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Unemployment and Inflation Dynamics in the Monetary Policy Armamentarium*

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An armamentarium comprises the resources assembled for a particular purpose, such as treating an illnesses or fighting a battle. A central bank uses its armamentarium to conduct monetary policy. The paper's main points are (1) In a cyclical recovery, unemployment glides downward at a low rate. This rate was roughly uniform across historical recoveries since 1948. (2) In the recovery from 2009 through 2019, the natural rate of unemployment declined along with the actual unemployment rate, as evidenced by the fact that inflation was low and stable during that period. (3) The labor market during 2020 remained significantly tighter than total unemployment would suggest. (4) Low and steady inflation became firmly anchored during the expansion of 2009- 2019, but anchoring declined during the turbulence of the pandemic. The diminished anchoring of inflation may have been helpful in the disinflation that occurred in 2023.
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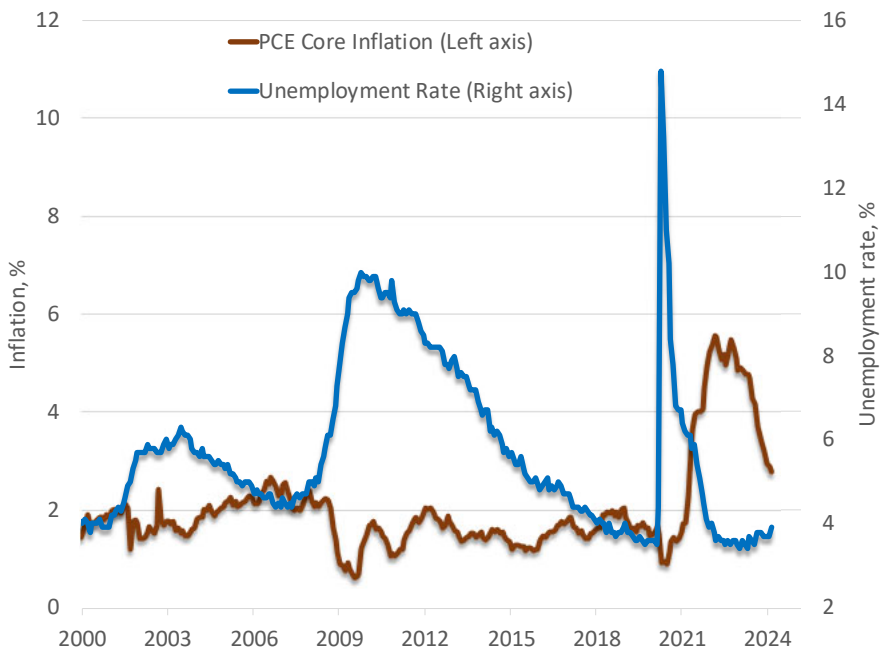


Figure 1: Unemployment and Inflation

Note: Data through Mar 2024.

1 Introduction

Twice, in the last fifteen years, the unemployment rate exhibited behavior that is hard to reconcile with conventional views. First, during the 2009-2019 recovery, unemployment declined from 10.0 to 3.5 percent, while inflation stuck closely to the Fed's target of a constant two percent (Figure 1). A constant-natural-unemployment-rate view suggests inflation would rise. Second, in the pandemic cycle, unemployment rose to the extreme rate of 14.7 percent, then declined rapidly, while inflation rose to 7 percent and remains today above the 2-percent target.

Our research on unemployment recoveries and the natural unemployment rate suggests that these were not anomalies:

- Unemployment is an indicator of the labor market tightness but not of inflationary pressure (Hall and Kudlyak (2023)).

- The natural rate of unemployment is not constant, but rather likely declines down a smooth path during a cyclical recovery (Hall and Kudlyak (2023)).

- There are two kinds of unemployment—*temporary-layoff unemployment* and unemployment due to other reasons—*jobless unemployment*. To understand the labor market during the pandemic and its aftermath, one should examine separately the two types of unemployment (Hall and Kudlyak (2022b)). One kind accounted for the explosion of unemployment in the pandemic but is not associated with declining inflation. The other kind may be associated, but rose only slightly. The labor market during 2020 remained significantly tighter than total unemployment would suggest.

- The pandemic shock likely loosened inflation anchoring, which resulted in higher inflation during the shock, but also sped the return of inflation to more moderate levels as the shock dissipated (Hall and Kudlyak (2023)).

2 Inexorable recoveries of unemployment

2.1 Behavior of unemployment

We find that the historical behavior of unemployment comprises: occasional sharp upward movements in economic crises, at other times, an inexorable downward glide at a low but reliable proportional rate of about 0.1 log points per year, the rate of decline is approximately constant across the ten recoveries prior to the pandemic (Hall and Kudlyak (2022a)). The glide continues until unemployment reaches approximately 3.5 percent or until another economic crisis interrupts the glide (see Figure 2).

Why did unemployment recover so consistently after every recession from 1948 through 2008? Despite high variation in monetary and fiscal policy, productivity and labor-force growth, there was little variation in the rate of decline of unemployment.

Our thesis is that the economy has a powerful tendency to self-recover from adverse shocks (Hall and Kudlyak (2022c)): A natural force causes job-seekers to match with available jobs and to lower unemployment. The process is slow because a typical crisis breaks worker-firm employment relationships, and creating new stable relationships is time consuming (Hall and Kudlyak (2019)). Recoveries are endogenous—the economy includes a strong internal force toward recovery that operates apart from policy instruments or productivity growth. The internal force is job creation as in the Diamond-Mortensen-Pissarides model but operating more slowly via a negative feedback from unemployment to job creation: the bulge of unemployment created by crises at the beginning of a recovery endogenously slows the recovery.

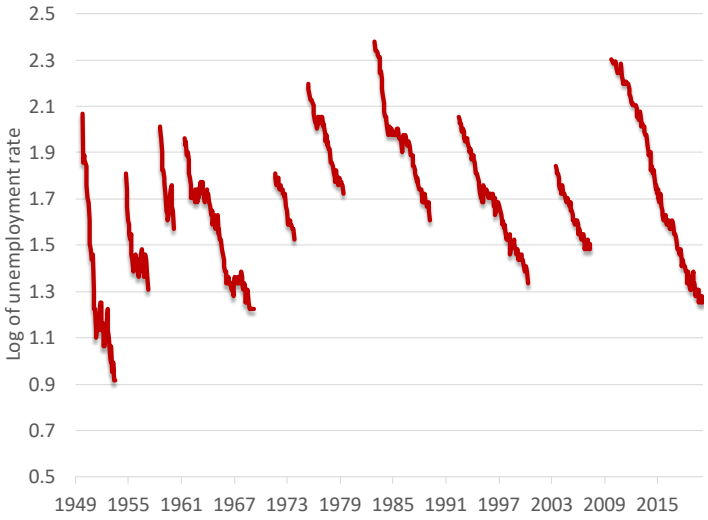


Figure 2: Paths of unemployment during recoveries, pre-2020

Note: Data through Mar 2024, updated from Hall and Kudlyak (2022a).

2.2 Policy implications

During a recovery, unemployment seems little responsive to disturbances. Our tentative conclusion that policy has little impact on unemployment during recoveries still leaves room for effective policy to prevent or moderate recessions.

3 The active role of the natural rate of unemployment

3.1 Identification issue in estimation of the Phillips curve by regression

Empirical Phillips curves often associate the inflation response with the unemployment gap:

$$\pi_t - \pi_t^* = -\phi \cdot (u_t - u_t^*) \tag{1}$$

If ϕ is large, the Phillips curve is nearly vertical; even small values of the unemployment gap go with large effects on inflation. If ϕ is small, the Phillips curve is nearly flat.

In this widely-used regression framework, given observations on π_t, u_t and a construct for π_t^*, the key parameters of the Phillips curve—the slope ϕ and the natural rate of un-

employment u_t^*—are not identified.[1] In Hall and Kudlyak (2023), we show that the slope is downward biased if a constant natural rate of unemployment is used in place of the true natural rate, which is positively correlated with actual unemployment.

Suppose the natural rate u_t^* is unobservable and so, is omitted. The regression then is

$$\pi_t - \pi_t^* = -\hat{\phi} u_t.$$

The coefficient is

$$\hat{\phi} = \frac{\text{Cov}(\phi(u_t - u_t^*), u_t)}{\text{V}(u_t)},$$

or

$$\hat{\phi} = (1 - C)\,\phi,$$

where C is the unobservable regression coefficient of u_t^* on u_t.

If C is zero, the regression gives the true slope of the Phillip's curve, ϕ. If the natural rate is positively correlated with the actual unemployment rate, C is positive, and the regression coefficient $\hat{\phi}$ understates the true relation between inflation and the unemployment gap.

3.2 Failure of identification

The explicit or implicit reliance on a belief that $C = 0$ is close to universal in research based on a regression of the inflation gap on unemployment.

The Phillips curve regression with unobserved u_t^* rests on the identifying assumption that C has a known value. Absent a persuasive reason to believe this assumption, regression yields no usable information about the slope coefficient, ϕ, or the natural rate, u^*.

The basic regression model is not identified—observations of the inflation gap and unemployment do not pin down the slope of the Phillips curve, ϕ.

3.3 Achieving identification

The burden of identification is profound. To extract the slope of the Phillips curve from data on inflation and unemployment, researchers need to bring in special assumptions or additional data.

We propose a new method based on the Phillips curve's property that when inflation is at its anchored level, unemployment is at its natural rate, $u_t = u_t^*$ when $\pi_t = \pi_t^*$ (Hall and Kudlyak (2023)).

In the 2009-2019 recovery, u^* stayed close to u_t, given an inflation anchor of 2 percent, see Figure 3. This procedure applies only to the recovery with stable inflation. There is no

[1] See, for example, Jorgensen and Lansing (2019) for a discussion of measurement of π_t^*.

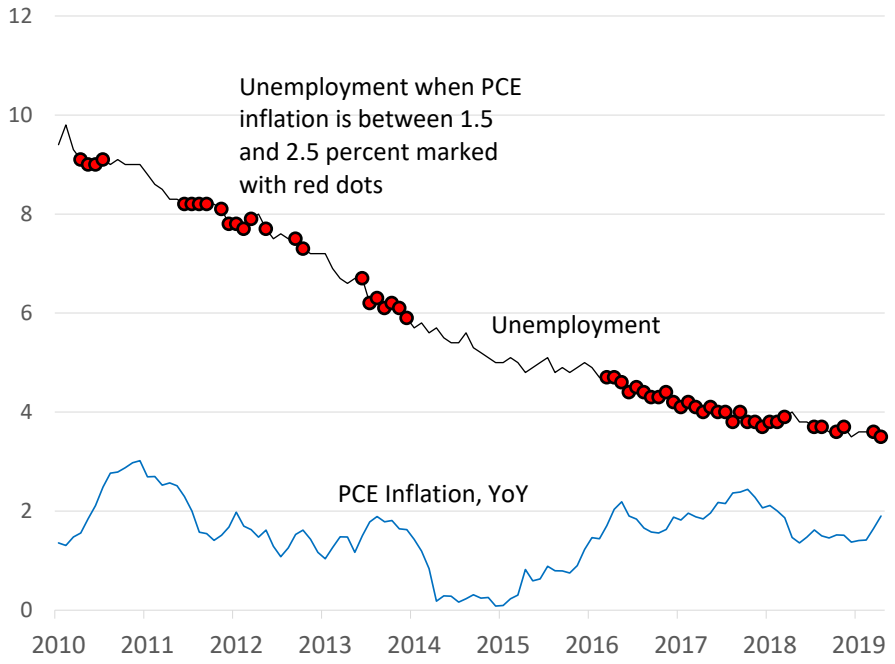


Figure 3: In the 2009-2019 recovery, u^* stayed close to u_t, given an inflation anchor of 2 percent

Note: Authors' calculations using data from the CPS and the NIPAs. Source: Hall and Kudlyak (2023).

case of a recession with constant inflation, so we cannot use this approach to learn about the natural rate in recessions.

3.4 Other ways to infer the time-series path of the natural rate of unemployment

We describe three existing methods that achieve identification, explicitly or implicitly:

- Find or create a time series that expresses the natural rate as a long-run trend in actual unemployment.

- Build a sub-model for the natural rate, which expresses the natural rate as a latent variable that follows a specified stochastic process. Estimate the sub-model jointly with the Phillips curve. For examples of this approach see Gordon (1997), Laubach (2001), King and Morley (2007), Crump, Eusepi, Giannoni and Sahin (2019), Crump, Eusepi, Giannoni and Sahin (2022).

- Use a GE model to calculate a counterfactual path of the unemployment rate in a model free of wage stickiness. For examples of this approach see Galí, Smets and Wouters (2011), Furlanetto and Groshenny (2016), among others.

Figure 4 shows vastly different $Cov(u_t, u_t^*)$ across approaches. CBO's measure implies that variations in the natural rate are a small and unimportant component of total unemployment. King and Morley (2007)'s natural rate accounts for almost all of the movement of total. Galí et al. (2011)'s natural rate accounts for around half.

3.5 Conclusions from this analysis

Our discussion of the omission of a time-varying natural rate from a regression for the slope of the Phillips curve is an application of the standard analysis of the bias from an omitted right-hand variable.

If the true natural rate is highly correlated with the actual rate, Phillips curves estimated with constant or nearly constant natural rates of unemployment uncorrelated with the actual rate will inevitably be close to flat.

The resolution of the natural-rate identification puzzle ultimately feeds back into a key macro question—is inflation sticky or flexible?

4 Price flexibility versus price stickiness

The parameter ϕ controls the influence of inflation on real activity, as measured by unemployment. It captures the price-flexibility of the economy,

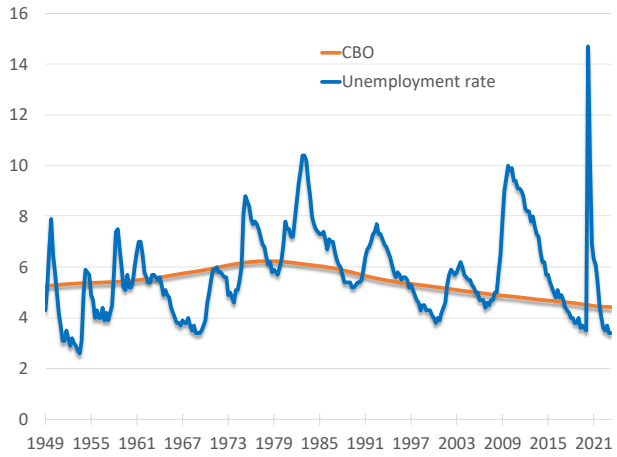
$$\pi_t - \pi_t^* = -\phi \cdot (u_t - u_t^*) \tag{2}$$

or in an aggregate-supply form

$$u_t = u_t^* - \frac{1}{\phi} \cdot (\pi_t - \pi_t^*) \tag{3}$$

If ϕ is high, the economy has flexible prices and fits the real business cycle paradigm. Higher values of ϕ make the model more like the real-business-cycle model, where real activity is not influenced by monetary factors such as inflation. With full monetary neutrality, ϕ is large and unemployment tracks u_t^*.

If ϕ is close to zero, prices are somewhat or fully sticky, and monetary factors have important involvement in the determination of real variables.the Phillips curve is nearly flat. Large movements of unemployment are paired with small movements in inflation.



(a) CBO, noncyclical rate of unemployment

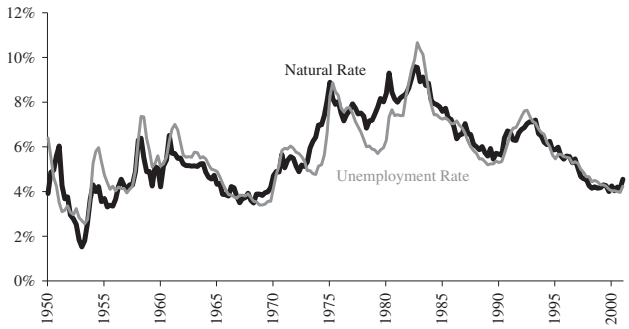
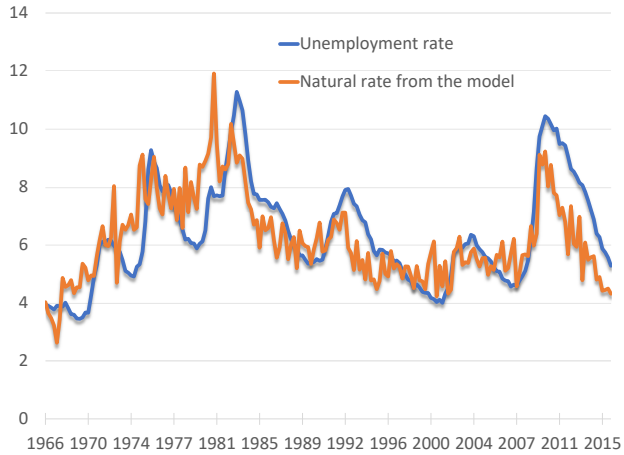


Fig. 2. The natural rate of unemployment.

(b) King and Morley (2007), VAR



(c) Gali, Smets, Wouters (2012), GE

Figure 4: Vastly different $Cov(u_t, u_t^*)$ across approaches

4.1 Views on the slope of the Philips curve

Whether inflation is sticky, or flexible, is a key question of macroeconomics. One view, widely present in the literature, is that the Phillips-curve slope, ϕ, is small. The profession call this the sticky view of the slope of the Philips curve.

According to the flexible view of inflation, the slope of the Phillips curve, ϕ, is substantial, while the unemployment gap, $u_t - u_t^*$, is small and transitory. A frequently used name in the literature is the "real business cycle model".

There are two ways that the unemployment gap contributes almost nothing to the implied inflation rate during recoveries. Both agree that $\phi(u - u^*)$ is essentially zero. The *low-and-sticky view* of the slope of the Philips curve: ϕ was small, while the inflation pressure, $u_t - u_t^*$ was large and negative. The *flexible view*: ϕ was material during the recovery, while the inflation pressure, $u_t - u_t^*$, was small and positive.

Both views fit the data. Additional analysis helping to reveal u_t^* or ϕ would be needed to determine which view is correct.

4.2 The flexible view of the slope of the Philips curve

In the flexible view of the Phillips curve, low unemployment does not necessarily signal high inflation pressure. During recoveries, an economy resembles a real business cycles economy, with $\frac{1}{\phi}$ being relatively low and the Phillips curve being steep.

The flexibility of prices is the key differentiating factor. Our view requires that prices are somewhat flexible, so the Phillips curve is reasonably steep, whereas the opposing low and sticky view posits stickier prices and a flatter Phillips curve.

4.3 Is inflation sticky or flexible?

We propose that rather than being a slow-moving function of mainly demographic forces uncorrelated with actual unemployment, the natural rate of unemployment is substantially positively correlated with the actual rate of unemployment.

The increase in tightness during a recovery does not imply a rising level of upward pressure on inflation. This is because tightness and the natural rate move in the same direction during recoveries.

In the flexible view of the Phillips curve, low unemployment does not necessarily signal high inflation pressure. Under our view of inflation, during recoveries, inflation pressure is low because the unemployment gap is close to zero. Under a contrasting, sticky-price view, inflation pressure is low because the Phillips curve's slope is close to zero.

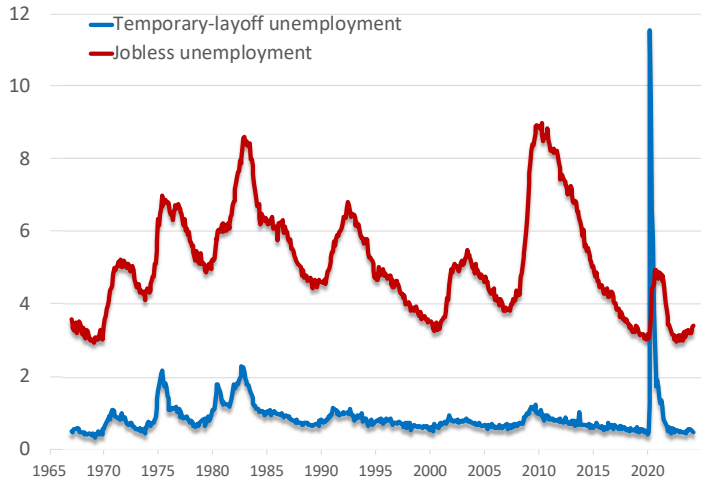


Figure 5: The Unemployed with and without Jobs

Note: Data through Mar 2024, updated from Hall and Kudlyak (2022b).

5 Unemployment and inflation in the pandemic cycle and after

During the pandemic, unemployment exhibited a violent swing: first, a rapid increase to unprecedented heights in March-April 2020, and then a rapid decline in unemployment (Figure 5).

The rapid increase of unemployment was not due to a typical deterioration in demand, as was typical in the earlier recession episodes. Instead, it coincided with the locally-mandated stay-at-home-orders (Kudlyak and Wolcott (2020)). The rapid decline of unemployment was not due to a typical slow search and matching process but mostly due to recalls of the temporary-laid off workers.

5.1 The unemployed with and without jobs

To understand the labor market during the pandemic and its aftermath, one should examine separately temporary-layoff unemployment and unemployment due to other reasons—*jobless unemployment* (Hall and Kudlyak (2022b)). The unemployed on temporary layoff wait to be called back to their jobs and do not go through the search and matching process.

Historically, a large fraction of unemployment was jobless (Wolcott, Ochse, Kudlyak and Kouchekinia (2020)). For example, in the 2007-09 recession, jobless unemployment reached 9%. In contrast, during the pandemic, the entire run-up in total unemployment from 3.5 to 14.7% in April 2020 was due to temporary-layoff unemployment. The jobless unemployment rate increased slowly and peaked at 4.9% in September-November 2020.

A key distinction between jobless and temporary-layoff unemployment is that temporary-layoff unemployment returns to normal much faster than jobless unemployment does. A decline in temporary-layoff unemployment takes place as conditions improve and firms recall workers. No search or matching is involved. A decline in jobless unemployment takes time. Creation of new, stable, firm-worker relationships is a long and costly process (Hall and Kudlyak (2019)). Terminated workers often circle through a number of short-term jobs before finding a stable job.

5.2 Tight labor market in the pandemic recession

Despite the historically high unemployment rate in 2020, the labor market was comparatively tight. The jobless unemployment rate reached its peak of 4.9 percent, while in the 2007-09 recession it increased to 9% (Figure 5). The job-finding rates of the jobless unemployed remained relatively high (Figure 6). The vacancy-jobless unemployment ratio did not drop that much (Figure 7). The labor market perceptions line up well with jobless unemployment (Figure 8).

Note, however, that the relatively low labor market slack not to be confused with the high social cost of temporary-layoff unemployment (Hall and Kudlyak (2022b)).

5.3 Unemployment and inflation during and post-pandemic

Our earlier work suggests that the natural rate of unemployment followed closely the decline of the actual unemployment rate. What about the runaway inflation and disinflation post-pandemic?

The pandemic was a major turbulence shock to the anchored inflation. During the long 2009-2019 recovery, inflation became anchored at just below 2 percent per year. In this stable environment, sellers adapted their price-setting procedures to stability. The Phillips curve became flat because sellers tended to leave prices unchanged for extended periods—relatively few sellers responded to change each month.

The turbulence that the pandemic brought to sellers' economic situations induced more frequent price changes than in the tranquil pre-pandemic times. The pandemic loosened the anchoring of the inflation rate that prevailed during 2009-2019. The behavior of price

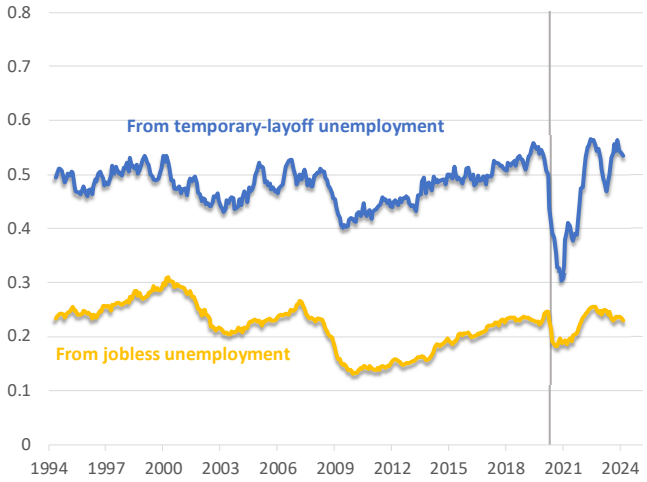


Figure 6: Work-Finding Rates

Note: The figure shows the rate at which the unemployed transition into employment from one month to the next, with the later month labeled on the horizontal-axis. Authors calculations from the CPS micro data. Monthly series, SA using Census X-13-ARIMA-SEATS, MA(5). The vertical line indicates April 2020. Data through Feb 2024, updated from Hall and Kudlyak (2022b).

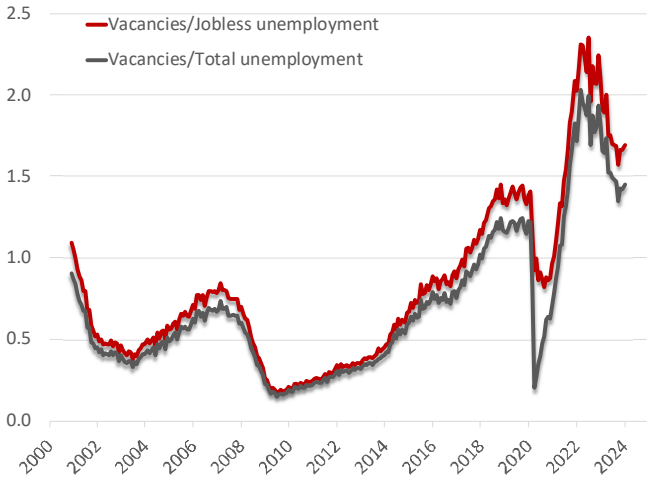


Figure 7: Vacancy-Jobless Unemployment Ratio

Note: Data through Jan 2024, updated from Hall and Kudlyak (2022b).

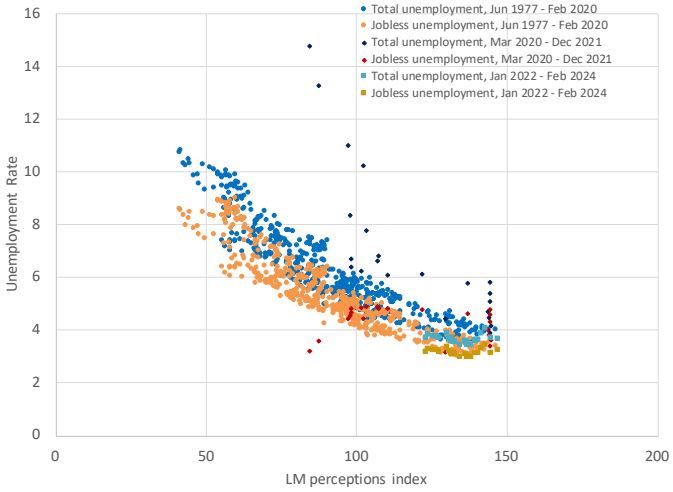


Figure 8: Jobless Unemployment and Labor Market Perceptions

Note: The labor market perceptions index is the percent of the consumers who say that jobs are plentiful minus the percent of those who say that jobs are hard to find, plus 100, constructed from the Conference Board data. Data through Feb 2024.

changes that accompanied and followed the pandemic illustrates how a major shock frees up the process (Hall (2023), Blanco, Boar, Jones and Midrigan (2023) and Cavallo, Lippi and Miyahara (2023), and work cited there). First, a burst of inflation greater than expected from the Phillips curve of 2019. Followed by rapid disinflation without much increase in unemployment.

In the Phillips curve framework, an increase in turbulence represents a regime change—the Phillips curve becomes more sensitive to changes in the unemployment gap. The Phillips curve became steeper. That is, in tranquil times the Phillips curve is relatively flat—any shifts in demand show up mostly as quantity changes, while in turbulent times, the shifts in demand have large effects on inflation.

That means that the cost in terms of elevated unemployment of a policy to restore price stability may be lower than it would have been if inflation had become anchored at its high rate.

6 Conclusions

During recoveries, tightness is indicative of labor market pressure but not necessarily of inflationary pressure. The labor market can gradually tighten in the sense of the Diamond-Mortensen-Pissarides model's measures of labor-market tightness, while inflation remains at a constant low level.

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