight versus slack labor markets persists even four years following the shock. Further, β_1 is larger in absolute value for Blacks than for Whites at every horizon, with the difference between the coefficients statistically significant at the 1% level at every horizon longer than five quarters.[12]

[Figure 3 about here.]

Even though our analysis is at the MSA level and controls for economic conditions using industry-by-MSA and industry-by-quarter fixed effects, a potential concern is that developments in the federal funds rate are endogenous and correlated with variables affecting local employment growth. Because decreases in the federal funds rate tend to occur in response to deteriorations in the economy, the coefficients in Table 3 will be biased upwards (i.e., less negative) if employment growth in slack labor markets is more pro-cyclical. To alleviate this concern, we examine the effects of unexpected changes in monetary policy, identified using high-frequency movements in the federal funds futures rate around FOMC announcements, following Kuttner (2001) and others. We use the running sum of these high-frequency monetary shocks to instrument for the federal funds rate within a 2SLS framework. This 2SLS

[12]This difference is statistically significant at the 5% level at every horizon longer than one quarter.

estimation is in the spirit of Gertler and Karadi (2015), who use these high-frequency monetary shocks as an external instrument within a structural VAR framework. Because the running sum of monetary shocks is highly predictive of the federal funds rate, it is a valid instrument under the assumption that no other news about the economy is revealed during the 30-minute window around the FOMC meeting.

As a first step in this analysis, we re-estimate our baseline specification (equation 3) after replacing the federal funds rate with the high-frequency shocks. In the instrumental variables approach, this specification is the reduced form regression, wherein we examine the relation between the dependent variable and the instrument itself. We report the results in Table 6.

[Table 6 about here.]

Directly studying the differential impact of monetary shocks in tight versus slack labor markets yields qualitatively similar results as in our analysis that examines the federal funds rate in Table 3. Panel A of Table 6 shows that, whereas an expansionary monetary policy shock leads to higher Black employment growth in tighter labor markets (column 1; $p < 0.05$), White employment growth does not depend on labor market tightness in a statistically significant manner. Similarly, the education group least attached to the labor force—workers without a high school diploma—is more sensitive to monetary policy shocks in tight labor markets than in slack ones (Panel B). Further, whereas monetary expansions lead to greater employment growth in tighter labor markets for women, this effect is not statistically significant for men (Panel C). For each of these demographic categories, these differences across groups are statistically significant.

Finally, to measure the effect of changes in the federal funds rate itself, we run a 2SLS specification in which we use the high-frequency monetary policy shocks to instrument the federal funds rate. Specifically, we instrument for the interaction between the federal funds rate and the local employment-to-population ratio using the interaction between the monetary shocks and the local employment-to-population ratio. Panel A of Table 7 reports the results of the first stage equation:[13]

$$\begin{aligned} FedFunds_t \times Empl/Pop_{m,t-1} = \alpha_1 \times MonetaryShock_t \times Empl/Pop_{m,t-1} + \\ \alpha_2 \times Empl/Pop_{m,t-1} + \theta_{j,m} + \delta_{j,t} + \eta_{j,g,m,t}, \quad (5) \end{aligned}$$

where $MonetaryShock_t$ is the high-frequency monetary shock variable in quarter t. As Panel A shows, the coefficient of interest, α_1, is positive and highly statistically significant

[13]Panel A reports the results of the first stage equation in the context of the analysis of Black employment growth, but we obtain very similar results for the samples corresponding to the other demographic groups.

($p < 0.001$). The first stage F-statistic is 4,984, leaving no concern that $MonetaryShock$ is a weak instrument.

[Table 7 about here.]

The remaining panels of Table 7 present the results of the instrumental variable analysis, which estimates a specification similar to equation (3) but that substitutes the predicted values from equation (5) for the interaction between the federal funds rate times the local employment-to-population ratio. Compared to the analogous OLS estimates reported in Table 3, the IV estimates in Table 7 are slightly larger in magnitude (i.e., more negative). The difference between the estimates suggests that the covariate of interest $FedFunds_t \times Empl/Pop_{m,t-1}$ might be positively correlated with an omitted determinant of employment growth in the OLS specification.[14]

Panel B of Table 7 reports results by race. Monetary policy expansions lead to larger increases in Black employment growth when the labor market is tighter (Column 2). The coefficient implies that a one standard deviation drop in the federal funds rate increases subsequent two-year Black employment growth by 1.02 percentage points more in tight labor markets (90th percentile) than in slack labor markets (10th percentile). This additional boost to employment growth in tighter labor markets is substantial, corresponding to 10.2% of the mean Black employment growth over the sample period. In contrast, the 2SLS coefficient for Whites (column 3) is statistically insignificant and trivial in magnitude. The difference between the two coefficients is statistically significant at the 1% level. These estimates imply that the impact of monetary easings on employment growth does not depend on labor market tightness for Whites as it does for Blacks.

Results across education groups are reported in Panel C. The coefficient for those who did not complete high school (column 4) is more than three times as large as the coefficients for each of the three other education groups (columns 5-7) and is statistically different from them. For example, the p-value of the difference between the coefficients for those who did not complete high school and those with a bachelor's degree is less than 0.001.[15] The point estimate implies that a standard deviation drop in the federal funds rate increases the two-year employment growth of workers who did not complete high school by 0.55 percentage points more in tight labor markets (90th percentile) than in slack ones (10th percentile). For these unskilled workers, this additional impact of monetary policy in tighter labor markets corresponds to 26% of their average two-year employment growth over the sample period.

[14] Because the Fed eases monetary policy during economic downturns, we would expect the OLS estimates to be upward biased (i.e., less negative than the 2SLS results) if employment growth is more pro-cyclical in slack labor markets.

[15] The differences between the coefficients for the three groups with greater educational attainment are not statistically significant.

Finally, Panel D shows IV estimates of the effects on females and males. The IV estimates are again larger in magnitude than the OLS estimates, and we continue to find heterogeneous effects. Monetary expansions boost women's employment more in tight labor markets than in slack ones (column 8). A one standard deviation drop in the federal funds rate is associated with a growth in female employment that is 0.37 percentage points higher in tight labor markets (90th percentile) than in slack ones (10th percentile). The coefficient estimate for men is one-half of what it is for women, and the difference between the two coefficients is statistically significant at the 7% level.

Taken together, these results show consistent evidence that monetary policy has heterogeneous effects on employment across demographic groups. They also present a common pattern: expansionary monetary policy promotes employment of demographic groups with historically lower labor market attachment—Blacks, the least educated, and women—the most when labor markets are tight. For these groups, the impact of monetary policy in tight labor markets lasts several years. In contrast, this pattern is muted or nonexistent for groups with greater labor market attachment—Whites, skilled workers, and men.

The results thus suggest that sustained expansionary monetary policy, which allows the labor markets to tighten significantly, might be required to generate robust employment growth among workers who are less attached to the labor market. We show that, as long as labor markets are slack, the impact of monetary policy on Blacks, unskilled workers, and women is muted. Next, we explore the implications of this heterogeneity for monetary policy in the context of a heterogeneous agent New Keynesian model in which workers differ by their productivity.

3 Model

In this section, we introduce a medium-scale New Keynesian business cycle model (Smets and Wouters, 2007; Christiano et al., 2005) with a search-and-matching friction in the labor market (Blanchard and Galí, 2010) to, first, show that a standard model that matches salient business cycle features can replicate our key empirical result and, second, to conduct counterfactual analysis. Crucially, the model features skill differences among workers, following the approach in Dolado et al. (2021).

3.1 Households

There are three types of households—entrepreneurs (E), high-skilled workers (H), and low-skilled workers (L)—with no transitions across types. Households are fully insured against idiosyncratic unemployment risk within and across the three types $j^+ \in \{E, H, L\}$.[16] Following Dolado et al. (2021), we model this setting through complete markets in which different households can trade with each other (and, similarly, within household types) in a full set of state-contingent claims $a_{t+1}^{j^+}(s^t, s_{t+1})$ at nominal price $q_{t,t+1}(s_{t+1}|s^t)$.[17]

Assuming full insurance within a particular type, we can model each type as a representative household that maximizes lifetime utility, which depends on consumption $c_t^{j^+}$. The term σ_c governs the intertemporal elasticity of substitution, which we assume is identical across types. We allow for time variation in household discount factors to capture shifts in aggregate demand. Specifically, future utils are discounted from period t to period 0 by $\tilde{\beta}_t \equiv \beta^t \Pi_{h=0}^{t-1} \xi_h$, where ξ follows an exogenous AR(1)-process $\log \xi_t = \rho_\xi \log \xi_{t-1} + \varepsilon_t^\xi$, and ε_t^ξ is an i.i.d. discount factor shock with zero mean and variance σ_ξ^2. The discount factor between any two consecutive periods is then given by $\beta_t \equiv \tilde{\beta}_{t+1}/\tilde{\beta}_t = \beta \xi_t$.

High-skilled and low-skilled workers supply labor fully inelastically (Faia, 2008, 2009) but split their time endowments between employment n_t^j and unemployment u_t^j, $j \in \{H, L\}$. We assume that the entrepreneur types do not work and only consume; however, only they can invest in physical capital k_t, which is rented out to intermediate firms at rate r_t—the entrepreneur type, therefore, allows separating the labor market from investment decisions on the household side. Capital depreciates at rate δ, and adjusting the capital stock is subject to quadratic adjustment costs parameterized by ϕ_k. Entrepreneurs are also the sole owners of the firms in the economy, receiving dividends d_t. All households pay lump-sum taxes $\tau_t^{j^+}$ to the government.

The utility maximization problem of the entrepreneurs, subject to their budget constraint and the law of motion for capital, is then given by:

$$\max_{c_t^E, i_t, k_{t+1}, a_{t+1}^E(s^t, s_{t+1})} = E_0 \sum_{t=0}^{\infty} \tilde{\beta}_t \frac{\left(c_t^E\right)^{1-\sigma_c}}{1-\sigma_c} \ , \tag{6}$$

subject to

$$c_t^E + z_t^I i_t + \tau_t^E + \frac{1}{P_t} \sum_{s_{t+1} \in \mathcal{S}} q_{t,t+1}\left(s_{t+1}|s^t\right) a_{t+1}^E(s^t, s_{t+1}) \leq r_t k_t + \frac{a_t^E\left(s^t\right)}{P_t} + d_t \ ,$$

$$i_t = k_{t+1} - (1-\delta)k_t + \frac{\phi_k}{2}\left(\frac{k_{t+1}}{k_t} - 1\right)^2 k_t \ .$$

[16]Below, we will index the smaller subset of workers, $\{H, L\}$, by j.

[17]Specifically, these assets pay a nominal value of one at time $t+1$ in state s_{t+1}, and their nominal price depends on the shock history s^t.

The relative price of investment z_t^I is assumed to follow an exogenous AR(1) process, where the innovation to this process represents an investment-specific shock: $\log z_t^I = \rho_{zI} \log z_{t-1}^I + \varepsilon_t^{zI}$. Defining gross inflation as $\Pi_t = P_t/P_{t-1}$, where P_t is the price level of final consumption goods, and $R_t = \left(\sum_{s_{t+1}} q_{t,t+1}(s_{t+1}|s^t)\right)^{-1}$ as the gross nominal interest rate of a risk-free nominal bond, the optimization problem yields the standard Euler equation: $(c_t^E)^{-\sigma_c} = \beta E_t\{(c_{t+1}^E)^{-\sigma_c}(R_t/\Pi_{t+1})\}$. In addition, we obtain a standard no-arbitrage condition connecting the net return on capital, i.e., after capital adjustment costs and depreciation, to the ex-ante real interest rate $R_t/(E_t\Pi_{t+1})$.

Workers of type $j \in \{H, L\}$ maximize utility:

$$\max_{c_t^j, a_{t+1}^j(s^t, s_{t+1})} = E_0 \sum_{t=0}^{\infty} \tilde{\beta}_t \frac{\left(c_t^j\right)^{1-\sigma_c}}{1-\sigma_c} , \tag{7}$$

subject to their budget constraint and the evolution of their labor-market status

$$\begin{aligned} & c_t^j + \tau_t^j + \frac{1}{P_t} \sum_{s_{t+1} \in \mathcal{S}} q_{t,t+1}\left(s_{t+1}|s^t\right) a_{t+1}^j(s^t, s_{t+1}) \leq w_t^j n_t^j + b_u^j u_t^j + \frac{a_t^j\left(s^t\right)}{P_t} , \\ & n_{t+1}^j = (1-\omega^j) n_t^j + \mu_t^j u_t^j . \end{aligned}$$

Employed household members earn the real wage w_t^j, whereas unemployed members receive inflation-indexed and time-invariant (real) unemployment benefits, b_u^j. We discuss the transition from working to being unemployed and back below.

3.2 Labor Market

The three different types of households are assumed to have constant masses χ^H, χ^L, and χ^E. We normalize the sum of these masses to one and further assume:

$$n_t^j + u_t^j = 1, \qquad j \in \{H, L\} , \tag{8}$$

so that the shares of employed and unemployed workers sum to one, and aggregate employment and unemployment satisfy $N_t^j = \chi^j n_t^j$ and $U_t^j = \chi^j u_t^j$, respectively.

Intermediate goods firms (introduced below) looking to hire at a specific skill level j post vacancies, v_t^j. The vacancies are then potentially filled with unemployed job-searchers, U_t^j, according to the matching technology

$$m_t^j = \psi^j \left(v_t^j\right)^{\zeta} \left(U_t^j\right)^{1-\zeta} , \tag{9}$$

where ψ^j parameterizes the efficiency of the matching process and ζ is the matching elasticity.

We can then define the type-j-specific market tightness θ_t^j, vacancy filling probability ν_t^j, and hiring probability μ_t^j as:

$$\theta_t^j = \frac{v_t^j}{U_t^j} \ , \qquad \nu_t^j = \frac{m_t^j}{v_t^j} \ , \qquad \mu_t^j = \frac{m_t^j}{U_t^j} \ . \tag{10}$$

Employed workers are exogenously separated from their jobs at rate ω^j and then become unemployed. Unemployed workers either find a job or stay unemployed. The transition between the two labor market states is, therefore, governed by the following law of motion:

$$N_{t+1}^j = (1-\omega^j)N_t^j + m_t^j \ , \qquad j \in \{H, L\} \ . \tag{11}$$

It is important to note the timing: n_t^j is predetermined at time t; an intermediate firm can only affect its $t+1$ employment level by posting a vacancy v_t^j at time t.

3.3 Intermediate Goods Firms

A homogeneous intermediate good Y_t is produced by a continuum of perfectly competitive firms using labor N_t^j of both worker types and aggregate capital $K_t = \chi^E k_t$ as inputs. The production function has a Cobb-Douglas structure between capital and composite labor in the form

$$F(K_t, N_t^H, N_t^L) = A_t K_t^\alpha \left[\lambda \left(N_t^H\right)^\rho + (1-\lambda)\left(N_t^L\right)^\rho\right]^{\frac{1-\alpha}{\rho}} \ , \tag{12}$$

where α denotes the share of capital, ρ governs the substitutability of the labor types, and λ the intensity of use. Total factor productivity (TFP) A_t follows an exogenous AR(1) process: $\log A_t = \rho_A \log A_{t-1} + \varepsilon_t^A$.

Firms can only affect the next period's employment N_{t+1}^j by choosing how many vacancies v_t^j to post at a unit cost of κ. The optimization problem of the firm is then given by the following equations, where the firm takes the real price of intermediate goods, ϱ_t, as given:

$$
\begin{aligned}
V^F\left(N_t^H, N_t^L, s_t\right) = & \max_{K_t, N_{t+1}^L, N_{t+1}^H, v_t^L, v_t^H} \varrho_t F(K_t, N_t^H, N_t^L) - r_t K_t \\
& - \sum_{j \in \{H,L\}} \left(w_t^j N_t^j + \kappa v_t^j\right) + E_t \Lambda_{t+1} V^F\left(N_{t+1}^H, N_{t+1}^L, s_{t+1}\right) \ ,
\end{aligned}
$$

subject to

$$
N_{t+1}^j = (1-\omega^j) N_t^j + \nu_t^j v_t^j \ , \qquad j \in \{H, L\} \ . \tag{13}
$$

As the entrepreneurs own the firms, their stochastic discount factor determines the discounting: $\Lambda_{t+1} = \beta_t \left(c_{t+1}^E / c_t^E\right)$.

The optimization problem yields the following first-order conditions for the intermediate goods firms

$$
r_t = \varrho_t F_{K,t} \tag{14}
$$

$$
\frac{\kappa^j}{\nu_t^j} = E_t \Lambda_{t+1} \left(\varrho_{t+1} F_{N,t+1}^j - w_{t+1}^j + (1-\omega^j) \frac{\kappa^j}{\nu_{t+1}^j} \right) \ , \qquad j \in \{H, L\} \tag{15}
$$

with

$$
F_{K,t} = \left(\lambda \left(N_t^H\right)^\rho + (1-\lambda)\left(N_t^L\right)^\rho\right)^{\frac{1-\alpha}{\rho}} A_t \alpha K_t^{\alpha-1} \tag{16}
$$

$$
F_{N,t}^H = K_t^\alpha A_t \lambda (1-\alpha) \left(\lambda \left({N^H}_t\right)^\rho + (1-\lambda)\left(N_t^L\right)^\rho\right)^{\frac{1-\alpha-\rho}{\rho}} \left(N_t^H\right)^{\rho-1} \tag{17}
$$

$$
F_{N,t}^L = K_t^\alpha A_t (1-\lambda)(1-\alpha) \left(\lambda \left({N^H}_t\right)^\rho + (1-\lambda)\left(N_t^L\right)^\rho\right)^{\frac{1-\alpha-\rho}{\rho}} \left(N_t^L\right)^{\rho-1} . \tag{18}
$$

3.4 Wage Bargaining

High- and low-skilled workers are substitutes (to a degree) in the production of intermediate goods, but the wage negotiations are conducted separately for the two markets, and in each, the surplus from a match is split between workers and intermediate firms using Nash bargaining (with workers' weights ϑ^j):

$$
\max_{w_t^j} \vartheta^j \log\left(V_t^{E,j}\right) + (1-\vartheta^j) \log\left(V_t^{F,j}\right) \ , \qquad j \in \{H, L\}, \tag{19}
$$

subject to

$$V_t^{E,j} = \frac{\partial \mathcal{L}}{\partial n_t^j} = w_t^j - b_u^j \frac{(1-\omega^j)}{\mu_t^j} \tag{20}$$

$$V_t^{F,j} = \frac{\partial V^F(N_t^j)}{\partial N_t^j} = \varrho_t F_{N,t}^j - w_t^j + (1-\omega^j)\frac{\kappa}{\nu_t^j}, \tag{21}$$

where $V_t^{E,j}$ is the marginal value of employment for the household, and $V_t^{F,j}$ is the value of filling a vacancy for the firm. $\mathcal{L}$ and V^F are the Lagrangian of the household and the value function of the firm, respectively.

The real wage w_t^j is then given by:

$$w_t^j = \vartheta^j \left[\varrho_t F_{N,t}^j + (1-\omega^j)\frac{\kappa}{\nu_t^j}\right] + (1-\vartheta^j) b_u^j \frac{(1-\omega^j)}{\mu_t^j} \ . \tag{22}$$

3.5 Final Goods Producers

The economy is populated by a continuum of monopolistically competitive final goods producers $i \in [0,1]$, each of which differentiates an amount $y_t(i)$ of the homogeneous intermediate good Y_t. They face a downward-sloping demand curve

$$y_t(i) = \left(\frac{p_t(i)}{P_t}\right)^{-\eta} Y_t \ , \tag{23}$$

for each good i, where η denotes the elasticity of substitution between differentiated goods.

Final goods producers take the relative price ϱ_t of the intermediate good and the aggregate price level $P_t = \left[\int_0^1 p_t(i)^{1-\eta}\right]^{1/(1-\eta)}$ as given. We assume a Calvo-type price adjustment friction with probability θ_p to keep prices constant. If they can adjust prices, final goods firms will choose the new price, $p_t^*(i)$, to maximize:

$$p_t^*(i) \equiv \underset{p_t(i)}{\arg\max}\, \mathbb{E}_t \sum_{s=0}^{\infty} \theta_p^s \Lambda_{t+s} \left[\frac{p_t(i)}{P_{t+s}} - (1-\iota)\varrho_{t+s}\right] y_{t+s}(i) \ , \tag{24}$$

$$y_{t+s}(i) = \left(\frac{p_t(i)}{P_{t+s}}\right)^{-\eta} Y_{t+s} \ , \tag{25}$$

where ι is a subsidy to eliminate the distortion from monopolistic competition. Final goods producers are symmetric, so conditional on being able to change prices, they all choose the same price $p_t^* \equiv p_t^*(i)$, where

$$p_t^* = \frac{(1-\iota)\eta}{\eta - 1} E_t \frac{\sum_{s=0}^{\infty} \theta_p^s \Lambda_{t+s} y_{t+s}(i) P_{t+s} \varrho_{t+s}}{\sum_{s=0}^{\infty} \theta_p^s \Lambda_{t+s} y_{t+s}(i)} \ . \tag{26}$$

Finally, under Calvo pricing, the aggregate price level evolves as

$$P_t = \left[(1-\theta_p)(p_t^*)^{1-\eta} + \theta_p P_{t-1}^{1-\eta}\right]^{\frac{1}{1-\eta}} \ . \tag{27}$$

3.6 Government sector

The central bank sets the nominal interest rate according to a Taylor rule that responds to inflation deviations from its target and to deviations of aggregate output from its steady state:

$$\frac{R_t}{\bar{R}} = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\theta_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\theta_y} e_t \ , \tag{28}$$

where e_t is a monetary policy shock with $\log e_t = \rho_R \log e_{t-1} + \varepsilon_t^R$.

Fiscal policy includes exogenous government consumption G_t, a production subsidy ι to final goods producers, and inflation-indexed unemployment benefits b_u^j. Lump-sum taxes T_t ensure that the government budget is balanced in every period:

$$T_t = G_t + \iota \varrho_t Y_t + \sum_{j \in \{H,L\}} b_u^j U_t^j \ , \tag{29}$$

$$\log G_t = (1-\rho_G) \log\left(\bar{G}\right) + \rho_G \log G_{t-1} + \varepsilon_t^G \ . \tag{30}$$

We assume that all types pay the same lump-sum level of taxes, i.e., $\tau_t^j = T_t$ for $j^+ \in \{E, H, L\}$, implying that the aggregate tax revenue is also equal to T_t.

3.7 Goods and Asset Markets Clearing

Households can only trade assets with each other; therefore, market clearing in the asset markets is given by:

$$\sum_{j^+ \in \{E,H,L\}} \chi^{j^+} a_{t+1}^{j^+}\left(s^t, s_{t+1}\right) = 0 \qquad \text{for all } s^t, s_{t+1} \in \mathcal{S} \ . \tag{31}$$

The final output is used for consumption, investment, government expenditures, and posting vacancies,

$$Y_t = C_t + I_t + G_t + \sum_{j \in \{H,L\}} \kappa^j v_t^j \ , \tag{32}$$

where $C_t = \sum_{j^+ \in \{E,H,L\}} \chi^{j^+} c_t^{j^+}$ and $I_t = \chi^E i_t$.

3.8 Calibration

We calibrate the model at the quarterly frequency using the parameters listed in Table 8. Our calibration strategy of the labor market closely follows Dolado et al. (2021), focusing on U.S. data from 1980 to 2007. The share of high (low)-skilled workers in the economy is set to match the average share of workers with some (no) college education. We allow for asymmetries in labor market frictions, both in separation rates $\omega^H < \omega^L$ and in matching efficiencies $\psi^L < \psi^H$(Wolcott, 2021), while assuming symmetry in the matching elasticity, ζ, and vacancy posting costs, κ. We choose the bargaining power of high- and low-skilled workers, ϑ^H and ϑ^L, to match the respective unemployment rates in the two market segments (2.80% and 7.80%, respectively). These choices imply a lower bargaining power for low-skilled households. Unemployment benefits, b_u^H and b_u^L, are assumed to be equal across both segments, resulting in lower wage replacement rates in the high-skilled sector, which is consistent with the existence of a maximum unemployment benefit ceiling in the U.S. (Fischer, 2017). We calibrate the role of labor in production using a Cobb-Douglas production function and allow for high substitutability between the two types of labor: $\rho = 1$ and $\lambda = 0.7$, so that the high-skilled workers indeed have a higher marginal product of labor. The remaining parameters are set following the literature, as described in Table 8.

[Table 8 about here.]

Similar to Dolado et al. (2021), our calibration implies that steady-state hiring and vacancy-filling probabilities are higher for high-skilled labor, whereas steady-state tightness is higher in the low-skilled market. However, as noted above, in steady state high-skilled workers are more attached to the labor market in that their unemployment rate is lower.

3.9 Heterogeneous Labor Market Effects of Monetary Policy: Model Simulations

We use the model to study the differential labor market effects of an expansionary monetary policy shock—specifically, a quarter-point cut in the policy rate—in tight versus slack labor markets.[18] To do so, we solve the model via second-order perturbation and compute

[18]Appendix Figure A.1 shows the IRFs of aggregate variables to the monetary easing. Overall, the model successfully replicates salient features of the business cycle. Focusing on the two labor-market scenarios that we introduce below, while the results are qualitatively similar, the responses are somewhat stronger in the tight scenario.

generalized impulse response functions (IRFs) at two points in the state space. The first is a non-tight labor market state, which is calculated at the ergodic mean under the baseline calibration (we loosely call this state the "slack" state). The second is a high-tightness state, which we initialize by moving employment levels in the high- and low-skilled sectors 15 percent off their ergodic mean levels. In this scenario, tightness in both the high- and the low-skilled market endogenously increases by 30 percent due to changes in firms' vacancy postings.

[Figure 4 about here.]

We now study the differential response of employment in tight vs. slack labor markets. Figure 4 examines the differential response of employment to a 25 basis point policy rate cut across tight versus slack labor markets, separately for low-skilled (blue) and high-skilled (red) workers. A positive value in the figure implies that following the interest rate cut, employment reacts more when the labor market is tight relative to when it is slack. In line with our empirical results, employment of low-skilled workers reacts more strongly in tight as compared to slack labor markets. In particular, the employment response of low-skilled workers is, at its peak, 0.15 percentage points higher in tight labor markets than in slack labor markets. Low-skilled workers, therefore, particularly benefit from monetary expansions when labor markets are tight. In contrast, and in line with our empirical results, for high-skilled workers, the differential response to the rate cut across labor-market tightness is much less pronounced. In fact, the differential response of tight versus slack employment for high-skilled workers is slightly positive upon impact, then turns negative before subsequently converging back to zero. When markets are tight, monetary expansions induce firms to hire relatively more low-skilled workers, whereas high-skilled hiring does not exhibit this pattern.

Figure A.2 in the appendix provides analogous results to those in Figure 4 but analyzes the differential response of wages, rather than employment, to the same policy shock. The figure shows that for both high- and low-skilled workers the wage response to the monetary expansion is larger in tight than in slack labor markets, as we would expect. However, in contrast to the employment results, this differential effect across tight and slack labor markets is *smaller* for the low-skilled workers. That is, the effect of labor market tightness on wages is dampened for low-skilled labor markets as compared to high-skilled markets.

Next, we use the model to analyze how the slope of the Phillips Curve affects the relation between labor market tightness, monetary policy, and employment. Evidence from before the onset of the Covid-19 pandemic suggests that the Phillips Curve flattened (see, e.g., Simon et al., 2013; Hall, 2013), giving rise to the criticism that preemptively increasing rates hurts minority employment and is unwarranted given the low inflationary pressure at the time. For example, referring to the increase in the federal funds rates in 2015, Federal Reserve Board Governor Lael Brainard stated in September 2020 that "There was no need to pre-emptively withdraw, or prepare to withdraw, on the basis of an expectation of inflation materializing" (Brookings, 2020).

We investigate the role of the slope of the Phillips curve by lowering the degree of price stickiness in our model economy from the baseline value of $\theta_p = 0.8$ to $\theta_p = 0.7$, thereby increasing the slope of the Phillips curve. The left panel of Figure 5 plots the IRFs for these two different degrees of price flexibility (and, hence, slopes of the Phillips curve). The figure shows that when the Phillips curve is flatter, the differential employment effect on low-skilled workers in tight versus slack labor markets is larger. Put differently, a flatter Phillips curve amplifies the effect of tight labor markets in mediating the impact of monetary expansions on low-skilled employment growth. As such, the benefits that low-skilled workers obtain from monetary expansions when labor markets are tight are particularly pronounced when the Phillips curve is flat. Due to this flat Phillips curve, the central bank can tighten labor markets and allow lower-productivity workers to enter the workforce.

[Figure 5 about here.]

Next, we examine the effects of the Federal Reserve Board's 2020 policy change, in which, following a policy review, the Federal Reserve reinterpreted its objective to put more weight on full and inclusive employment. To do so, we compare the differential employment IRFs for the low-skilled workers under two scenarios. In the first, the central bank uses the baseline Taylor rule with an inflation coefficient of $\zeta_\pi = 1.5$, while in the second scenario, the central bank puts less weight on inflation, using an inflation coefficient of $\zeta_\pi = 1.1$. Results are presented in the right panel of Figure 5. Consistent with the Federal Reserve Board's motivation, we find that for low-skilled workers, the differential effect of monetary policy in tight versus slack labor markets is stronger under the dovish policy rule. The benefits that low-skilled workers obtain from monetary expansions when labor markets are tight are, thus, particularly pronounced when the central bank follows a more dovish policy. Due to this dovish stance, the central bank keeps interest rates lower for longer, thereby tightening labor markets, which facilitates lower-productivity workers to enter the workforce.

These model simulations show that an off-the-shelf New Keynesian model with ingredients that the previous literature highlights are important to model business cycles can successfully also rationalize the differential employment growth of workers of differential skills in tight versus slack labor markets. The counterfactual analysis also showcases that the higher employment growth of low-type workers in tight labor markets is even more pronounced when the feedback from economic slack to inflation is muted, as modeled via a flatter Phillips curve, or when monetary policy is less responsive to inflation. These results suggest that inclusive employment growth can be achieved by monetary policy that is less hawkish and when inflation only weakly reacts to tightness in the labor markets. Conversely, the findings suggest that the employment prospects of workers with lower labor force attachment are especially harmed when monetary policy is more hawkish and when the Phillips curve is flatter. Of course, these results do not imply that it is optimal for the central bank to put less weight on inflation. A formal welfare analysis is beyond the scope of this paper.

4 Conclusion

Expansionary monetary policy has heterogeneous effects on the labor force, with labor market tightness playing an important mediating role. We show empirically that expansionary monetary policy boosts the employment of workers with weak labor force attachment more in tight labor markets than in slack ones. This pattern holds across racial and education categories as well as by gender, as the employment benefits for Blacks, high school dropouts, and women increase with labor market tightness. The beneficial impact of monetary policy on less-attached workers is economically sizeable and long-lasting.

Using a New Keynesian model with workers of heterogeneous types, we analyze how labor market tightness transmits changes in monetary policy into employment growth of workers of different types. The model predicts that the expansionary effect of monetary policy on the employment of less-attached workers is stronger in tighter labor markets. We further show that a monetary policy that puts less weight on inflation particularly benefits less-attached workers. By keeping rates low for longer, employment becomes more inclusive. Similarly, a flatter Philips curve enables the central bank to maintain low rates, implying that expansionary monetary shocks lead to larger increases in the employment of low labor force participation workers.

Our empirical and theoretical results both suggest that sustained expansionary monetary policy, which tightens labor markets, facilitates robust employment growth among less-attached workers. Our findings thus imply that the Federal Reserve's 2020 change in its conduct of monetary policy could have beneficial impacts on the employment of female, minority, and low-skilled workers. At the same time, expansionary monetary policy increases inflationary pressure and may also foster wealth inequality by raising asset prices (Amberg et al., 2022; Peydró et al., 2023). Managing the tradeoff between broad-based employment goals, inflation targets, and wealth inequality is an important topic of further research.

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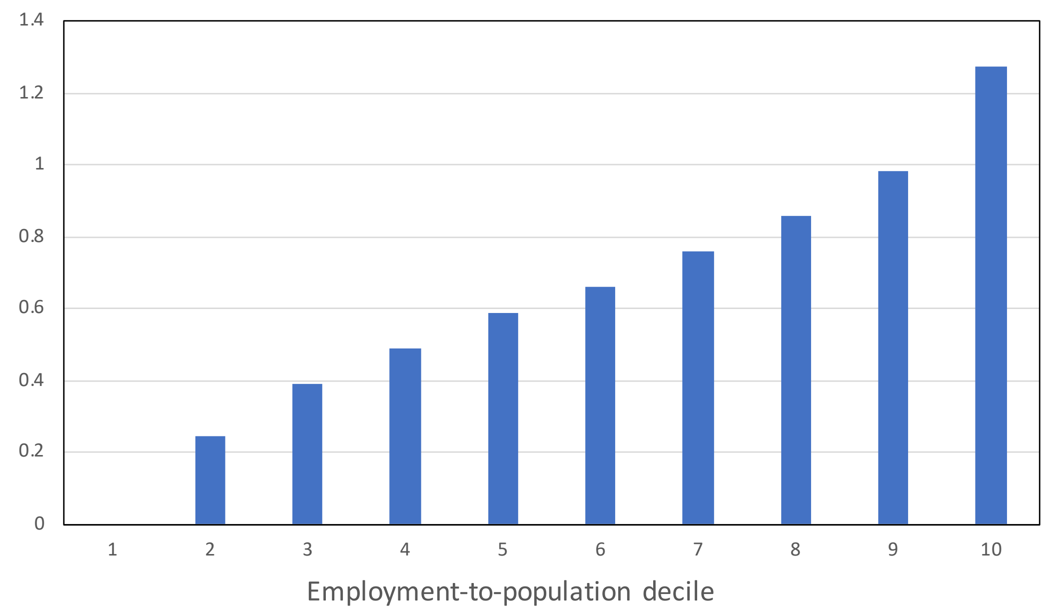
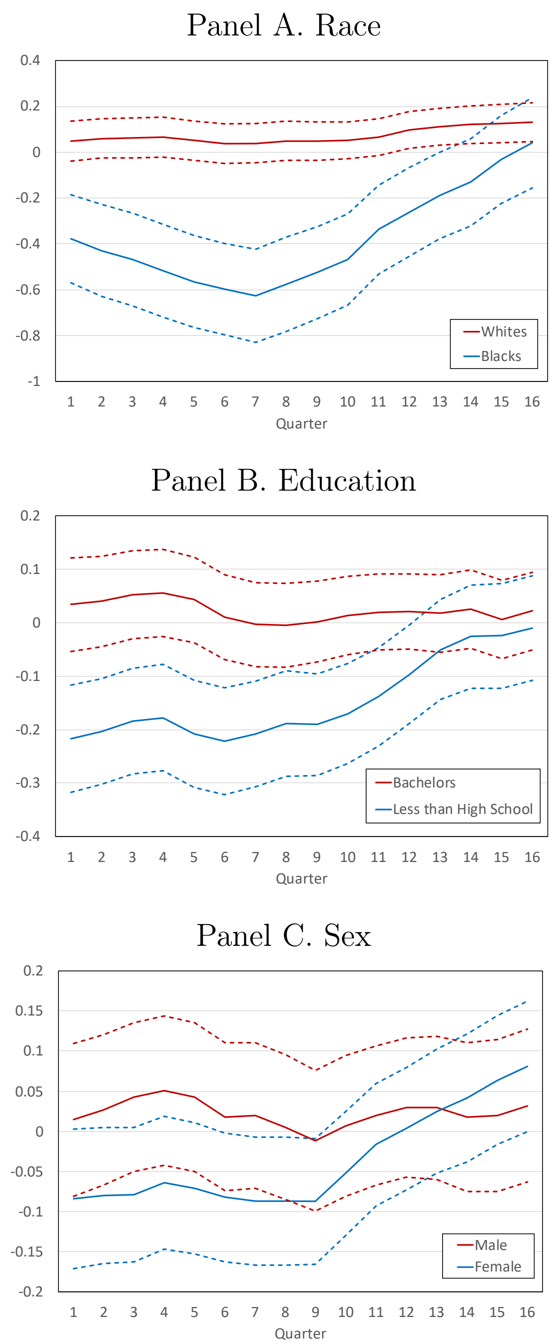
Figure 1: **Predicted Black Employment Growth by Labor Market Tightness, Fourth Quarter 2000**



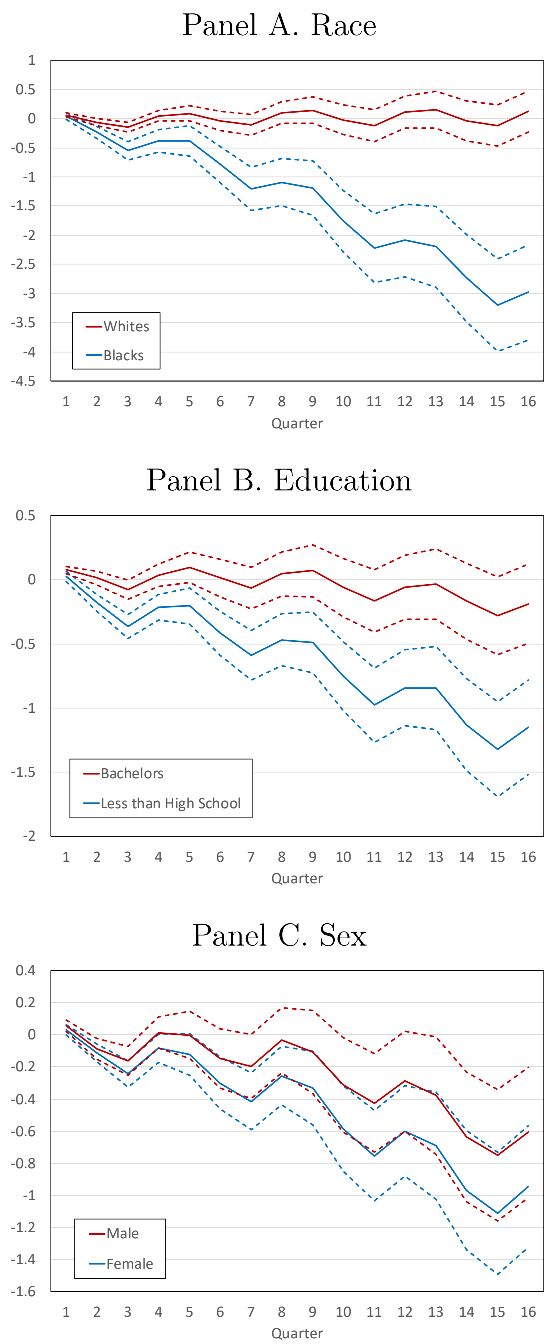
This figure plots the predicted differential effect of a one standard deviation cut in the federal funds rate on subsequent two-year Black employment growth across labor markets of different tightness, measured using deciles of the employment-to-population ratio. The deciles of employment-to-population ratio (across MSAs) are calculated in the fourth quarter of 2000. For each decile, the figure plots the additional predicted employment growth relative to that predicted for the lowest employment-to-population decile. Predicted values are calculated from the estimates in Panel A of Table 3 using the mean employment-to-population ratio for each decile.

Figure 2: **Temporal Dynamics**



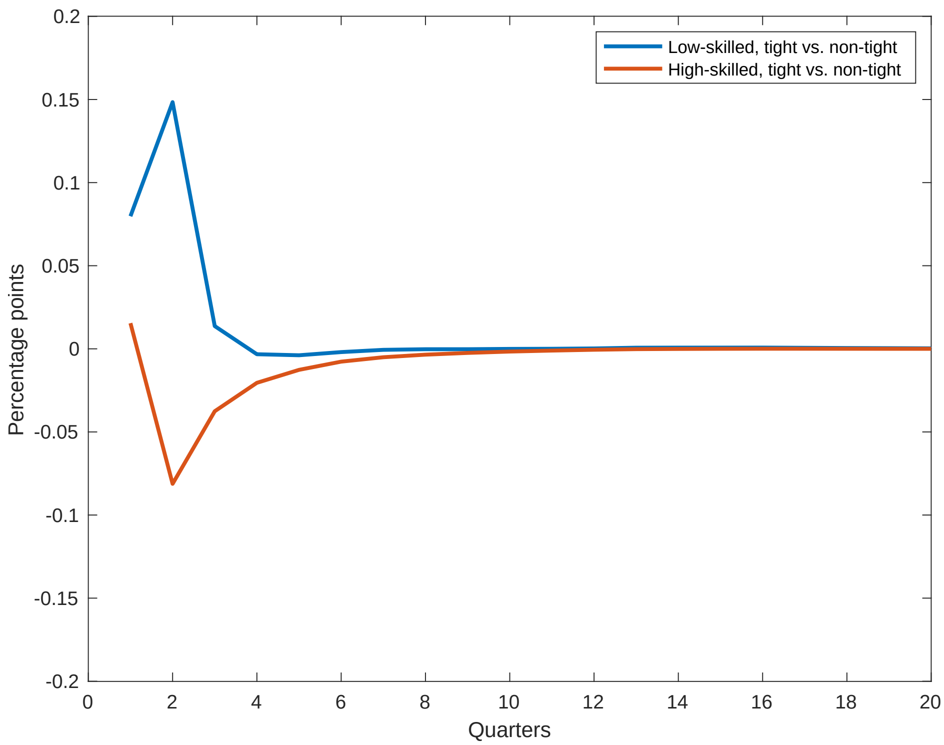
This figure depicts the temporal dynamics of the differential impact of monetary policy on employment growth in tight versus slack labor markets. The figure shows the impact of monetary policy over a one-year horizon starting in different quarters following the monetary policy rate change for different demographic groups within three categories: race (Panel A), education (Panel B), and sex (Panel C). For each quarter, beginning one quarter to 16 quarters out, the figure plots the coefficient on the interaction term between the federal funds rate and the local prime age employment-to-population ratio in equation (4). Dashed lines present one standard deviation confidence intervals.

Figure 3: **Long-run Impact**



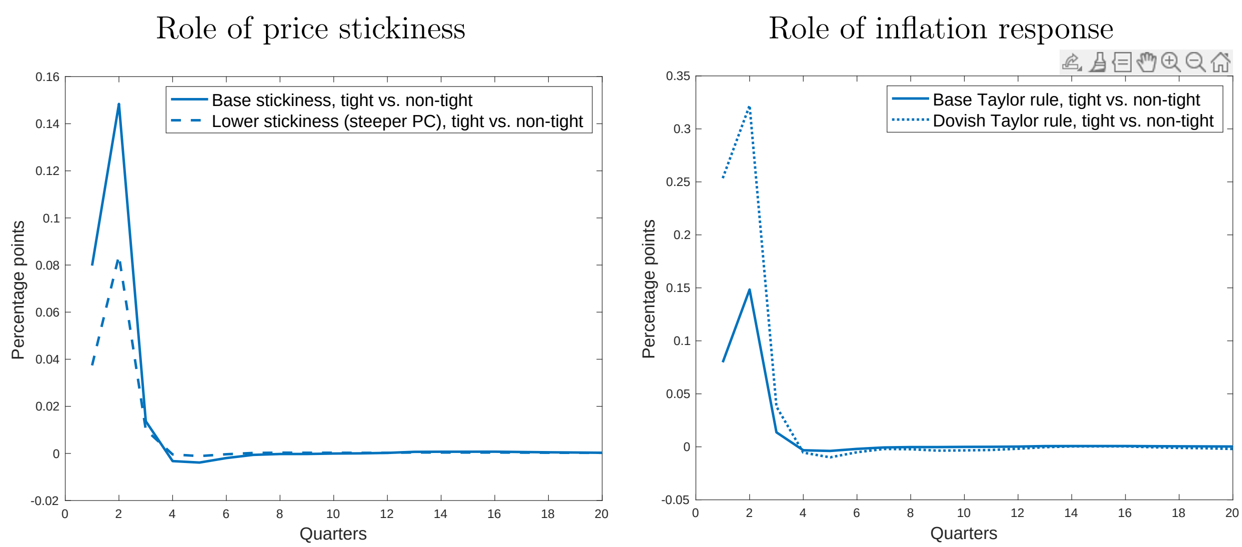
This figure depicts the cumulative impact over time of monetary policy on employment growth in tight versus slack labor markets for different demographic groups within three categories: race (Panel A), education (Panel B), and sex (Panel C). For each demographic group, the figure depicts the relation between cumulative employment growth and the interaction of the federal funds rate and labor market tightness over horizons of one to 16 quarters. For each such time horizon, the figure plots the interaction coefficient between the federal funds rate and the local-level prime age employment-to-population ratio in equation (3), with the dependent variable equal to cumulative employment growth over that time horizon. Dashed lines present one standard deviation confidence intervals.

Figure 4: Differential effects of monetary policy on employment by skill-type: Tight vs. slack labor markets



This figure plots the difference in the employment irfs after a 25 basis point policy rate cut between tight and slack labor markets, separately for low-skilled (blue) and high-skilled (red) workers. See text for details.

Figure 5: Differential employment effects: scenarios – low-skilled



Left panel: baseline price stickiness vs. more flexible prices ($\theta_p = 0.7$). Right panel: baseline Taylor rule vs. more dovish Taylor rule ($\zeta_\pi = 1.1$).

Table 1: **Average Labor Force Attachment by Demographic Group, 1990q1–2019q1**

	Mean	Standard Error
Blacks	56.6%	0.1
Whites	62.3%	0.1
Less than High School	40.3%	0.1
High School	58.9%	0.2
Some College	68.1%	0.2
Bachelors Degree	75.7%	0.1
Female	55.2%	0.1
Male	68.5%	0.2

Data are calculated from statistics reported by the Bureau of Labor Statistics.

Table 2: **Summary Statistics**

	N	Mean	SD	p10	p25	p50	p75	p90
Federal Funds Rate	1,204,974	2.32	2.25	0.09	0.16	1.52	4.81	5.42
Monetary Shock	1,204,974	-3.73	0.93	-4.58	-4.57	-3.70	-3.59	-2.19
Emp/Pop	1,204,974	0.67	0.14	0.49	0.58	0.67	0.77	0.86
Two Year Employment Growth								
Blacks	513,140	10.04	21.81	-12.71	-2.01	8.01	18.84	33.75
Whites	1,019,587	6.12	13.72	-7.55	-0.98	4.76	11.23	20.67
Less than High School	753,583	2.12	14.09	-12.68	-5.67	0.92	8.35	17.84
High School	1,031,445	0.60	12.54	-12.09	-6.08	-0.59	5.69	14.18
Some College	1,039,754	0.97	12.37	-11.53	-5.55	-0.24	5.88	14.35
Bachelors Degree	920,562	1.12	12.02	-11.39	-5.36	0.08	6.14	14.31
Female	1,082,355	6.53	15.74	-9.48	-1.67	5.04	12.51	23.34
Male	1,155,480	7.02	15.84	-8.76	-1.20	5.46	12.84	23.66

This table provides summary statistics for the main variables used in the analysis. The statistics are equal-weighted across MSA-industry-subgroup-quarter cells.

Table 3: **Two-Year Employment Growth and Federal Funds Rate by Labor Market Tightness**

Panel A: Race

	(1) Blacks	(2) Whites
Fed Funds Rate × Emp/Pop	-1.09***	0.10
	(0.40)	(0.18)
	[0.00]	
R^2	0.30	0.28
Observations	511,843	1,019,176

Panel B: Education

	(3) Less than High School	(4) High School	(5) Some College	(6) Bachelors Degree
Fed Funds Rate × Emp/Pop	-0.47**	0.00	0.02	0.05
	(0.20)	(0.17)	(0.16)	(0.17)
	[0.00]	[0.66]	[0.77]	
R^2	0.30	0.26	0.26	0.27
Observations	752,685	1,030,813	1,039,149	919,853

Panel C: Sex

	(7) Female	(8) Male
Fed Funds Rate × Emp/Pop	-0.26	-0.03
	(0.18)	(0.20)
	[0.02]	
R^2	0.28	0.24
Observations	1,081,865	1,155,071

All Regressions are run at the MSA-industry-quarter level and include MSA-industry fixed effects, industry-quarter fixed effects, and the non-interacted Employment-to-Population ratio (not reported). Standard errors adjusted for clustering at MSA level. p-value of difference from Whites (Panel A), from Bachelors Degree (Panel B), and from males (Panel C) in square brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 4: **Two-Year Employment Growth and Federal Funds Rate by Labor Market Tightness: Alternative Normalization**

Panel A: Race	(1) Blacks	(2) Whites
Fed Funds Rate × Emp/Pop	-1.13***	0.10
	(0.38)	(0.18)
	[0.00]	
R^2	0.30	0.29
Observations	505,162	947,208

Panel B: Education	(3) Less than High School	(4) High School	(5) Some College	(6) Bachelors Degree
Fed Funds Rate × Emp/Pop	-0.54***	-0.08	-0.07	-0.07
	(0.19)	(0.16)	(0.16)	(0.17)
	[0.00]	[0.87]	[0.98]	
R^2	0.30	0.27	0.26	0.28
Observations	752,609	1,030,395	1,038,016	918,320

Panel C: Sex	(7) Female	(8) Male
Fed Funds Rate × Emp/Pop	-0.35*	-0.10
	(0.18)	(0.20)
	[0.01]	
R^2	0.28	0.25
Observations	1,081,787	1,154,768

For each demographic group, the dependent is the two-year change in employment of the demographic group normalized by lagged *total* employment (i.e. across all demographic groups) in the MSA. All Regressions are run at the MSA-industry-quarter level and include MSA-industry fixed effects, industry-quarter fixed effects, and the non-interacted Employment-to-Population ratio (not reported). Standard errors adjusted for clustering at MSA level. p-value of difference from Whites (Panel A), from Bachelors Degree (Panel B), and from males (Panel C) in square brackets. * p<0.10, ** p<0.05, *** p<0.01

Table 5: **Two-Year Employment Growth and Federal Funds Rate by Labor Market Tightness, with MSA-by-Quarter Fixed Effects**

Panel A: Race

	(1) MSA-by-Quarter FE	(2) Baseline Regression
Diff. in Fed Funds Rate X Emp/Pop, Blacks vs. Whites	-0.81***	-1.19***
	(0.00)	(0.00)
R^2	0.41	0.30
Observations	1,530,981	1,531,019

Panel B: Education

	MSA-by-Quarter FE			Baseline Regression		
	(3) Less than High School	(4) High School	(5) Some College	(6) Less than High School	(7) High School	(8) Some College
Diff. in Fed Funds Rate X Emp/Pop, Omitted group = Bachelors Degree	-0.54***	-0.02	-0.03	-0.51***	-0.05	-0.03
	(0.00)	(0.83)	(0.72)	(0.00)	(0.66)	(0.77)
R^2	0.42	0.39	0.39	0.29	0.27	0.27
Observations	1,672,508	1,950,607	1,958,954	1,672,538	1,950,666	1,959,002

Panel C: Sex

	(9) MSA-by-Quarter FE	(10) Baseline Regression
Diff. in Fed Funds Rate X Emp/Pop, Female vs. Male	-0.23**	-0.22**
	(0.02)	(0.02)
R^2	0.37	0.26
Observations	2,236,936	2,236,936

Regression results present the difference in the interaction coefficient between the Fed funds rate and labor market tightness across different demographic groups within three different demographic categories – Race, Education, and Sex. All Regressions are run at the MSA-industry-quarter level and include MSA-industry fixed effects and industry-quarter fixed effects. Regressions in Columns 1, 3 through 5, and 9 are run with MSA-by-industry fixed effects. Columns 2, 6 through 8, and 10 present the analogous difference in the interaction coefficients across demographic groups without the inclusion of MSA-by-quarter fixed effects, and are calculated from Table 3. Standard errors adjusted for clustering at MSA level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 6: **Two-Year Employment Growth and Monetary Shocks by Labor Market Tightness**

Panel A: Race

	(1) Blacks	(2) Whites
Monetary Shock × Emp/Pop	-2.62**	0.11
	(1.09)	(0.51)
	[0.00]	
R^2	0.30	0.28
Observations	511,843	1,019,176

Panel B: Education

	(3) Less than High School	(4) High School	(5) Some College	(6) Bachelors Degree
Monetary Shock × Emp/Pop	-1.39***	-0.32	-0.36	-0.16
	(0.52)	(0.46)	(0.45)	(0.52)
	[0.00]	[0.58]	[0.42]	
R^2	0.30	0.26	0.26	0.27
Observations	752,685	1,030,813	1,039,149	919,853

Panel C: Sex

	(7) Female	(8) Male
Monetary Shock × Emp/Pop	-0.91*	-0.45
	(0.53)	(0.56)
	[0.07]	
R^2	0.28	0.24
Observations	1,081,865	1,155,071

All Regressions are run at the MSA-industry-quarter level and include MSA-industry fixed effects, industry-quarter fixed effects, and the non-interacted Employment-to-Population ratio (not reported). Monetary Shock is the accumulated running sum of high-frequency innovations in the federal funds future (as in Kuttner, 2001) from the start of the sample period through each quarter t. Standard errors adjusted for clustering at MSA level. p-value of difference from Whites (Panel A), from Bachelors Degree (Panel B), and from males (Panel C) in square brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 7: **Two-Year Employment Growth and Federal Funds Rate by Labor Market Tightness: 2SLS Estimates**

Panel A: First Stage				
	(1) Fed Funds Rate × Emp/Pop			
Monetary Shock × Emp/Pop	2.13***			
	(0.03)			
F − statistic	4,984.19			
Observations	511,843			
Panel B: Race				
	(2) Blacks	(3) Whites		
Fed Funds Rate × Emp/Pop	-1.23**	0.05		
	(0.51)	(0.24)		
	[0.00]			
R^2	0.00	0.01		
Observations	511,843	1,019,176		
Panel C: Education				
	(4) Less than High School	(5) High School	(6) Some College	(7) Bachelors Degree
Fed Funds Rate × Emp/Pop	-0.66***	-0.15	-0.17	-0.08
	(0.25)	(0.22)	(0.22)	(0.25)
	[0.00]	[0.58]	[0.42]	
R^2	0.01	0.01	0.01	0.00
Observations	752,685	1,030,813	1,039,149	919,853
Panel D: Sex				
	(8) Female	(9) Male		
Fed Funds Rate × Emp/Pop	-0.44*	-0.22		
	(0.25)	(0.27)		
	[0.07]			
R^2	0.00	0.01		
Observations	1,081,865	1,155,071		

Panel A reports first-stage results of a 2SLS specification which instruments for the interaction between the federal funds rate and the local employment-to-population ratio using the interaction between the monetary shock variable and the local employment-to-population ratio. Monetary Shock is the accumulated running sum of high-frequency innovations in the federal funds future (as in Kuttner, 2001) from the start of the sample period through each quarter t. Panels B–D report results of the second stage regressions, which are run at the MSA-industry-quarter level and include MSA-industry fixed effects, industry-quarter fixed effects, and the non-interacted employment-to-population ratio (not reported). Standard errors adjusted for clustering at MSA level. p-value of difference from Whites (Panel B), from Bachelors Degree (Panel C), and from males (Panel D) in square brackets. * p<0.10, ** p<0.05, *** p<0.01

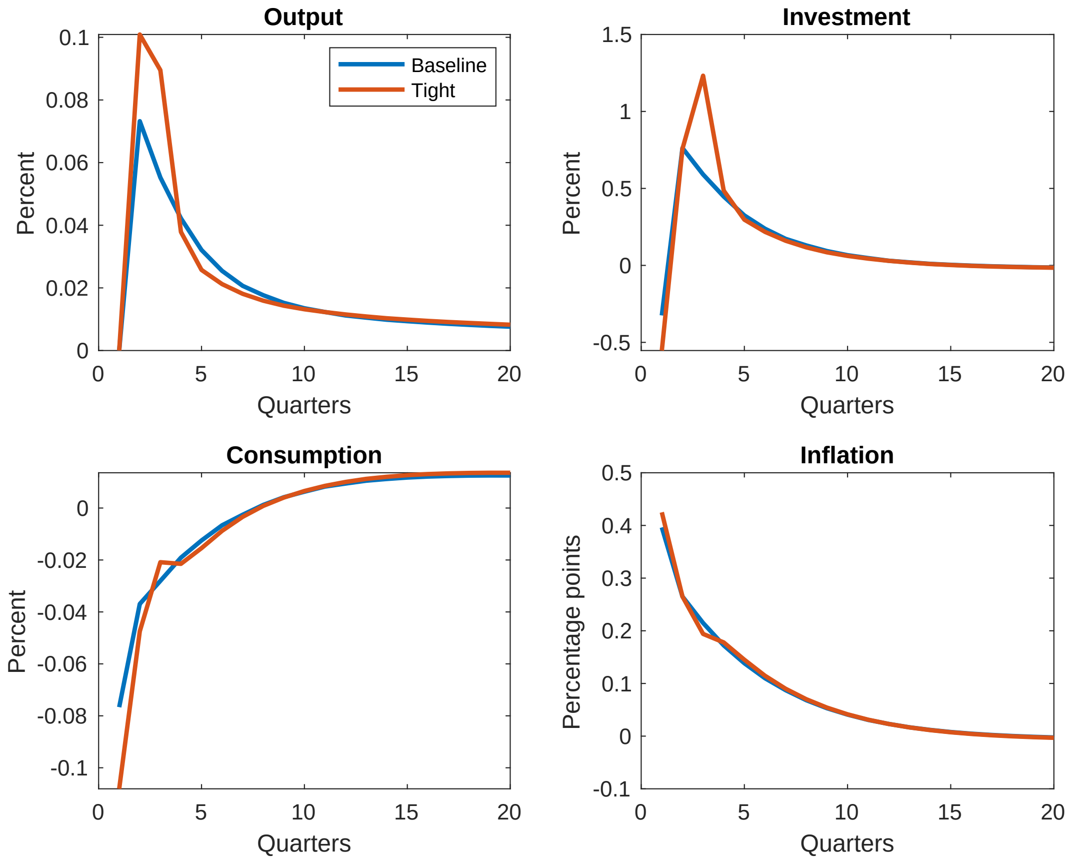
Table 8: Parameter Values

Parameter	**Value**	**Description**
		Labor market
χ^H	0.21	share of high skilled
χ^L	0.69	share of low skilled
χ^E	0.10	share of entrepreneurs
ω^H	0.03	separation rate - H
ω^L	0.07	separation rate - L
ψ^H	0.75	matching efficiency - H
ψ^L	0.57	matching efficiency - L
ζ	0.50	matching elasticity
κ	0.13	vacancy costs
ϑ^H	0.82	bargaining power of workers - H
ϑ^L	0.46	bargaining power of workers - L
b_u^H	0.21	unemployment benefits - H
b_u^L	0.21	unemployment benefits - L
ρ_{wH}	0.60	wage rigidity/persistence - H
ρ_{wL}	0.60	wage rigidity/persistence - L
		Households
β	0.99	personal discount factor
σ_c	2.00	intertemporal elasticity of substitution
ϕ_k	4.00	capital adjustment costs
δ	0.01	depreciation rate
		Firms
α	0.30	share of capital
λ	0.70	intensity of use
ρ	1.00	substitutability of the labor types
η	6.00	elast. of subst. bw diff. goods
θ_p	0.80	Calvo price rigidities
ι	0.17	employment subsidy
		Policy and shocks
$\bar{G}/\bar{Y}$	0.20	stst government exp. share
θ_π	1.50	monetary policy reaction to inflation
θ_y	0.50	monetary policy reaction to output
ρ_{shock}	0.80	persistences of exogenous shocks
σ_{shock}	0.01	standard deviations of exogenous shocks

Persistences and standard deviations refer to the following exogenous shocks: $\{\xi, A, g, R, zI\}$.

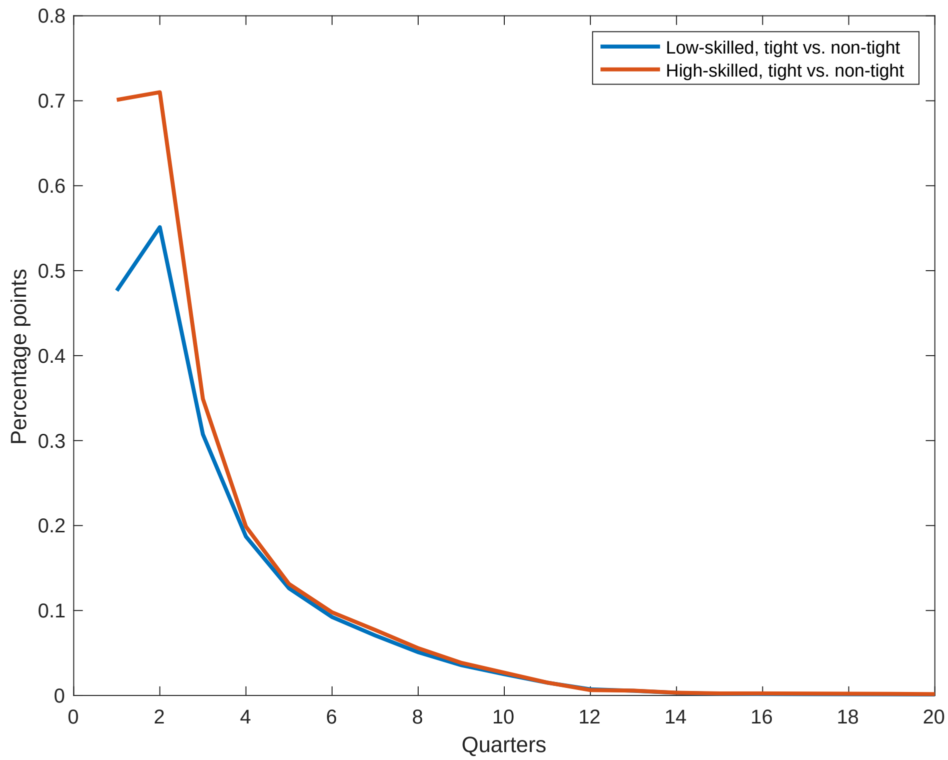
A Additional Figures and Tables

Figure A.1: Differential effects of monetary policy on aggregate variables



This figure plots the irf of aggregate variables after a 25 basis point policy rate cut, separately for tight (red) and non-tight (blue) labor markets. See text for details.

Figure A.2: Differential effects of monetary policy on wages by skill-type: Tight vs. slack labor markets



This figure plots the difference in the wage irfs after a 25 basis point policy rate cut between tight and slack labor markets, separately for low-skilled (blue) and high-skilled (red) workers. See main text for details.