PIIE PETERSON INSTITUTE FOR INTERNATIONAL ECONOMICS

WORKING PAPER

24-23 Labor Market Tightness and Inflation Before and After the COVID-19 Pandemic

Justin Bloesch

December 2024

ABSTRACT

This paper reviews evidence on the role of the labor market in driving inflation and analyzes the US labor market, and its contribution to inflation, during the COVID pandemic and recovery. I argue that the quits rate is a good measure of labor market tightness and is the best predictor of nominal wage growth. I further argue that wages largely pass through into prices, but other factors like sector-specific supply shocks are needed to explain the dynamics of price inflation. The COVID pandemic created large disruptions in the labor market, resulting in an increase in job openings and quits, high nominal wage growth, and temporary labor market mismatch. The shocks associated with COVID have subsequently faded, and nonlinearities in both the wage Phillips curve and Beveridge curve allowed for nominal wage growth to normalize without a large increase in unemployment. Lastly, I argue that the relationship between wages and prices is mostly one-directional: Past price increases are not a major driver of wage gains. The period of high nominal wage growth in the recovery from COVID therefore reflected temporarily high labor demand as the economy quickly reopened, but not a classic wage-price spiral.

JEL Codes: J63, E31, E24, J31
Keywords: Labor Market Tightness, Inflation, Wage Growth

Justin Bloesch is an assistant professor in the Cornell Department of Economics and in the School of Industrial and Labor Relations.

Note: This Working Paper is part of a series titled Understanding the COVID Era Inflation. PIIE gratefully acknowledges the financial support from a donor who wishes to remain anonymous for the research presented in this Working Paper. The research was conducted independently; funders are never given the right to review a publication before its release.

1 INTRODUCTION

During the COVID-19 pandemic and its aftermath, the United States experienced large increases in inflation, rapid wage growth, and tight labor markets. This has led to significant debate about the role of the labor market in contributing to high inflation. Prior to the pandemic, decades of price stability raised doubts about whether there is a relationship between the labor market and price inflation at all. To the extent a structural relationship between labor market tightness and inflation does exist, what indicators of the labor market should we use to both understand and predict inflation, and what are the forces governing this relationship? Has the labor market fundamentally changed during the COVID pandemic and the subsequent recovery?

In this paper, I assess the role of labor market tightness in contributing to inflation, drawing on the available research, as well as my own examination of the labor market's contribution to inflation during COVID. I draw three main conclusions. First, tight labor markets do contribute to inflation: The quits rate is the best measure of labor market tightness for predicting nominal wage growth, and empirical evidence suggests that wage increases pass through meaningfully into prices. However, a large portion of the variation in inflation is not well explained by the labor market, and so labor-only stories are insufficient to explain most inflation patterns. Second, the experience of COVID reflects large but temporary disruptions to the labor market, combined with elevated demand for labor, most of which have already receded. Third, the general absence of contractual cost-of-living adjustments lessens the likelihood of the US entering a wage-price spiral, minimizing the need for the Federal Reserve to depress the labor market to bring inflation back to its target.

I will begin by reviewing evidence on how labor market tightness affects nominal wage growth and price inflation in the labor market prior to COVID. I argue that the wage Phillips curve is alive and well: Tight labor markets increase nominal wage growth. I will also argue that the quits rate, the rate at which workers voluntarily leave their jobs, is theoretically and empirically the best predictor of nominal wage growth. Next I will turn to price inflation, where the connections to the labor market are more nuanced. While the minimum wage literature suggests that increased wage costs are largely passed through into prices, there are various factors that complicate a clean relationship between labor market tightness and price inflation, such as procyclical labor productivity and sector-specific supply shocks. Tight labor markets may also affect inflation through channels other than wage growth: Strong employment gains provide the income for strong consumer demand, so rapid growth in total labor income may push up prices, particularly in sectors where the supply of goods and services is inelastic. On the whole, the evidence from the years prior to COVID suggests that tight labor markets contribute meaningfully to price inflation, but a large share of variation in price inflation is not explained by the labor market.

With this evidence in hand, I will examine the labor market and inflation during the COVID period, which was characterized by a very large increase in the number of job openings, a rise in quits, a decrease in labor supply, and rapid wage growth and inflation. These patterns, and the rise in job openings in particular, led economists and policymakers to worry that COVID had permanently made it harder to match workers to jobs, leaving the economy with

a higher natural rate of unemployment. I will argue instead that COVID will have minimal lasting impacts on the labor market, and that inflation can normalize without a large increase in unemployment. Focusing first on job openings, I will argue that the rise in job openings during COVID represented a combination of three forces: (i) a surge in labor demand as firms were rehiring all at once, (ii) a temporary increase in labor market mismatch, and (iii) a continued upward time trend in the job openings series that existed prior to COVID. The decline in labor supply was also temporary, and nonlinearities in both the wage Phillips curve and Beveridge curve allowed demand for labor and wage growth to fall without a large increase in the unemployment rate. With labor demand, labor supply, and mismatch normalizing, the labor market today increasingly resembles the labor market prior to COVID.

Lastly, I will argue that the US did not exhibit dynamics of a wage-price spiral: The rise in wage growth experienced over the last few years was not the result of a feedback from price inflation into wage growth. Instead, the wage growth experienced in the US was the result of high labor demand, as the rise in wage growth in job postings preceded the rise of inflation during this cycle. The lack of wage-price spiral dynamics lessened the risk of inflation becoming entrenched, limiting the need for the Federal Reserve depress the labor market to stabilize inflation.

2 LABOR MARKET TIGHTNESS, WAGE GROWTH, AND INFLATION

In this section, I will discuss evidence on both the wage Phillips curve and price Phillips curve, i.e., how labor market tightness affects nominal wage growth and price inflation. I will compare various measures of labor market slack in predicting nominal wage growth and argue that the quits rate does a better job of predicting wage growth than other measures, such as the unemployment gap or ratio of vacancies to unemployed workers. I will review the evidence from the minimum wage literature that shows that wages pass through to prices in a way that is consistent with constant markups over marginal cost. I will then discuss various forces that complicate the simple story of labor market tightness increasing inflation, including procyclical productivity and sector-specific shocks that are unrelated to the labor market. I will conclude that while labor market tightness contributes significantly to inflation, most of the variation of inflation over time is not attributable to the state of the labor market, particularly at high frequencies.

2.1 Which Labor Market Variables Predict Wage Growth?

The Modern New Keynesian Phillips Curve: A Primer. Dating back to Phillips (1958), the original Phillips curve is a relationship between nominal wage growth and the unemployment rate. With New Keynesian models using sticky prices to reintroduce a role for monetary policy into macroeconomic modeling, the modern New Keynesian Phillips curve is an equation that expresses current price inflation, rather than wage growth, as a function of some measure of current slack and expected inflation. More recently, modelers have introduced sticky wages into New Keynesian models, bringing back the Phillips (1958) relationship between labor market tightness and wage growth, but within a New Keynesian

framework.[1] To address the question of what indicators of slack are the best at predicting inflation, I will start by exploring which measures of slack are most predictive of nominal wage growth, i.e., what variables should be on the right-hand side of the wage Phillips curve.

Traditional Indicator: Unemployment Gap. In the original wage Phillips curve, the unemployment rate was the variable used to measure slack in the labor market. However, a given rate of unemployment may not have the same effect on wage growth or inflation at all points in time: There may be times when the economy has a harder timer reemploying unemployed workers, and so what should matter for wage growth or inflation is instead the gap between the actual unemployment rate and the "natural" rate of unemployment (Phelps 1967, Friedman 1968), often denoted as u^*. This is the lowest unemployment rate that is consistent with stable inflation, which is sometimes called the nonaccelerating inflation rate of unemployment (NAIRU).[2] If the unemployment rate is above the natural rate, then the labor market is slack, and inflation should fall. If the unemployment rate is below the natural rate of unemployment, and workers are in short supply, then inflation should rise.

One challenge of using the unemployment gap as a measure of labor market slack is that one of the crucial components, the natural rate of unemployment, is unobservable and may change over time. Therefore, government agencies and many researchers, such the US Congressional Budget Office (CBO), Barnichon and Matthes (2017), Giannoni et al. (2019), and Holsten et al. (2017) among others, estimate the path of the natural rate of unemployment over time.[3] Estimating the natural rate of unemployment can be very challenging, and most estimates have very wide confidence bounds. In some of the regressions reported below, I will use the CBO estimate of the noncyclical rate of unemployment as the natural rate of unemployment.

Vacancies to Unemployment Ratio. Unemployment alone may not be a sufficient indicator for labor market slack because it does not take into account firms' unmet demand for labor. In many search models where workers and firms match in a frictional labor market, the ratio of job openings (or vacancies, which I will use synonymously) to unemployed workers is the relevant measure of labor market tightness (Pissarides 2000). If posting vacancies is costly, tight labor markets (i.e., many vacancies per unemployed worker) make it harder for firms to hire workers, making firms' search for workers more costly. Similarly, when vacancies are abundant, workers have an easier time finding jobs, improving workers' bargaining position. Both forces will push wages up, and so the

1 Erceg et al. (2000) introduced nominal wage rigidities in a DSGE model, and Galí (2011) use their environment to estimate the old wage Phillips curve: a regression of wage growth on the unemployment rate. Phillips (1958) discusses a nonlinear relationship between the unemployment rate and wage growth, while most current models are linearized and by default can only study a linear relationship between slack and wage growth.

2 These concepts may have slightly different meanings: The NAIRU is sometimes to considered to be a short-run concept and the natural rate a longer-term concept.

3 Some researchers emphasize variations of the unemployment gap, such as Ball and Mazumder (2019) who focus on fluctuations in short-term unemployment.

ratio of vacancies to unemployed workers may be a good predictor of wage growth. Accordingly, the ratio of vacancies to unemployed workers has become increasingly popular as a measure of labor market tightness (Domash and Summers 2022; Benigno and Eggertsson 2024; Barnichon and Shapiro 2024).

Do Vacancies and Unemployment Matter Equally? In simple search models, the only people who search for a job are unemployed workers. This would imply that the ratio of vacancies to unemployed worker summarizes the state of labor market tightness.[4] However, in practice, a firm looking to fill a vacancy will encounter more than just unemployed workers: Searching workers may include workers who are already employed as well as people who are not in the labor force (Abraham et al. 2020, Andolfatto and Birinci 2022). Therefore, the unemployment rate is not a sufficient indicator of the total number of searchers in the labor market, and vacancy and unemployment rates should not be treated symmetrically when defining labor market tightness.

To illustrate this point, consider a simple example where the unemployment rate is U, so fraction $1 - U$ of the labor force is employed. Suppose that employed workers search with probability λ. Labor market tightness is then defined as

$$\text{tightness} = \frac{\text{vacancies}}{\text{searchers}} = \frac{V}{\lambda(1 - U) + U},$$

where the numerator is the number of vacancies or job openings, and the denominator is the sum of workers who currently have jobs and are searching $\lambda(1 - U)$ plus the number of unemployed workers U. In this setting, a 10 percent increase in vacancies will result in a 10 percent increase in tightness: Tightness and vacancies will move one-for-one. However, a 10 percent increase in the unemployment rate will not have a proportionate effect on labor market tightness, as unemployed workers are only a fraction of the searchers in the labor market.[5] Building on this logic, Bloesch, Lee, and Weber (2024) show in a New Keynesian model with on-the-job search that the weight on vacancy rate in the wage Phillips curve should be 2–3 times the weight on the unemployment rate: A 10 percent increase in the vacancy rate will raise wages by 2–3 times as much as a 10 percent decrease in the unemployment rate. The fact that on-the-job search models put more weight on vacancies than unemployment in the wage Phillips curve makes the job openings rate a conceptually appealing indicator for predicting how slack affects wage growth. Unfortunately, recent trends in the job openings series in the Job Openings and Labor Turnover Survey (JOLTS) raise doubts as to whether the vacancy rate is a useful indicator for real time analysis, as I will discuss next.

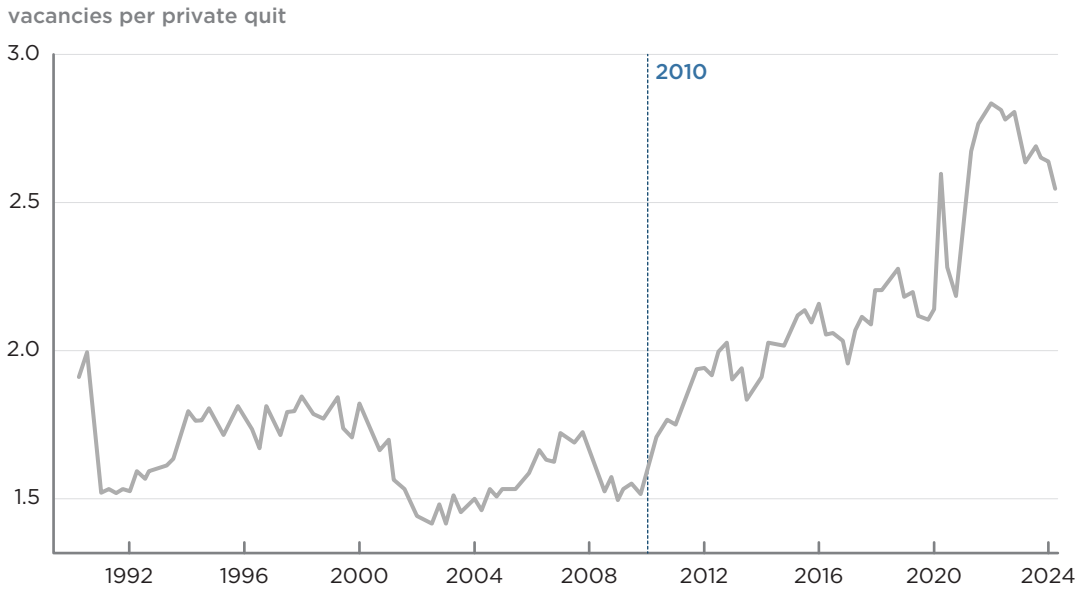
An Upward Trend in the JOLTS Measure of Job Openings. While the rate of job openings or vacancies is theoretically a very important object to measure firms' demand for labor and labor market tightness, it is uncertain whether measured job openings are recently as useful as they were in the past for assessing the state of labor market tightness. Mongey and Horwich (2023) show that beginning

4 For example, see Gagliardone and Gertler (2023) and Benigno and Eggertsson (2024).

5 This is even more the case when accounting for individuals who are not in the labor force, who may be searching for jobs with a low intensity but are not counted as unemployed.

Figure 1

Rising vacancies per private quit since 2010 suggests that the vacancy rate is not comparable over time



Notes: This figure shows the ratio of total job openings over private industry quits. The series are aggregated by averaging at the quarterly level. Job openings prior to 2001 come from Barnichon (2010), and after 2001 from the Job Openings and Labor Turnover Survey (JOLTS). The private quits series prior to 2001 comes from Davis et al. (2012), and JOLTS thereafter. Both vacancies and quits are procyclical, and the volatility of vacancies is greater than for quits. Therefore, we would expect the ratio of vacancies to quits to rise in booms and fall in recessions. This pattern of falling V/Q during slumps is evident in the early 1990s recession, early 2000s recession, and in 2008. A similar figure of nonfarm job openings to nonfarm quits, rather than private industry quits, using JOLTS since 2001 when such data is available, shows a similar rise beginning in 2010.

Sources: Barnichon (2010); Davis et al. (2012); US Bureau of Labor Statistics via St. Louis Federal Reserve Economic Data (FRED).

around 2010, the ratio of job openings to quits measured in JOLTS started rising significantly above what would be expected during an economic recovery. Figure 1 demonstrates this upward trend by plotting the ratio of vacancies to quits.[6] These series should be closely related, as a higher vacancy rate gives workers more opportunities to voluntarily quit to other jobs. If both series were measured consistently, and if there were no shifts in the efficiency of matching workers to jobs, we should expect that the ratio of vacancies to quits should not change much over time. Prior to 2010, the ratio of vacancies to quits typically varied between 1.4 and 1.8. However, around 2011, the rate of job openings began accelerating rapidly, and the ratio of vacancies to quits continued to rise throughout the 2010s cycle. While some of this is to be expected as the labor market recovered through the 2010s, by 2019 the ratio of vacancies to quits was over 2.2. This trend has continued through COVID: By the second quarter of 2024, this ratio was still above 2.5. I will discuss the rise in the vacancy rate

6 Specifically, we use nonfarm job openings and private quits. For job openings prior to 2001, we use the Barnichon (2010) Composite Help-Wanted Index, which covers all nonfarm employment. For quits prior to 2001, we use the Davis et al. (2012) series, which covers private industries. To maintain consistency, we continue to use nonfarm job openings (JTSJOL from FRED) and private quits (JTS1000QUL from FRED) from JOLTS beginning in 2001.

during COVID more extensively in Section 3.1, and I will focus only on the pre-COVID trends in this section.[7]

A substantial literature sought to explain the rise in vacancies in the early 2010s, when the rate of job openings was surprisingly high given the depressed state the labor market. However, as I will argue, none of these explanations provide a good account of the continued rise in the vacancy rate in the later 2010s, leading to doubt about the long-run consistency of the measure. To start, Gavazza et al. (2018) seek to explain why vacancies did not fall as much as expected after 2010. The authors argue that firms' recruiting effort per vacancy is also cyclical, and so many job openings will remain unfilled as firms put only marginal effort into filling them. The presence of many job openings coinciding with high unemployment would lead to lower measured "matching efficiency" in the labor market. Şahin et al. (2014) investigate whether increased mismatch between workers' skills and the jobs and occupations where there are openings might help explain the rise in vacancies in the early 2010s. The authors find some role for mismatch but conclude that mismatch accounts for at most one third in the rise of unemployment after the Great Recession. Similar to lower recruiting efforts, greater labor market mismatch would imply that a high vacancy rate and a high unemployment rate can coexist, also implying low matching efficiency. Bagga et al. (2023) similarly estimate that matching efficiency persistently fell in the 2010s and never recovered.

Despite this extensive body of research, explaining the continued rise in job openings since 2010 with lower matching efficiency remains unconvincing. The main reason is that if matching efficiency falls, the natural rate of unemployment should rise: When matching workers to jobs is harder, workers will linger longer in unemployment.[8] However, the mismatch story predicts a rising natural rate of unemployment u^* and is thus challenged by the observation that the unemployment rate reached its lowest level in decades in the 2010s, attaining a low of 3.5 percent in 2019. Further, wage growth and inflation in the late 2010s were muted by historical standards, suggesting that unemployment was not below its hypothetical natural rate. There is therefore little reason to think that poor matching efficiency was the source of high vacancies by the late 2010s. We need an alternative explanation.

One possible reason for a rising level of measured job openings could be that online job websites made it cheaper and easier for firms to advertise vacancies. However, the development of online job boards alone is not a compelling explanation for rising job openings in the JOLTS series, as the Bureau of Labor Statistics surveys firms directly about positions that are available and ready to be filled, which the cost of posting an ad online should not directly affect. One more speculative reason for greater reporting of job vacancies is a shift toward formality and transparency in hiring, in which firms seek to avoid discriminating

7 The rise in job openings during the 2010s is not only relative to quits: The job openings rate also rises above what would be predicted using past job openings' past relationship with hires, the unemployment rate, or wage growth. All of these other labor market series have mostly stationary relationships with each other, while the job openings rate uniquely rises during the 2010s.

8 This logic is outlined in more detail recently by Blanchard et al. (2022).

or the perception of discrimination.[9] Historically, many hires occurred without a formal vacancy (Davis et al. 2013), and cultural or political efforts to fight discrimination, combined with greater ease of formalizing openings with an online platform, may help explain the rise in stated openings by firms.

Whatever the reason for its increase, the dramatic rise in the job openings rate since 2010 should make researchers and policymakers cautious about using the job openings series as a measure of labor market tightness or for making comparisons over periods of time longer than a few years.[10] Most recently, the job openings rate rose dramatically following the COVID pandemic as well, sparking debate about the extent of labor market tightness in the economic recovery from the COVID shock. As I will discuss in section 3.1, a mismatch in the labor market likely did increase, but long-term trends in the job openings series still plague the series as a useful indicator of labor market tightness.

The Quits Rate as a Measure of Labor Market Tightness. The challenges in measuring job openings leave a clear favorite for measuring labor market tightness: the quits rate, defined as the share of workers who voluntarily leave their job every month. This measure is closely related to another series that is prominent in the academic literature: the job-to-job transition rate, often called the "EE rate," to denote employment to employment transitions. In this section, I will review the evidence on the impact of the quits rate and job-to-job transition rate on wage growth and discuss why the quits rate is a better predictor of nominal wage growth.

As a matter of definitions, job-to-job transitions and quits are highly related, as most workers who quit their job leave for another job.[11] Both job-to-job transitions and quits are good measures of labor market tightness because they reveal the strength of workers' outside options. If workers are receiving more offers from other employers or feel confident enough to leave their jobs without future employment secured, that is a strong indicator that demand for labor is high and labor markets are tight.

Extensive research has shown that both measures are strongly predictive of wage growth. Faberman and Justiniano (2015) report a very strong relationship between the quits rate and wage growth, particularly for the employment cost index. Moscarini and Postel-Vinay (2016) show that job-to-job transitions dominate the job finding rate of the unemployed in explaining wage growth. Crucially, these authors also show that wage growth for stayers (defined as workers who do not change employers) is also strongly predicted by the rate of job-to-job transitions. To the extent that higher wages may contribute to inflationary pressure, the wage growth of stayers is of particular interest because wage growth for these workers is by definition not due to productivity-enhancing

9 This mechanism was suggested by Professor Joseph Stiglitz.

10 Another concern with series from JOLTS is that the response rates have fallen dramatically over the last decade, to a recent low near 30 percent. However, the declining response rate would not explain why the job openings series and quits rate series have diverged in JOLTS.

11 Some job-to-job transitions may be the result of firings or layoffs where workers find jobs in advance or very quickly, and some quits are voluntary separations into unemployment or non-participation. However, these measures will be very similar, as most job-to-job transitions are voluntary quits on the part of the worker.

reallocation. Karahan et al. (2017) similarly find that the rate of job-to-job transitions is more important than the job finding rate of the unemployed in predicting wage growth.

While research demonstrates that both series predict wage growth, I favor the quits rate, for both theoretical and empirical reasons. On a theoretical basis, if turnover is costly for employers, firms should be equally concerned about turnover associated with workers leaving for another firm and with that associated with workers leaving for nonemployment. Bloesch et al. (2024) show in a structural DSGE model with on-the-job search that the quits rate is a good summary statistic for labor market tightness that is predictive of nominal wage growth. Qiu (2022) shows that quits from employment to non-participation is procyclical, and so job-to-job transitions may not fully capture the pro-cyclicality of turnover that firms face. Empirically, Heise et al. (2024) estimate the wage Phillips curve and show that quits outperforms numerous other labor market indicators in predicting wage growth, including the ratio of vacancies to unemployed workers and the hiring rate, among others. The measure of job-to-job transitions from Fujita et al. (2024), which predicted wage growth very well prior to COVID, did not rise to high levels during the COVID recovery.[12] Therefore the job-to-job transition rate has a hard time accounting for the increase in wage growth during COVID, as I will show in the next section.

Evidence on the Aggregate Wage Phillips Curve. In this section, I use simple time series evidence to evaluate which measures of labor market tightness best predict nominal wage growth. Table 1 shows results from regressing the four-quarter percent growth in wages and salaries in private-sector industries measured by the employment cost index (ECI) on four measures of labor market slack: the unemployment gap, measured by the unemployment rate less the CBO estimate of the noncyclical rate of unemployment, the V/U ratio, the monthly job-to-job transition rate (denoted as the EE rate), and the monthly private quits rate. The measures of labor market slack are aggregated by averaging at the quarterly level, and then smoothed using a four quarter moving average.[13] The ECI is a desirable measure of wage growth because it controls for industry and occupation composition.[14] I use private quits data from JOLTS starting in 2001 and the extended quits series for private industries from Davis et al. (2012) for 1991–2000. For job openings prior to 2001, I use the Help-Wanted index from Barnichon (2010). The job-to-job transition rate from Fujita, Moscarini, and Postel-Vinay (2024) is available beginning in the first quarter of 1995.[15]

12 Moscarini and Postel-Vinay (2023) derive a job ladder model and find that the ratio of the job-to-job mobility over the rate of job finding from unemployment, which the authors call the "acceptance" ratio, predicts wage growth and inflation. Heise, Pearce, and Weber (2024) find that the quits rate outperforms the acceptance ratio in tracking nominal wage growth measured by the employment cost index.

13 Including measures of inflation expectations in the regression, such as the University of Michigan's 1-year ahead expected inflation, or the four-quarter growth rate in the CPI lagged by one year, do not significantly change the results.

14 The employment cost index is not adjusted for composition in the sense that the composition of workers within an occupation and industry will change as labor market tightness changes. If during slack labor markets, firms can be more selective in the workers they hire, this means that worker quality in a particular occupation or industry will be countercyclical.

15 Figure A.1 in the appendix shows a time series for these labor market variables.

Table 1
Labor market variables and nominal wage growth, 1991–2019

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ECI	*ECI*	*ECI*	*ECI*	*ECI*	*ECI*	*ECI*
Unemployment Gap	−0.365*** (0.033)				0.060 (0.104)		
V/U Ratio		1.713*** (0.495)				−0.938*** (0.312)	
EE Transition Rate			2.808*** (0.240)				1.101*** (0.297)
Quits Rate				1.872*** (0.105)	2.140*** (0.509)	2.441*** (0.250)	1.285*** (0.174)
Observations	116	116	94	116	116	116	94

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports a quarterly regression of four-quarter growth in the employment cost index (ECI) wages and salaries for private industries on various four-quarter moving averages labor market variables. The unemployment gap, V/U ratio, job-to-job transition rate (labeled "EE transition rate"), and quits rates are averaged at the quarterly level. The job-to-job transition rate is available beginning in the fourth quarter of 1995 and is regularly updated. Standard errors are Newey-West with a lag of 4.

Sources: Fujita et al. (2024); US Bureau of Labor Statistics via FRED; Barnichon (2010); Davis et al. (2012); Congressional Budget Office via FRED.

Columns (1–4) of table 1 report the coefficients separately for each measure of labor market tightness. Low unemployment, a high V/U ratio, a higher EE rate, and a high quits rate are all correlated with faster nominal wage growth. The regression coefficients are all in levels, so for example, the coefficient in column (1) can be interpreted as a one percentage point increase in the unemployment rate being associated with 0.365 percentage points lower wage growth. In column (4), a one percentage point increase in the monthly quits rate is associated with 1.87 percentage points higher wage growth. Column (5) shows that when including both quits and unemployment, the coefficient on the quits rate increases, and the coefficient on unemployment becomes statistically insignificant. Column (6) similarly shows that when including both the quits rate and the V/U ratio, the quits rate remains significant, while the V/U ratio takes on the wrong sign.[16] Column (7) shows that when including the job-to-job transition rate and the quits rate, both remain significant in the sample that ends in 2019.

16 In the on-the-job search model in Bloesch et al. (2024), we show that when including quits and other labor market variables in a wage Phillips curve regression, the model implies "wrong-signed" weights on variables like the job openings rate or unemployment rate when also including the quits rate as an independent variable. This is because the quits rate is a near-ideal proxy for labor market tightness that puts more weight on vacancies than unemployment, so the inclusion of additional variables may mean those additional variables get negative or opposite-signed weights.

Table 2
Labor market variables and nominal wage growth, 1991–2024Q2

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ECI	*ECI*	*ECI*	*ECI*	*ECI*	*ECI*	*ECI*
Unemployment Gap	−0.383*** (0.051)				0.074 (0.058)		
V/U Ratio		1.803*** (0.232)				0.338 (0.336)	
EE Transition Rate			2.556*** (0.415)				−0.220 (0.397)
Quits Rate				2.165*** (0.162)	2.432*** (0.274)	1.889*** (0.247)	2.283*** (0.267)
Observations	134	134	112	134	134	134	112

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Notes: This table reports a quarterly regression of four quarter growth in the employment cost index (ECI) on various four-quarter moving averages of labor market variables. The unemployment gap, V/U ratio, job-to-job transition rate (labeled "EE transition rate"), and quits rates are averaged at the quarterly level. The job-to-job transition rate is available beginning in the fourth quarter of 1995 and is regularly updated. Standard errors are Newey-West with a lag of 4.
Sources: Fujita et al. (2024); US Bureau of Labor Statistics via FRED; Barnichon (2010); Davis et al. (2012); Congressional Budget Office via FRED.

Table 2 reports the same regression results, except now including the data through the second quarter of 2024 to include the COVID period. The results are quite similar, except that now the quits rate outperforms the job-to-job transition rate. This is because the quits rate during COVID was elevated relative to historical levels, while the job-to-job transition rate was not.

Across multiple specifications in table 2, an increase in the quits rate of one percentage point is associated with two percentage points faster growth in nominal wages measured by the ECI for wages and salaries of workers in private sector industries. This slope should be considered steep: A typical business cycle sees the quits rate fluctuate by 0.5–1 percentage points, indicating a 1–2 percentage point change in nominal wage growth.[17]

2.2 Do Wages Pass Through to Prices?

In the previous section, I confirmed that nominal wage growth is higher when labor markets are tight, and that the quits rate is the best recent predictor of nominal wage growth. To understand how tight labor markets affect inflation, a natural step is to explore the evidence on how much firms raise prices when wages increase.

A recent literature on minimum wage increases provides a useful setting for understanding wage to price pass-through. Ashenfelter and Jurajda (2022) study the effects of minimum wages on the price of Big Macs at McDonald's. These authors find a cost-weighted pass-through of around 0.7: For every 10 percent

17 Using the log levels of labor market variables does not meaningfully change the results.

that wages are exogenously increased, prices would increase by 7 percent at a firm where its only cost was labor. Harasztosi and Lindner (2019) study a sudden and large minimum wage increase in Hungary. The authors find that consumers pay for the majority of the wage increase, and firms that are more intensively affected by the higher minimum wage raise their prices more. Their results are consistent with nearly one-to-one pass-through of wages to prices in proportion to labor's share of costs in production and support a simple model of constant markups over marginal cost. The authors find that pass-through of wages to prices is significantly dampened in firms that produce tradable goods and exported goods. This comports with the results from Heise et al. (2022), who show that the pass-through of wages to goods prices has fallen over time, as domestic producers are increasingly subject to competition from imports and have less power to pass through wage increase to prices.

Overall, the empirical evidence suggests that the pass-through of wage costs to prices is substantial. At the same time, an increase in the minimum wage is a different shock than, say, an expansionary monetary policy shock that raises both wages and aggregate demand generally. Can we use the minimum wage evidence to understand how wages pass through to prices in response to a change in monetary policy? If anything, one may expect that a monetary policy shock that achieves the same wage increase would lead to more price inflation, since consumer demand would rise and tighter labor markets would increase costly competition for workers, both of which would contribute to firms raising prices beyond the amount that would result from exogenous wage increases alone. There may be offsetting effects that tight labor markets provide workers better chances to move to more productive matches, alleviating inflationary pressures. In the next section, I will discuss these forces and review evidence on how labor market tightness affects price inflation.

2.3 Labor Market Tightness and Price Inflation

If labor market tightness affects wages, and if wages pass through at least partially into prices, then we should expect to see a correlation between our measure of labor market tightness (here the quits rate) and price inflation. Table 3 reports results from regressing various measures of nominal wage growth and price inflation on the quits rate from 1991 to 2019—thus, excluding the COVID period. Column (1) reports the same regression of growth in wages and salaries from the employment cost index for private sector industries on the quits rate as in table 1. Column (2) reports a similar regression but for the employment cost index total compensation as the dependent variable, showing a smaller coefficient on compensation than for wages. This is in large part because growth in the cost of health insurance benefits, which is included in compensation but not in wages and salaries, varies substantially over time but is largely noncyclical.

Columns (3)–(7) report similar regressions but using various measures of inflation as the dependent variable. Column (3) reports the coefficient of the CPI for personal care services on the quits rate. Of all components of inflation, the personal care services category is a component where we should expect the greatest pass-through of wages to prices, since personal care services are highly labor intensive and are not subject to large changes in trade, technological change, or intermediate input costs. Indeed, we find a similar effect of the quits

Table 3
Quits rate and nominal growth variables, 1991–2019

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ECI Wages Private	*ECI Compensation Private*	*CPI Personal Care*	*Core PCE*	*PCE Services*	*Core PCE Services less Housing*	*Market PCE Services less Housing*
Quits Rate	1.872*** (0.105)	1.544*** (0.263)	1.972*** (0.243)	0.314 (0.229)	0.761** (0.341)	0.350 (0.344)	0.300 (0.362)
R-squared	0.765	0.395	0.522	0.035	0.131	0.022	0.009
Observations	116	116	116	116	116	116	116

CPI = consumer price index; PCE = personal consumption expenditures

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results for quarterly regressions of various measures of nominal wage growth and price inflation on the private quits rate. Quarterly price indices calculated as the value the end of the quarter to be consistent with the employment cost index (ECI). The nominal growth variables are four-quarter growth, and the independent variable is the 4-quarter moving average of the quits rate. The time period for every regression is 1991–2019.

Sources: US Bureau of Economic Analysis via FRED; US Bureau of Labor Statistics via FRED; Konczal (2024); Davis et al. (2012).

rate on price growth for CPI personal care services as for nominal wage growth. Column (4) reports the coefficient of the quits rate on the personal consumption expenditures chain-type price index excluding food and energy (core PCE), with a coefficient of 0.314, which is not statistically significant. Column (5) reports the coefficient of the quits rate on the inflation rate in all PCE services, which includes housing services, with a coefficient of 0.761, less than half the coefficient on wage growth. In Column (6), the dependent variable is core PCE services less housing. The coefficient on quits drops by more than half and is no longer statistically significant. Column (7) reports the coefficient for market-based PCE services less housing (but includes energy services), which excludes imputed prices, some of which are imputed directly from labor costs. The coefficient on the quits rate drops further and the R-squared drops to 0.009. As for magnitudes, the quits rate rose by 1.1 percentage points over the course of the recovery from the Great Recession; the results from these regressions imply that such a rise would be associated with faster annual wage growth by around 2 percentage points, higher PCE services inflation by under 1 percentage point, and a statistically insignificant higher core PCE services inflation less housing by a less than half a percentage point.

There are few takeaways from this table. First, using the quits rate on the right hand side of the Phillips curve does not undo the results that many researchers have found of a weak effect of labor market variables on overall price inflation in the post-Volcker era.[18] Second, the relationship between the labor

18 Hazell et al. (2022) show using state-level data that the Phillips curve using the unemployment rate was flat, even during the Volcker period. Recent work by Rubbo (2023) shows that in a New Keynesian model that takes into account nominal rigidities and the input-output structure of production, the slope of the Phillips curve is an order of magnitude lower than in a single sector economy.

market and price inflation varies significantly across sectors, and a large portion of the positive correlation between labor market variables and services inflation in this time period is in housing (Stock and Watson 2020, Amarnath and Williams 2022). This strong correlation between housing rents and the labor market may be partially explained by procyclical household formation: When nonemployed workers find jobs, they are more likely to form a new household (Kaplan 2012, Rios-Rull et al. 2016). Given the weight that housing has in inflation indices, it may be relevant to track aggregate labor income growth—which combines wage growth and employment growth—when predicting inflation in sectors where supply is inelastic, such as housing.[19] Third, even when including housing in column (5), variation in the quits rate can account for less than one seventh of the variation in price inflation, and it has an R-squared of 0.13. This suggests that at high frequencies, there are various shocks or pricing idiosyncrasies that drive price inflation that are unrelated to labor market tightness.

2.4 Tight Labor Markets and Labor Productivity

A major confounder for a simplistic pass-through of tight labor markets to wages to prices is that labor productivity may be procyclical. If high productivity accompanies strong labor demand, then workers can earn higher wages without firms charging higher prices, as the per-unit cost of production would not rise as fast as wages. Here I will discuss three ways that tight labor markets may induce increases in labor productivity: procyclical match quality, endogenous productivity effects from demand, and procyclical investment in labor-saving technologies.

The first way that tight labor markets will encourage productivity gains is by giving workers greater opportunities to quit into more productive jobs and higher-quality matches. Barlevy (2002) argues that strong labor markets create more opportunities to quit into more productive jobs. Moscarini and Postel-Vinay (2023) argue these kinds of gains are concentrated early in a labor market recovery, as workers make up for lost transitions during recessions when labor market churn is low. A second mechanism by which tight labor markets increase productivity is outlined in Michaillat and Saez (2015): Workers that provide services are frequently idle at work due to low demand. When demand increases, workers spend a higher fraction of their time producing services, endogenously increasing output per hour.

The above two mechanisms provide one-time increases or level shifts of productivity as the labor market tightens. As is the case in Moscarini and Postel-Vinay (2023), late in a recovery when the economy has returned to full employment and workers have had ample opportunity to find better matches, the productivity-enhancing forces of tight labor markets exhaust themselves. In order for the high wage growth in tight labor markets to not contribute to employment costs and inflation, tight labor markets must affect the growth *rate* of productivity.

19 Boehm and Pandalai-Nayar (2022) find evidence for convex supply curves across a wide range of industries. This means that the marginal cost of production is increasing, so increases in demand will push industries up their supply curve, so prices will increase as demand rises.

This leads to the third mechanism: that firms invest more in labor saving technologies when labor markets are tight (Habakkuk 1962), which could generate pro-cyclical growth in productivity. Examples of recent work that show that firms invest more in labor-saving technologies when labor is scarce include Ilzetzki (2023), San (2023), and Mann and Pozzoli (2022). Mui (2024) argues that productivity growth is correlated with prime-age employment rates in the US since 1986. While these studies are encouraging that tight labor markets improve the pace of productivity gains, it is difficult to quantify the magnitude of these effects. It also stretches the imagination to believe that productivity growth consistently responds one-for-one with wage growth as labor markets tighten. Therefore, increases in productivity gains can help mitigate the pass through of wage costs to prices, but productivity gains are unlikely to completely offset the inflationary impact of tight labor markets.

2.5 Putting the Pieces Together: Tightness, Wages, and Inflation

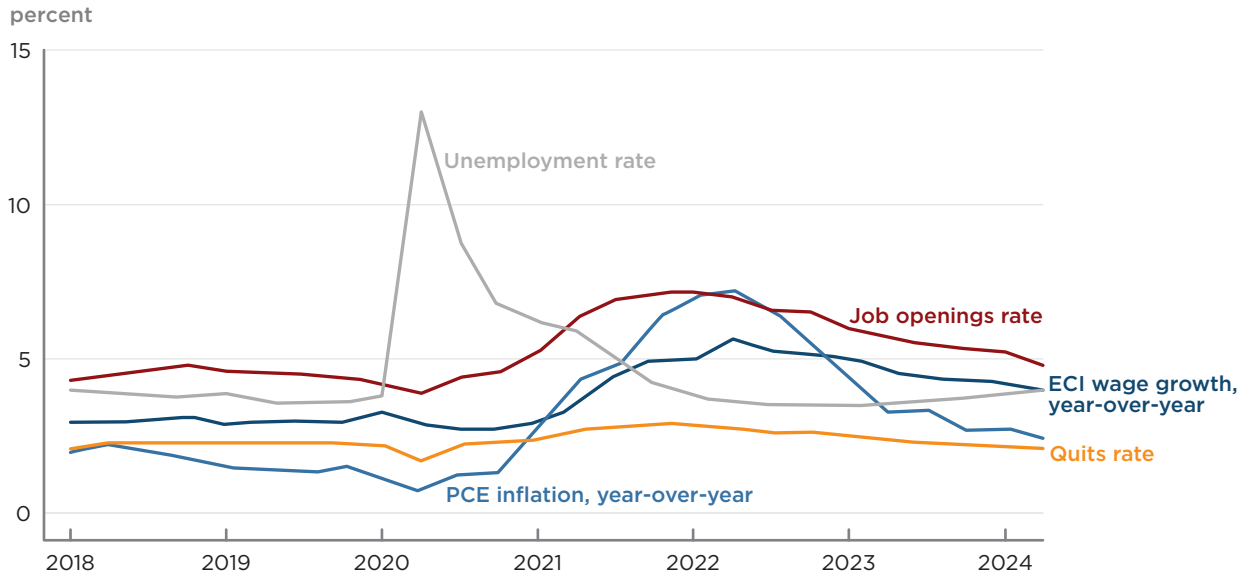
The most common story for how labor market tightness affects inflation is by tight labor markets increasing wage growth, which is a cost to firms that is passed through to prices for consumers. I summarized evidence that labor market tightness increases nominal wages and evidence that increases in minimum wages induce nearly one-for-one increases in prices (after scaling for the wage share of costs). The pace of aggregate labor income growth may also matter for inflation in sectors where supply is inelastic, such as housing. However, various factors complicate the price Phillips curve, including non-labor market shocks that affect inflation and labor productivity growth that may rise with labor market tightness. In all, greater labor market tightness clearly increases wage growth, and while much of this wage growth is passed on into prices, the majority of variation in inflation is not well explained by the state of the labor market.

3 INTERPRETING THE LABOR MARKET DURING COVID

The COVID shock was anything but a regular business cycle: Workers were intentionally sent home to prevent the spread of disease, household wealth levels grew as fiscal stimulus buoyed income, and millions of workers converted to remote work. Demand for goods surged and demand for in-person services fell. As vaccines were rolled out and health risks abated, consumers returned with a vengeance, and demand for labor greatly outstripped supply. Due to a combination of continued health risks and strong household balance sheets, workers were slow to return to the labor force, and immigration had fallen significantly below trend, lowering supply in the labor market.

Figure 2 shows the path of unemployment, the job openings rate, the quits rate, year-over-year growth in the employment cost index private wage and salaries, and year-over-year growth in the PCE chain-type price index. Unemployment spiked in the spring of 2020, as workers were sent home and fell relatively quickly as business and households adjusted, leveling out around 6 percent by early 2021. The unemployment rate began falling again in the spring of 2021 as vaccines were deployed. In late 2020, as demand was returning, job openings and quits began to surge, peaking in late 2021 and early 2022. Wage

Figure 2
Labor market variables and inflation experienced large swings during COVID



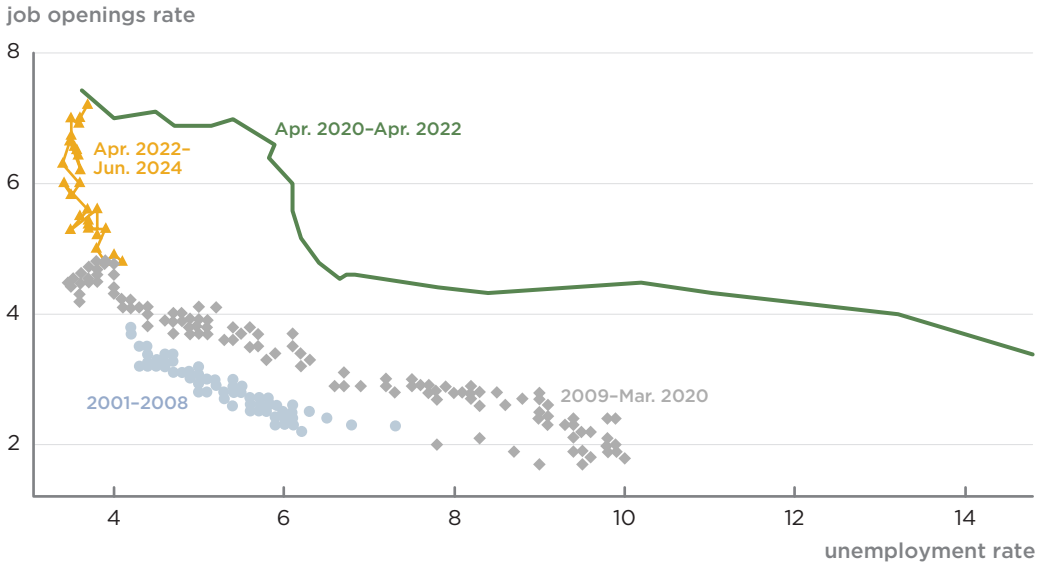
ECI = employment cost index; PCE = personal consumption expenditures
Notes: The job openings rate and quits rate are for nonfarm industries, as opposed to the private quits rate that was used in the previous regressions.
Sources: US Bureau of Economic Analysis via FRED; US Bureau of Labor Statistics via FRED.

growth and inflation followed, rising dramatically and peaking in early to mid-2022. Wage growth has since fallen below a 4 percent annualized rate, and PCE inflation is approaching 2 percent.

The unusual patterns in the labor market in the years following COVID led to numerous questions about whether COVID would persistently alter the dynamics of the labor market. Would the workers that dropped out of the labor force ever come back? Do the skills of available workers no longer match the skills that firms need, leaving greater mismatch in the labor market? Has the natural rate of unemployment risen, meaning that we should expect greater unemployment than prior to COVID? To bring inflation down, does the unemployment rate need to be above its pre-COVID levels?

In this section, I will explore these questions by discussing various features of the labor market during COVID. I will start by discussing the evolution of the Beveridge curve, which is the relationship between job openings and the unemployment rate. I will argue that the shift out in the Beveridge curve (i.e., a high rate of job openings coinciding with a high unemployment rate) during the COVID recovery reflected a mix of temporary labor market mismatch and a continuation of the long-term trends in the measurement of job openings. With labor market mismatch largely fading, I will argue that the natural rate of unemployment likely has not risen, and so the unemployment rate can remain near 4 percent, just above its level prior to COVID, while inflation subsides. Second, I will discuss the decline and recovery of labor supply, as both labor force participation and immigration have recovered. Third, I will discuss various nonlinearities and interactions between supply shocks and the labor market that may have amplified inflation during the COVID recovery.

Figure 3
The Beveridge curve shifted out during COVID, but is shifting back inward



Notes: This figure plots the unemployment rate and the job openings rate from 2001–2008, 2009–March 2020, April 2020–April 2022, and April 2022–June 2024. This relationship between job openings and the unemployment rate is called the Beveridge curve. The Beveridge curve shifted out during COVID, as both job openings and unemployment were elevated. Since April 2022, the rate of job openings has dramatically declined, while the unemployment rate has only slightly risen.
Source: US Bureau of Labor Statistics via FRED.

3.1 Mismatch and the Beveridge Curve

As shown in figure 2, job openings surged in early 2021 while unemployment was still elevated. The relationship between job openings and unemployment can be plotted in another format, commonly known as the Beveridge curve. The Beveridge curve can be helpful for understanding when the labor market is tight or loose, as well as if the economy is efficiently matching workers to vacant jobs. When the labor market tightens, vacancies rise and the unemployment rate falls. When the labor market loosens, vacancies fall and unemployment rises. Holding the degree to which workers are efficiently matched with jobs constant, changes in labor market tightness would be represented by a movement along the Beveridge curve. Changes in matching efficiency, however, are captured by shifts in the Beveridge curve toward or away from the origin. If vacancies and unemployment are simultaneously high, this suggests that the economy is matching workers to jobs less efficiently, which would be reflected by a shift out (i.e., up and to the right) in the Beveridge curve. If job openings and unemployment are lower, this indicates high matching efficiency.

As can be seen in figure 3, there was an enormous shift up and to the right in the Beveridge curve during COVID: Both job openings and the unemployment rate were elevated. This can be seen by the green squares, representing the path of unemployment and job openings from April 2020 to April 2022. In April 2020, unemployment jumped and firms laid off many workers. For the next two years, unemployment fell as job openings rose, and the economy moved to the top-left portion of the figure. Since April 2022, job openings have fallen with only a small

increase in unemployment, as shown by the yellow triangles. These large shifts in the Beveridge curve in part indicate that matching efficiency deteriorated, and then recovered, over the course of the COVID pandemic and recovery.

Changes in matching efficiency has implications both for the productive capacity of the economy and for inflation. Focusing first on productivity capacity, low matching efficiency implies that the economy can produce less and should have higher unemployment. Michaillat and Saez (2022) formalize this idea by arguing that there is level of unemployment that maximizes output, and that a level of unemployment that is higher or lower would decrease output. Because hiring workers takes real resources, such as the time of incumbent workers who screen and train new employees, there exists an optimal balance of time between production and hiring new workers. The authors argue that the unemployment rate that maximizes output is the square root of the unemployment rate multiplied by the job openings rate: $u^* = \sqrt{uv}$. Lower matching efficiency would raise the output-maximizing unemployment rate and decrease total output. If we observe that the unemployment rate and the job openings rate are high, as was the case from April 2020 through April 2022, this is an indicator that the output-maximizing level of unemployment has risen.

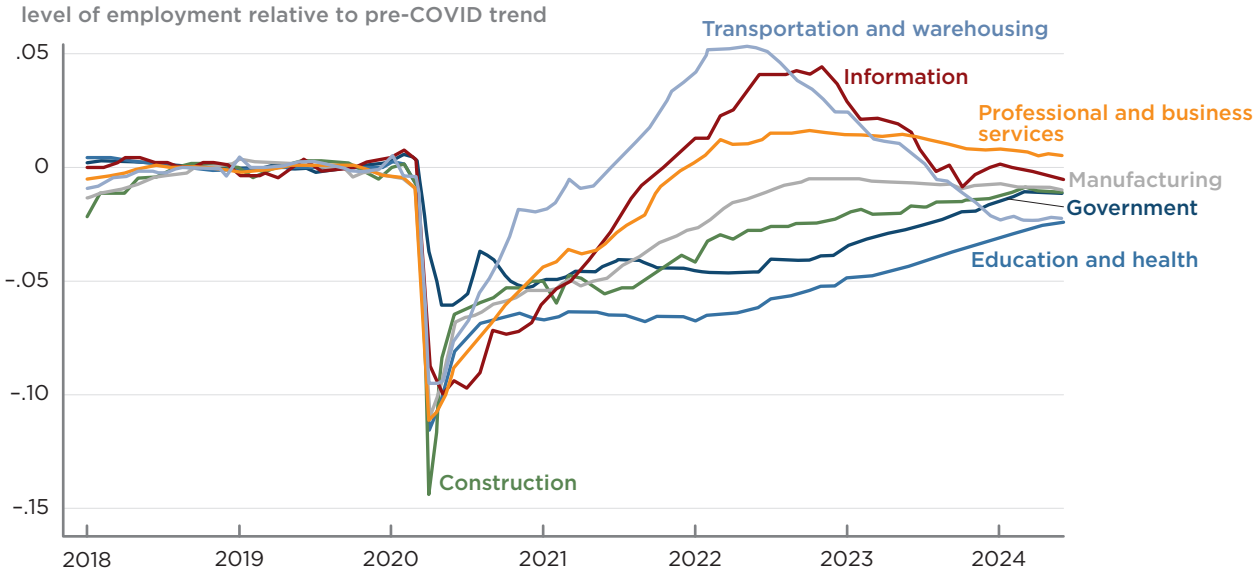
Just as a high job openings rate coinciding with a high unemployment rate means that the output-maximizing rate of unemployment has risen, the coexistence of a high job openings rate with a high unemployment rate also means that the *natural* rate of unemployment has risen, meaning that inflation is stabilized at a higher unemployment rate than before. Blanchard et al. (2022) made this case in April 2022, arguing that the Federal Reserve's optimistic forecasts about falling inflation without higher unemployment were misguided. Ball et al. (2022) similarly argued that unemployment would likely need to rise more than the Federal Reserve was forecasting to bring inflation down.

However, the patterns of job openings and unemployment since April 2022 imply a reversal of the outward shift of the Beveridge curve. The number of job openings has declined sharply from over 12 million in March 2022, to under 7.5 million by September 2024, and at the same time, the unemployment rate has risen only very modestly—from a low of 3.4 percent in April 2023 to only 4.1 percent in September 2024. Interpreted through the lens of the Beveridge curve, this is a shift inward, suggesting that the lowest sustainable unemployment rate has shifted back down.

How should we interpret these dramatic Beveridge curve developments in retrospect? I argue that three factors explain the rise and fall of job openings: (i) the rapid recovery led to a temporary period of high demand when most firms were trying to rehire all at once; (ii) there was significant, temporary mismatch in the labor market due to composition shifts in demand and shifts in supply across industries due to health risks; and (iii) there is a continued upward trend in the job openings series that began prior to COVID.

First and foremost, the rise in jobs openings reflected the rapid reopening, especially as vaccines became available and many households resumed regular spending habits. Additionally, large fiscal stimulus buoyed household balance sheets, enabling households to spend even as their labor market earnings had not fully recovered. A large portion of the rise in vacancies was simply that demand for labor was suddenly very high.

Figure 4
Industry employment converging to pre-COVID trends suggests fading mismatch



Notes: This figure shows the level of employment by industry relative to trend, where the industry-specific trends are computed from July 2018–December 2019. Leisure and hospitality, which experienced a dramatic drop in employment in 2020, was excluded to preserve the y-axis.
Source: Author's calculations based on data from the US Bureau of Labor Statistics via FRED.

The second factor driving the rise in job openings was temporary mismatch, and consequently lower matching efficiency, in the labor market. Figure 4 shows employment in most major industries (excluding leisure and hospitality)[20] from 2018–2024 relative to its pre-COVID trend.[21] If workers' skills are most closely related to the industries that they previously worked in, then dispersion of employment levels across industries relative to industry trends is an indicator of potential labor market mismatch. With the shift to goods spending and greater share of time spent online, employment in transportation and warehousing, information, and professional and business services surged. In-person services like leisure and hospitality and education and health services—as well as government—struggled to rehire, as workers either avoided in-person jobs or found work in higher paying sectors. The dispersion of industry employment levels relative to trend reached its peak in early 2022, just when the number of job openings peaked. Since then, sectors that were relatively underemployed like government, education and health, and leisure and hospitality have grown quickly, accounting for most of employment growth. Meanwhile, industries that saw the fastest employment growth out of COVID, such as transportation and warehousing, information, and professional and business services, have seen the

20 Employment in leisure and hospitality fell by nearly 50 percent between February and April 2020, but recovered to pre-COVID levels in April 2024.

21 The choice of time for the pre-COVID period can have significant effects on this figure 4. I choose a narrow window between July 2018 and December 2019, as the cyclical recoveries in construction and manufacturing from the Great Recession appeared to have slowed down in the second half of 2018. Most other large employment sectors are roughly on their long-term trend in their share of total employment during this time period.

slowest employment growth and in some cases outright employment declines.[22] By the middle of 2024, the employment level in all major industries converged back toward pre-COVID trend levels, suggesting that demand for labor across sectors has returned roughly to its pre-COVID growth trajectories. There is therefore little reason to think that labor market mismatch is much higher now than it was prior to COVID when the unemployment rate was below 4 percent.[23]

Lastly, the high vacancy rate following the COVID period reflects a continuation of the pre-COVID trend in vacancies described in figure 1. Figure 3 shows that the Beveridge curve has mostly returned to its pre-COVID position, but it has not fully returned: As of June 2024, the job openings rate is slightly higher than it was prior to COVID, and the unemployment rate is higher as well. Even if the increase in labor market mismatch has completely reversed, a continued upward trend in measured vacancies would leave the vacancy rate elevated relative to pre-COVID levels. Therefore, policymakers should exercise caution before interpreting a persistent outward shift in the Beveridge curve as a permanent drop in matching efficiency accompanied by a permanent rise in the natural rate of unemployment.[24] Instead, the continued elevated level of job openings likely reflects ongoing trends in how firms report job openings.

Did the Great Resignation Lead to the Rise in Vacancies? One explanation for the increase in job openings is that the pandemic may have inspired workers to reconsider their work and life situations and change jobs, creating a high number of job openings for firms to fill. As this "Great Resignation" subsides, job openings might naturally come down.

Upon inspection, this story does not stand up to scrutiny. When workers quit into another job, that may create a new vacancy for the job the worker who just left, but the worker taking a new job will lead to the filling of another vacancy. The measured number of quits should rise, but the number of job openings should remain unchanged, lowering the ratio of job openings to quits. However, during the labor market recovery following COVID, we saw the opposite: The ratio of job openings to quits surged. A more plausible story tells the causality in the opposite direction: Many firms had laid off workers, and these firms all wanted to simultaneously rehire many workers. Because firms post vacancies to accelerate hiring, this created an abundance of outside options for workers, enabling a greater share of workers to switch to more desirable jobs. Rather than a desire to change jobs leading to more vacancies, a more straightforward story is that the increase in vacancies allowed more workers to change jobs.

There is one compelling alternative story presented by Qiu (2022), who argues that when workers leave the labor force, this creates a vacancy on net because the worker did not accept another job. Qiu (2022) shows that the only other periods in American history where this occurred was during World Wars I and II, and the magnitude of workers leaving the labor force during COVID

22 Employment in levels fell below its post-COVID peak in transportation and warehousing and information.

23 Pizzinelli and Shibata (2023) also find that labor market mismatch was temporary.

24 Crump et al. (2022) take the opposite view, arguing that the natural rate of unemployment was still elevated by the end of 2023 at 6.5 percent, and the disinflation occurred due to supply shocks easing and because agents expected the unemployment rate to increase.

can account for a large fraction of the increase in job openings. Therefore, the decrease in labor force participation may have contributed to the rise in job openings. However, as I will show in the next section, labor force participation has been returning to pre-COVID levels, so this factor raising the job openings rate has been receding.

3.2 Labor Supply

One prominent feature of the early COVID recovery was that the supply of labor was substantially below pre-COVID levels. A combination of a desire to avoid health risks for workers and other members of their households, greater illness and mortality, generous fiscal support, and a near-total shutdown of immigration meant that the total number of individuals looking for work was substantially below pre-COVID levels.

It is not immediately obvious how a decrease in labor supply should affect wage growth and inflation. If individuals are choosing not to work, or if immigration declines, then there is less income being earned, and subsequently there should be less demand for goods and services, leading to lower demand for labor. For lower immigration and increased health risk, it is not obvious how the mix of both lower supply and demand net out. However, the balance of labor supply and demand effects from increased fiscal support are clearer: Greater income support and more generous unemployment insurance enabled workers to stay out of employment for longer, while sustaining demand for goods and services. Indeed, preventing a shortfall in demand while enabling people to avoid risky workplaces was the intention of many of the fiscal measures during COVID.

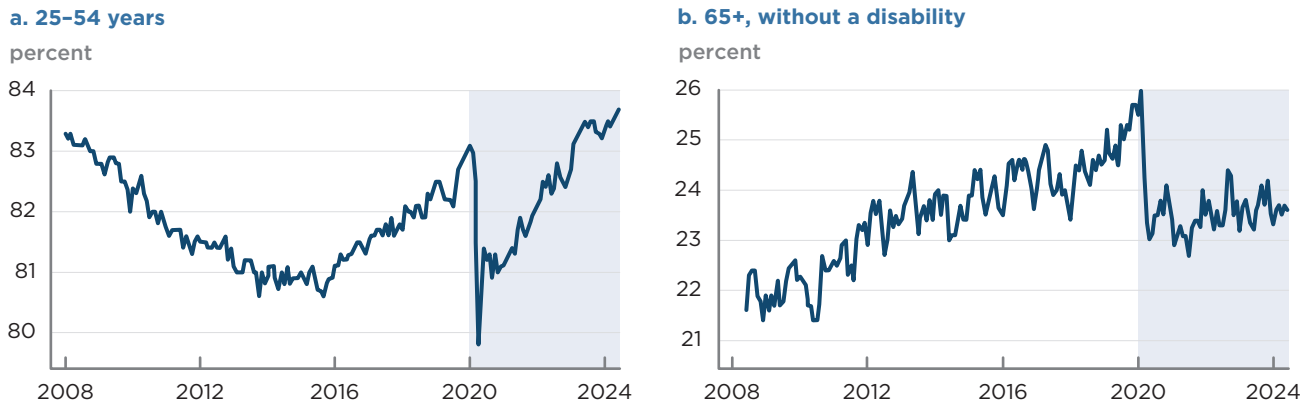
Many of the factors depressing labor supply have passed, as health risks are substantially mitigated and fiscal support has ended. Consequently, labor force participation has mostly recovered. As figure 5a shows, the labor force participation rate for individuals aged 25–54 has recovered and surpassed the pre-COVID level. Labor force participation has recovered to or surpassed its pre-COVID level for workers aged 16–24 and 55–64 as well. The only age group that has not seen a complete recovery of labor force participation is individuals above age 65: Figure 5b shows that the labor force participation rate for individuals 65 and over without a disability has not recovered since its drop in 2020.[25] However, individuals age 65 or over are less than 7 percent of the labor force, so an incomplete recovery of participation by this group has a small impact relative to the recovery in all other age groups.

As for immigration, recent evidence suggests that the rate of immigration not only recovered to its pre-COVID pace but surged in 2022 and 2023, with current estimates finding that 6 million people arrived within those two years (Topoleski 2023; Edelberg and Watson 2024). A rise in immigration would increase labor supply more than demand, and subsequently decrease labor market tightness, if immigrants have higher savings rates than native-born households or are more likely to be of working age. Duzhak (2023) argues that the fall in immigration contributed to higher vacancy to unemployment ratios during COVID, and Duzhak (2024) argues that the subsequent surge in

25 The labor force participation rate for individuals aged 65 and over with a disability is generally quite low, around 8 percent, and has recovered to its pre-COVID trend.

Figure 5

The labor force participation rate has recovered for individuals aged 25–54, but not for individuals aged 65+



Notes: This figure shows the labor force participation rate in percent for people aged 25–54 and 65+ from 2008 to June 2024. The labor force participation rate for people aged 25–54, often called "prime age," has recovered and exceeded its pre-COVID peak. However, the labor force participation rate for people over 65 has not recovered. While not shown in this figure, the labor force participation rate has also recovered for individuals aged 16–24.

Source: US Bureau of Labor Statistics via FRED.

immigration later lowered vacancy to unemployment ratios again. While this early evidence points to the decline and subsequent rebound of immigration impacting labor market tightness in the COVID and post-COVID era, further research is needed to fully evaluate how changes in the pace of immigration affect the labor market and inflation.

In total, even if depressed labor supply was contributing to inflation, the drop in labor supply has reversed, suggesting that any effects of changes in labor supply on inflation have faded.

3.3 Demand Shifts, Nonlinear Phillips Curve, and Supply Shocks Interactions

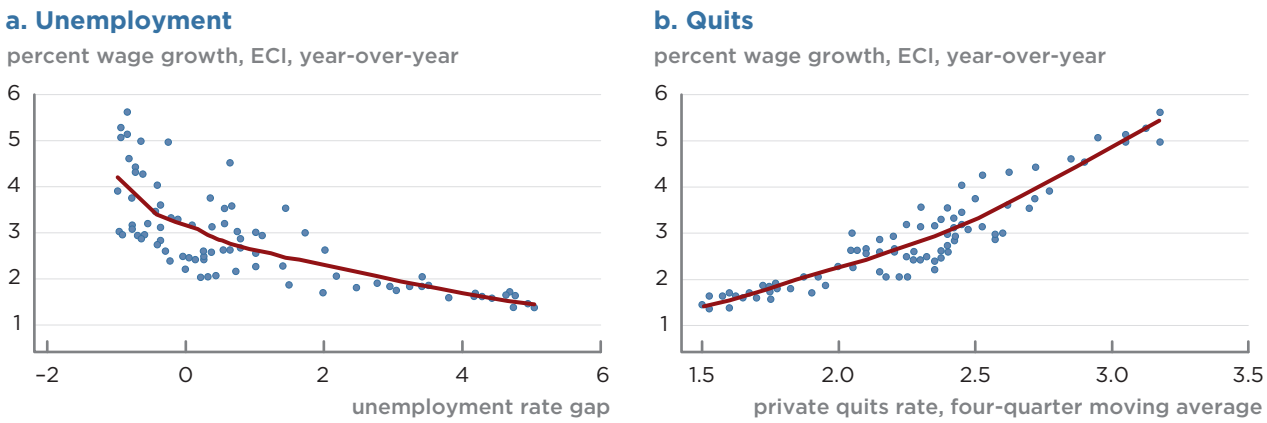
So far, I have only considered linear relationships between labor market variables and wage growth or price inflation. Given the extraordinary increase in both wage growth and inflation during the COVID pandemic and recovery, it is worth considering how nonlinear forces may arise, as well as potential interactions between the labor market and the various supply shocks that were ongoing during the same period.

One of the first interactions studied in the labor market during COVID was the interaction between downward nominal rigidity and sectoral demand shifts by Guerrieri et al. (2021).[26] The authors argue that if the composition of demand shifts across industries and if wages are sticky downwards, then sectors with increasing demand will have high wage growth, but sectors with falling demand will not. They argue that strong demand can help facilitate the reallocation of labor across sectors, but the strong demand would increase inflation as well.

While the sectoral story fit the data well in 2021, by 2022 nominal wages were growing rapidly across all sectors of the labor market, and price inflation

26 Stiglitz and Regmi (2023) discuss additional consequences of shifts in the composition of demand.

Figure 6
Nonlinearities in the wage Phillips curve, 1991–2024



Notes: This figure shows the nonlinear relationship between nominal wage growth, measured by the four-quarter growth of the employment cost index (ECI) wages and salaries for private industries, and two labor market series: in panel (a) the unemployment rate gap, measured as the difference between the unemployment rate and the Congressional Budget Office's estimate of the noncyclical unemployment rate, and in panel (b) the four-quarter moving average of the quits rate for private industries. Lines are fitted using a lowess smoother with bin width of 2. Both figures exclude the year 2020.

Sources: Bureau of Labor Statistics via FRED; Congressional Budget Office via FRED; Davis et al. (2012).

became more broadly based. Labor markets were tight enough and wage growth was high enough that downward nominal wage rigidity was not binding. This observation leads Benigno and Eggertsson (2024) to argue that the Phillips curve is nonlinear: When the labor market is slack, the Phillips curve is flat, as firms are reluctant to cut wages, and prices do not fall because firms' wage costs are not falling either. However, when demand is high and downward nominal rigidity no longer binds, both wage growth and inflation increase rapidly as the labor market tightens. This analysis accords with the view of Gagnon and Collins (2019), who argued prior to COVID that the Phillips curve is nonlinear. Importantly, the Phillips curve may have appeared flat prior to COVID because the economy was below potential—it was only during COVID that the economy was ran up against potential, and we were able to discover the point at which the Phillips curve became steep.

Figure 6 shows evidence of nonlinearities in the wage Phillips curve. Panel (a) of figure 6 plots the relationship between four-quarter growth of the employment cost index wages and salaries for private industries and the unemployment gap, measured as the difference between the unemployment rate and the CBO estimate of the noncyclical rate of unemployment. This figure shows that the relationship between nominal wage growth and the unemployment gap is highly nonlinear: When unemployment is high, the slope of the wage Phillips curve flattens, so small changes in the unemployment rate have smaller effects on the pace of wage growth.[27] In contrast, when unemployment is low, small changes in the unemployment rate are associated with large increases in nominal wage growth. This is consistent with a natural lower limit on the unemployment rate: Even if labor demand is very high, the unemployment rate cannot be

27 The figure with unemployment excludes 2020.

negative, and so increases in labor demand result in higher wage growth without further declines in the unemployment rate. Figure 6(b) plots the relationship between wage growth and the quits rate. This relationship is much closer to linear, but the slope is less steep when the quits rate is low, suggesting that downward nominal rigidity is preventing some firms from lowering wages when the labor market is slack.

While nonlinearities in the wage Phillips curve mean that nominal wage growth will rise rapidly if the labor market tightens beyond full employment, it also means that wage growth and inflation can come down without large increases in unemployment. Relatedly, Figura and Waller (2022) argue that Beveridge curve is also nonlinear: When unemployment is low, further increases in labor demand are mostly reflected in higher job openings, rather than lower unemployment. These two nonlinearities are connected: In a slack labor market, higher labor demand increases employment—thereby lowering unemployment—but has modest effects on wages. Once the pool of unemployed workers dries up, further increases in demand are reflected in job openings and quits, raising interfirm competition for already-employed workers and driving up nominal wage growth.[28] Thus, there is nonlinearity in both the wage Phillips curve and the Beveridge curve, where both curves become steeper when the labor market is tight. In periods such as the last few years when demand for labor starts very high, falling labor demand is reflected in declining job openings, quits, and wage growth, with only modest effects on the unemployment rate. The nonlinear wage Phillips and Beveridge curves therefore provide a good explanation for how the United States has achieved deceleration in wage growth without a large increase in unemployment.

While I argue that there is some nonlinearity in the relationship between wage growth and labor market variables (and clear nonlinearity between unemployment and wage growth), it would be a mistake to estimate nonlinearities in the *price* Phillips curve using data during the COVID pandemic and recovery. This is because the COVID period contained coinciding tight labor markets and large negative supply shocks. Therefore, exercises such as in Ball et al. (2022) that fit a nonlinear Phillips curve of price inflation on the V/U ratio, while including the COVID years in the sample, will overstate the slope of the Phillips curve on the steep portion of the curve.

Lastly, there is evidence that the interaction between supply shocks and tight labor markets amplified inflation during the COVID period. Benigno and Eggertsson (2024) argue that tight labor markets amplify the effects of inflationary supply shocks, and Amiti et al. (2023) show that when supply shocks disrupt importing goods from foreign firms, demand for the goods of domestic producers increases. This increases demand for domestic workers, and since domestic firms are less subject to international competition, these firms are more able to pass on higher wages into prices. Together, these papers suggest that a

28 The choice of labor market variable matters greatly when considering nonlinearities. For example, the job openings rate and the unemployment rate have a very nonlinear relationship, as do the quits rate and unemployment rate. This means that the relationship between wage growth and quits will be much more linear than the relationship between wage growth and unemployment. Further, in extremely tight labor markets, when wage growth is very high, there is a natural lower bound to the unemployment rate, making the slope of wage growth very steep with respect to small changes in unemployment.

tight labor market and negative supply shocks amplified each other's effect on inflation. With supply chains normalizing, falling labor market tightness pushing the economy away from the steep parts of the wage Phillips curve and Beveridge curve, and with the composition shifts in demand and supply shocks receding, the forces that fed inflation during the early COVID recovery continue to ease.

3.4 The Labor Market During COVID: A Summary

The labor market simultaneously experienced numerous shocks during the COVID shock and the recovery: shifts in the composition of demand, supply chain disruptions, increased risk and incidence of illness, generous fiscal support, and a drop of immigration. These shocks occurred in a labor market where the underlying wage Phillips and Beveridge curves are nonlinear, and high demand for labor pushed the economy onto the steep part of both of these curves. In total, the combination of these shocks and the underlying nonlinearity pushed job openings, quits, wage growth, and inflation to levels far outside the range of normal over the last 40 years. However, every one of the shocks listed has at least partially abated, and the labor market has gradually returned to patterns similar to the labor market prior to COVID without a large increase in unemployment.[29]

4 WAS THE UNITED STATES AT RISK OF A WAGE-PRICE SPIRAL?

A great deal of commentary during the last few years has compared the current inflationary experience with experience of the United States in the 1970s: Was inflation becoming entrenched, and was the United States entering a wage-price spiral? Might the future hold a wage-price spiral? Either by anticipation of future inflation or in response to realized inflation, high inflation could influence the prices specified in nominal contracts—including wages—raising firms' costs and household incomes and making inflation more persistent. In such a scenario, central banks may conclude that they must depress the economy significantly below potential to break the cycle, generating a sustained period of high unemployment. However, I will argue here that the United States did not exhibit wage-price spiral dynamics: Nominal wages were increasing due to high labor demand, and prices were increasing due to supply shocks and greater pricing power by firms. But there is little evidence that wages were themselves responding to the high prices.

I define a wage-price spiral here as a cycle where wage increases pass through into higher prices, and prices pass through back into wages, regardless of how tight the labor market is. In the previous sections, I established that wages largely pass through into prices. However, for this kind of wage-price spiral to develop, it must also be the case that wages respond to prices. In Bloesch, Lee, and Weber (2024), we explore this question of how wages respond to shocks to the cost of living. The thought experiment is to ask how wages respond

29 In this paper, I have not addressed the increase in working from home, which increased sharply during COVID. Working from home has important implications for the distribution of jobs across space, pay differences across occupations that can provide this amenity, and possible effects on labor supply for women and people with disabilities. Greater demand for work from home policies may have increased labor market mismatch, but this mismatch is likely receding with time as workers and firms adapt to the option of remote work.

to a shock that affect workers' cost of living but does not have a direct effect on workers' productivity: For example, how firms would change their wage policies in response to the increase in food prices due to the war in Ukraine.[30] Matching a range of microeconomic evidence on how wages are determined in the United States, we derive a New Keynesian model where firms set wages, and firms choose wages to avoid their workers being poached by other firms. Because a higher cost of living lowers real wages at all jobs proportionately, higher cost of living does not improve workers' outside options relative to their current job. If workers' outside options are not improved, then they are no more likely to quit their jobs, and so firms have no incentive to raise wages. In the end, a cost-of-living shock lowers real wages, but otherwise the labor market is unaffected. Real wages are restored when the shock that raised the cost of living recedes.[31] Consistent with this theory, Bernanke and Blanchard (2023) and Bernanke and Blanchard (2024) estimate that there was no "catch-up" of wages in response to higher prices in the United States.

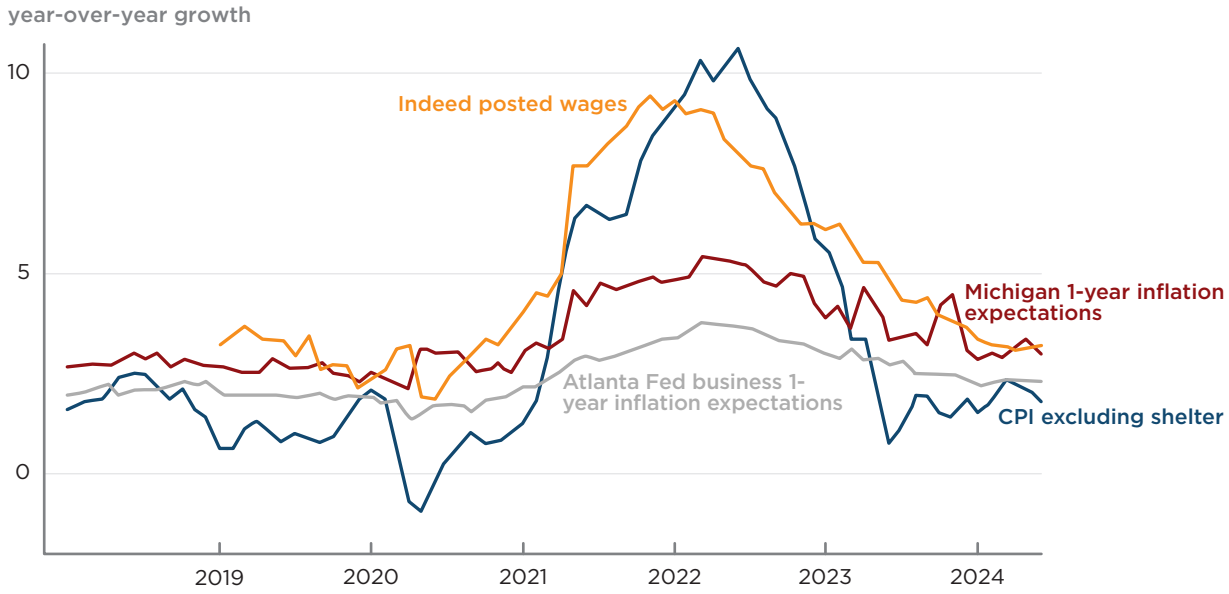
This view that nominal wages are unresponsive to cost of living shocks informs the interpretation of high nominal wage growth during the COVID recovery. Interpreted through the lens of a model where wages do not respond to prices, the rise in nominal wage growth during COVID is exclusively the result of tight labor markets, while overall inflation is driven both by rising nominal wages and supply shocks. For policymakers, this means that if the labor market variables such as the quits rate are stabilized to pre-COVID levels, then nominal wage growth will return to return to pre-COVID levels as well. If wages pass through to prices, and as long as negative supply shocks do not continuously get worse, then inflation will return to normal when the labor market and wage growth are stabilized.

Figure 7 shows suggestive evidence that the rise in wage growth during COVID was not a response to price inflation. The figure plots year-over-year growth in posted wages from the Indeed Wage Tracker, year-over-year growth of the consumer price index excluding shelter (to exclude a category known for built-in lags), 1-year ahead inflation expectations from the University of Michigan survey, and the mean 1-year ahead inflation expectations from the Federal Reserve Bank of Atlanta's Business Inflation Expectations. I focus on posted wages here because (i) posted wage growth leads actual wage growth; and (ii) posted wages will reflect the current level competition for workers that firms perceive, unaffected by longer-term wage contracts that firms decided on months or years ago. Figure 7 shows that the rise and fall of year-over-year growth in posted wages preceded or coincided with realized inflation and measures of households' and business' expectations of inflation. Posted wage growth peaks and begins reversing by the end of 2021, while realized and expected inflation peak in the spring of 2022. If wages were responding to inflation or expectations, we should have expected to see a revival in posted

30 Cost-of-living shocks are not representative of supply shocks, but they are helpful for isolating the mechanism of wage responses to inflation.

31 Both Lorenzoni and Werning (2023) and Weber and Wasner (2023) present scenarios where workers have influence over wage setting and demand higher wages in response to elevated inflation. Both of these papers argue for a more benign form of wage-price dynamics: a supply shock occurs that raises prices, wages respond, but the feedback between wages and prices eventually fades.

Figure 7
Posted wage growth precedes or coincides with realized and expected inflation



Notes: The figure shows the year-over-year growth in median posted wages from the Indeed Wage Tracker, the consumer price index (CPI) excluding shelter, the University of Michigan 1-year median inflation expectations, and the Federal Reserve Bank of Atlanta's business 1-year mean inflation expectations.
Sources: Federal Reserve Bank of Atlanta Business Inflation Expectations Survey; Indeed Hiring Lab; Surveys of Consumers, University of Michigan via FRED; US Bureau of Labor Statistics via FRED.

wage growth after the Russian invasion of Ukraine in February 2022. Instead, posted wage growth continued a steady path down as the labor market became less tight. The timing of the rise and fall of posted wage growth suggest that the surge in wage growth in 2021 and 2022 reflected changes in the labor demand relative to supply, not responses to realized or expected inflation. Accordingly, posted wage growth from Indeed peaked in November 2021, almost the exact same time that Indeed's index of the number of job postings peaked in December 2021, consistent with the theory that high wage growth reflected high demand.

The are some caveats in order. If the economy continued to be in a higher inflation environment, it is plausible that new norms would develop where firms are expected to provide raises that are roughly in line with inflation each year. The longer that inflation persists, the more that cost of living adjustments may also be bargained for in collective bargaining contracts.[32] Therefore, if the US economy maintained a tight labor market and very high inflation for an extended period of time, wages may begin responding to inflation directly, and the relationship between wage growth labor market variables such as quits would change.

32 For example, the United Auto Workers won a reinstatement of collective bargaining contracts through their strike in 2023 that was lost following the Great Recession.

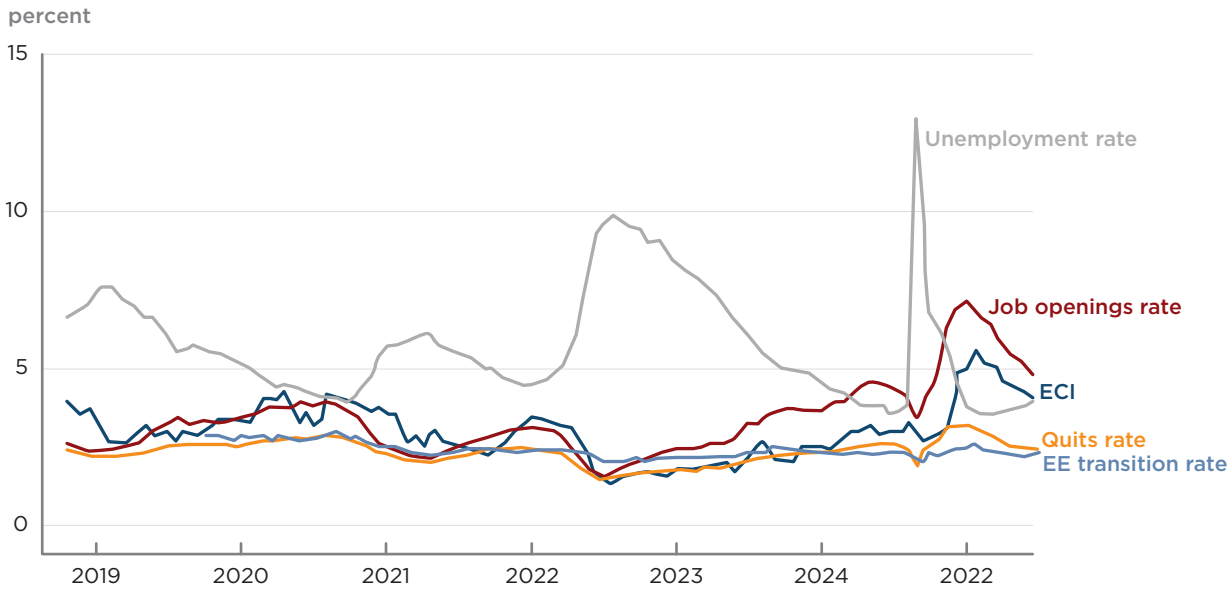
5 CONCLUSION

In this paper, I assess the relationship between labor market tightness and explore how the labor evolved during the COVID pandemic and recovery. I argue that the quits rate is the best indicator of labor market tightness and predictor of nominal wage growth. Microeconomic evidence suggests that wages pass through into prices, but the transmission of labor market tightness to price inflation is complicated by procyclical growth in labor productivity and shocks that affect price inflation but are not related to the labor market. I argue that the shift in the Beveridge curve during COVID reflects a combination of temporary high labor demand relative to supply, temporary mismatch, and a long-term trend in the JOLTS job openings series. The labor market has continued on a gradual path towards normalization, and the United States was at little risk of entering a wage-price spiral.

Going forward, questions remain about how the shift to remote work, the green transition, and artificial intelligence will affect the labor market. However, what remains consistent over time is that workers in the United States frequently change jobs, and firms will use compensation to compete for workers, especially in periods when demand for labor is high. Therefore, the fundamental relationships between labor market tightness and wage growth should continue to hold, while the relationship between labor market tightness and inflation will be subject to large and evolving forces as the economy continues to change.

APPENDIX

Figure A.1
Time series of labor market variables



Notes: This figure shows the quarterly time series of the unemployment rate, the job openings rate, the private quits rate, the employment-to-employment (EE) transition rate from Fujita et al. (2024), and four-quarter growth of the employment cost index (ECI) wage and salaries for private industries. Prior to 2001, the job openings rate is from Barnichon (2010), and the private quits rate is from Davis et al. (2012). The job openings rate is defined as the job openings level divided by the labor force, to be consistent with Barnichon (2010). See figure 1 for more details on these extended series.

Sources: Davis et al. (2012); Fujita et al. (2024); Barnichon (2010); US Bureau of Labor Statistics via FRED.

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