Commentary: Monetary Policy in Times of Structural Reallocation

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I. Introduction

The paper by Veronica Guerrieri, Guido Lorenzoni, Ludwig Straub and Iván Werning (GLSW) discusses a highly relevant topic. The authors thoroughly investigate optimal monetary policy when a demand shock hits two sectors asymmetrically and labor is mobile between the sectors. GLSW focus on conventional monetary policy. My remarks complement their paper with alternative monetary policy tools that have been implemented in response to the Great Recession and COVID-19.

I organize the rest my remarks around the two main results of their paper: (1) The demand shock that hits two sectors asymmetrically implies a nontrivial trade-off between inflation and unemployment for the central bank, and (2) the level of labor reallocation across sectors is inefficient. I discuss the implications of several alternative policy tools on these two results.

II. Inflation-Unemployment Trade-Off

II.i. Benchmark Model

I anchor this section with a textbook three equation New Keynesian model (see, e.g., Woodford 2011 and Galí 2015).

The model features an IS curve,

$$y_t = \mathbb{E}_t y_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t \pi_{t+1}), \tag{1}$$

and a Phillips curve,

$$\pi_t = \kappa(y_t - y_t^n) + \beta \mathbb{E}_t \pi_{t+1}, \tag{2}$$

and a rule for monetary policy. All variables are expressed as log deviations from the steadystate: y_t is output, y_t^n is the equilibrium output under flexible prices, and $y_t - y_t^n$ is the output gap. π_t is inflation, and i_t is the short-term nominal interest rate or the policy rate. $\mathbb{E}_t$ is the expectation operator. σ is the inverse intertemporal elasticity of substitution, β is the discount factor, and κ depends on structural parameters. All the parameters are positive.

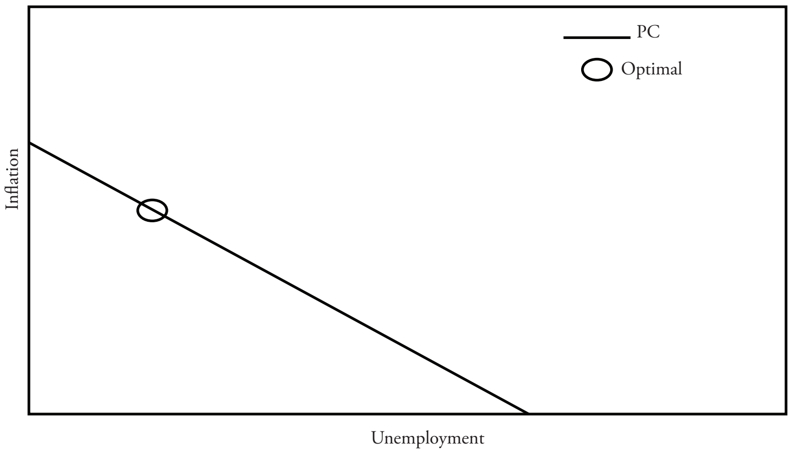
In the model, I use the output gap in the Phillips curve (equation 2) to measure real activity following the New Keynesian literature. The output gap is procyclical and has a positive correlation with inflation. Note GLSW focus on unemployment instead, which is countercyclical and negatively correlated with inflation. I follow their notion in my figures, where the Phillips curves are downward sloping.

II.ii. Guerrieri, Lorenzoni, Straub and Werning's Result

The first main result of GLSW is that the central bank faces a trade-off between inflation and unemployment when sectors encounter an asymmetric demand shock. Chart 1 summarizes this trade-off, which recreates the relevant region of Chart 2 of their paper. The solid line is the Phillips curve, and the circle represents the optimal monetary policy.

The asymmetric demand shock implies an endogenous cost-push shock to the Phillips curve, which breaks the standard result of "divine coincidence" (Blanchard and Galí 2007). Consequently, zero inflation-zero unemployment (the origin) is unattainable, and the

Chart 1
Phillips Curve in GLSW



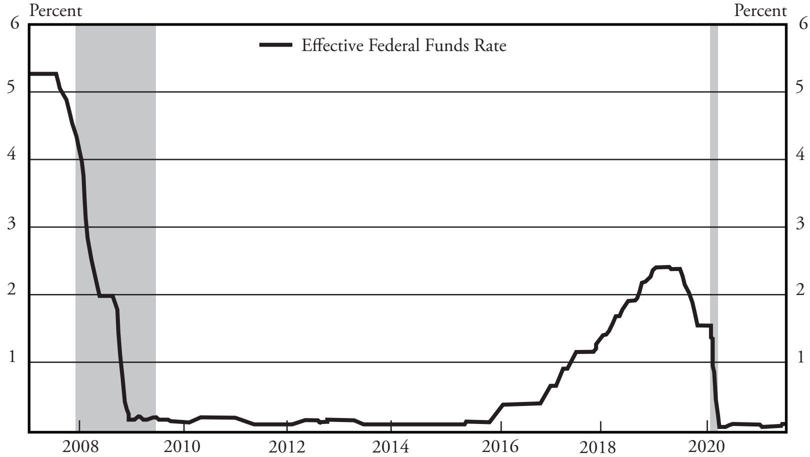
central bank faces a nontrivial trade-off between inflation and real activity, which is captured by the Phillips curve.

II.iii. Zero Lower Bound

GLSW do not discuss the implications of the zero lower bound (ZLB). But the ZLB has been the single most important characteristic of the macroeconomy that affects monetary policy since the Great Recession. Chart 2 plots the effective fed funds rate of the United States, which is the conventional monetary policy tool. In response to the Great Recession, the Fed lowered the policy rate to its ZLB from December 2008 to late 2015. COVID-19 has brought us back to the ZLB since April 2020. The ZLB is not unique to the United States, and it has plagued many advanced economies, including Japan, the euro area, and many other countries. We won't get a full picture of the COVID-19 crisis without discussing the ZLB.

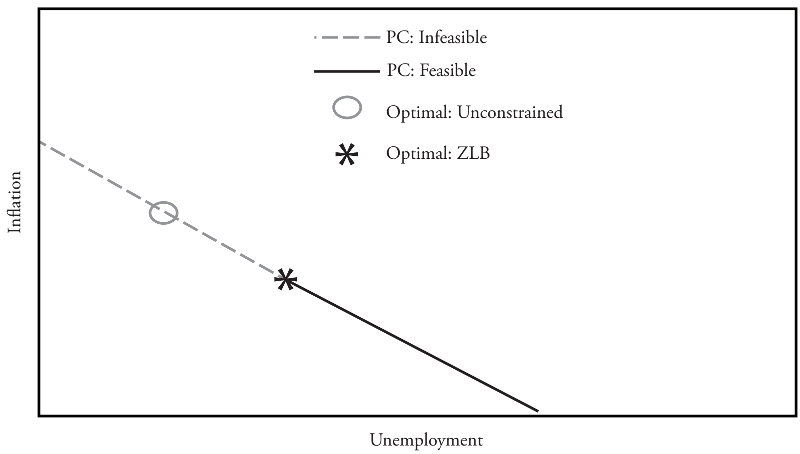
I illustrate the implications of the ZLB on the inflation unemployment trade-off in Chart 3. The ZLB prevents conventional monetary policy from providing further expansion, which imposes a limit on how far the IS curve in equation (1) can shift and makes the northwest region of the Phillips curve infeasible (see the dashed

Chart 2
Federal Funds Rate



Note: Gray bars represent NBER-defined recessions.
Source: Board of Governors of the Federal Reserve System.

Chart 3
Phillips Curve at the ZLB



gray line). The feasible portion of the Phillips curve is in the solid black line. The unconstrained optimal policy, which is marked by the circle, is no longer attainable when the policy rate is constrained by its ZLB. Instead, the new optimal policy at the ZLB is captured by the asterisk, which marks the edge of the feasible set. The constrained optimum has lower inflation and a higher unemployment rate than the unconstrained optimum, and low inflation and low real activity are the hallmark of the ZLB episodes.

When the policy rate got stuck at its ZLB, central banks around the world introduced several alternative policy tools including quantitative easing (QE), forward guidance, negative interest rate policy and average inflation targeting (AIT); see Sims and Wu (2021a) for a comparison between these policy tools. A large and still growing literature shows unconventional monetary policy, especially QE, is highly effective (see, e.g., Gagnon et al. 2011, Hamilton and Wu 2012, Krishnamurthy and Vissing-Jorgensen 2011, Wu and Xia 2016, Wu and Zhang 2019b). I organize the rest of this section around some of these unconventional policy tools, and discuss their roles in alleviating the trade-off that GLSW highlight.

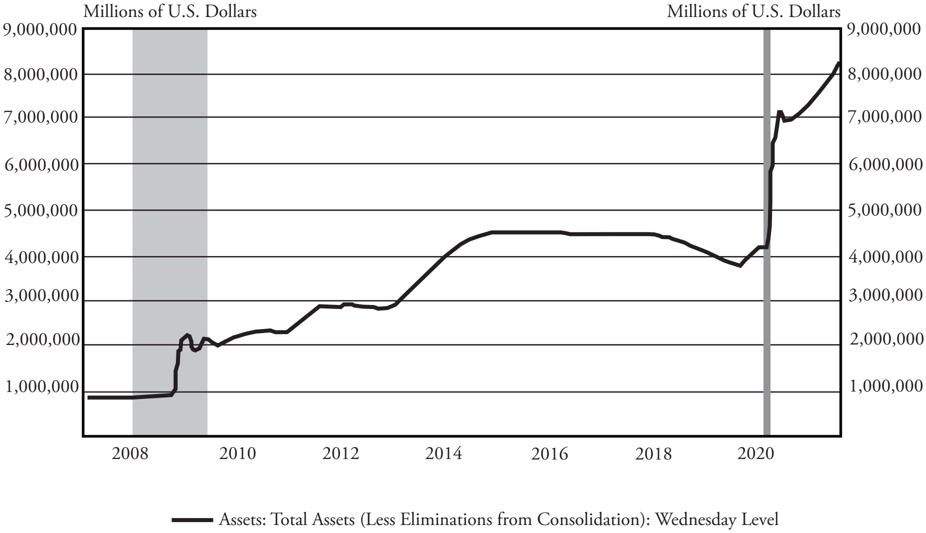
II.iv. Quantitative Easing

QE was first introduced by the Bank of Japan in the early 2000s and has been a prominent policy tool that many central banks employ to combat the ZLB since the Great Recession. Chart 4 shows the Federal Reserve's balance sheet expanded dramatically over the last decade and half. In response to the Great Recession, it increased from $900 billion in August 2008 to $4.5 trillion by the end of 2014. In response to COVID-19, the Fed has further expanded the balance sheet to over $8 trillion.

I base my discussion of QE on my paper titled "The Four Equation New Keynesian Model" joint with Eric Sims and Ji Zhang (Sims, Wu and Zhang 2021), in which we micro-found QE as a second policy instrument on top of the textbook three equation New Keynesian model outlined in equations 1 - 2.

In our model, QE acts as both a positive demand shock and a positive supply shock. First, QE works similarly to the conventional

Chart 4
Federal Reserve's Balance Sheet



Note: Gray bars represent NBER-defined recessions.
Source: Board of Governors of the Federal Reserve System.

monetary policy on the demand side of the economy: both of them stimulate aggregate demand by lowering interest rates. The difference is conventional monetary policy moves the short-term interest rate, whereas QE affects the long-term interest rate. With QE, the IS curve becomes

$$y_t = \mathbb{E}_t y_{t+1} - \frac{1}{\sigma}\left(i_t - \mathbb{E}_t \pi_{t+1}\right) - \frac{z}{\sigma}\left(\mathbb{E}_t i_{t+1}^{long} - i_t\right), \tag{3}$$

where z is the fraction of consumption of a nonstandard household. When $z = 0$, equation 3 collapses to 1. i_{t+1}^{long} is the return of holding a long-term bond from t to $t + 1$. Compared with equation 1, QE adds an extra term to the IS equation that captures the excess return of the long-term bond over the short rate.

Second, QE enters the Phillips curve as follows:

$$\pi_t = \kappa_2(y_t - y_t^n) + \beta \mathbb{E}_t \pi_{t+1} - \zeta qe_t, \tag{4}$$

where $\kappa_2 > 0$ and $\zeta > 0$ depend on underlying parameters. QE generates an endogenous cost-push shock to the Phillips curve. The mechanism for QE to enter the Phillips curve is similar to GLSW: it functions as a demand shock that affects two sectors asymmetrically.

Equations 3 and 4 explain how QE works. QE is often studied in medium scale DSGE models with bells and whistles (for example, see Gertler and Karadi 2011, 2013; Carlstrom et al. 2017; Sims and Wu 2021a). Although these models are instructive for studying the quantitative implications of QE, it is often difficult if not impossible to clearly see the transmission mechanism among tens of equations. Whereas small scale models, e.g., Sims et al. (2021), are analytically tractable and provide clear intuition.

How does the Phillips curve look graphically when the central bank introduces QE as a second policy instrument? I plot it in Chart 5. QE plays two roles. First, it mitigates the cost of the ZLB, which makes the infeasible region of the Phillips curve that is caused by the ZLB attainable again. This is consistent with the QE literature (see, e.g., Swanson and Williams (2014); Debortoli, Galí and Gambetti (2016); Garín, Lester and Sims (2019); Wu and Zhang (2019a); Sims and Wu (2020)). Second, per equation 4, QE shifts down the Phillips curve toward the origin from the gray dashed line to the black solid line in Chart 5. Optimal conventional monetary policy when QE is present is captured by the asterisk, which has lower inflation and unemployment rates relative to the optimum without QE, which is marked by the circle.

I have discussed how the central bank can improve the inflation-unemployment trade-off by adding QE to its toolkit. What happens when it chooses both conventional monetary policy and QE optimally? Chart 6 illustrates such a scenario.

One key feature for both GLSW and Sims, Wu and Zhang (2021) is the "Divine Coincidence" does not hold and the central bank faces a nontrivial trade-off between inflation and real activity. But Sims, Wu and Zhang (2021) show the central bank can achieve dual stability by using two instruments: the conventional monetary policy and QE.

Chart 5
Phillips Curve with QE

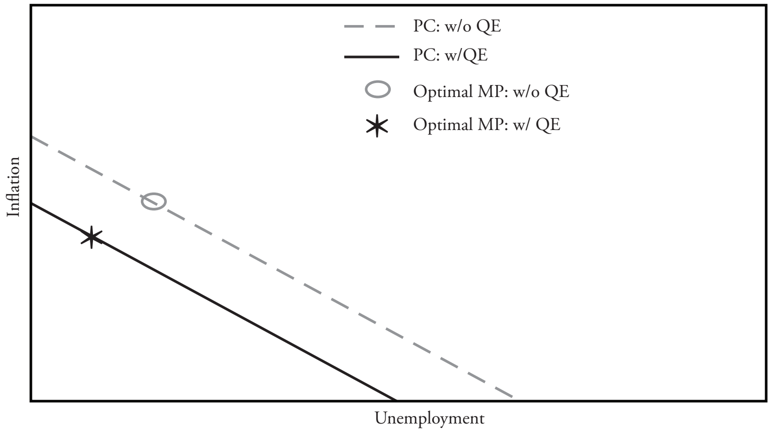
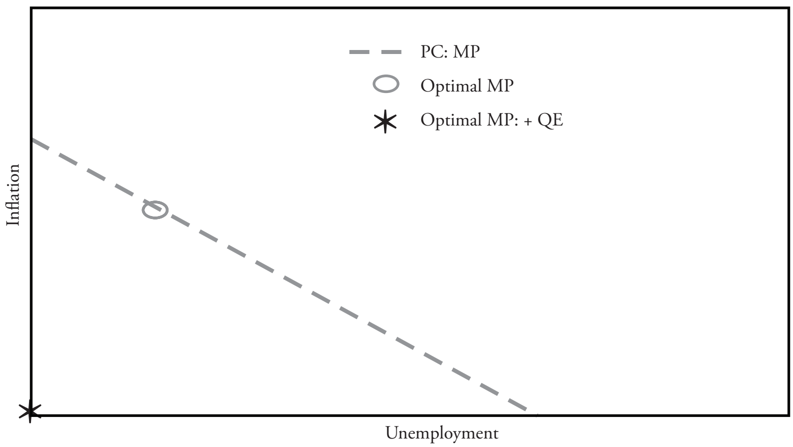


Chart 6
Choose Both QE and Conventional Monetary Policy Optimally



The new equilibrium with both instruments is the asterisk in Chart 6, which marks the origin. This intuitive result dates to Tinbergen (1952): the central bank has two targets, and it can achieve both with two policy instruments.

II.v. Average Inflation Targeting

I have thus far discussed the implications of QE on the inflation-unemployment trade-off the central bank faces, but QE is not the only alternative policy tool. At last year's Jackson Hole conference, Chair Powell announced the Fed will adopt average inflation targeting (AIT) as its new approach to manage inflation (Powell, 2020).

In Chart 7, I illustrate the implications of AIT on the Phillips curve. My discussion is based on my research project with Chengcheng Jia at the Cleveland Fed (Jia and Wu, 2021). AIT flattens the reduced-form Phillips curve and tilts it in a favorable way when a cost-push shock is present. The new Phillips curve under AIT is represented by the solid black line in Chart 7, whereas the Phillips curve under conventional policy, labeled "IT" for inflation targeting, is in the gray dashed line. AIT achieves a better equilibrium than IT with less inflation and a lower unemployment rate, which is captured by the asterisk.

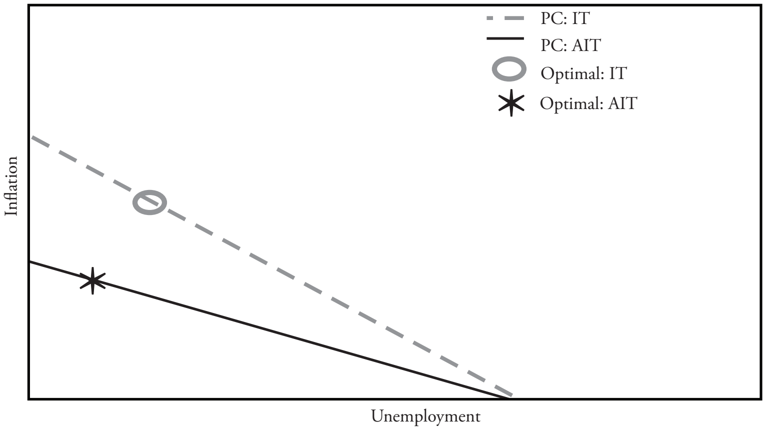
Why does AIT flatten the Phillips curve? When the inflation rate is above its target today, expected future inflation will be below the target, and that is the nature of AIT. A lower expected future inflation rate then feeds back into a lower inflation rate today via the logic of equation 2. This feedback effect is stronger when inflation is higher.

III. Inefficient Reallocation

The second main result of GLSW is that the level of labor reallocation across sectors is inefficient. This conclusion makes sense: conventional monetary policy targets the entire economy and does not differentiate between sectors that face different demand shocks. They also find that whether the reallocation motive implies a more expansionary or contractionary optimal policy depends on model assumptions on price and wage rigidities.

Since the onset of COVID-19, some new policy tools have emerged that can facilitate sectoral reallocation. The most prominent examples

Chart 7
Phillips Curve with AIT

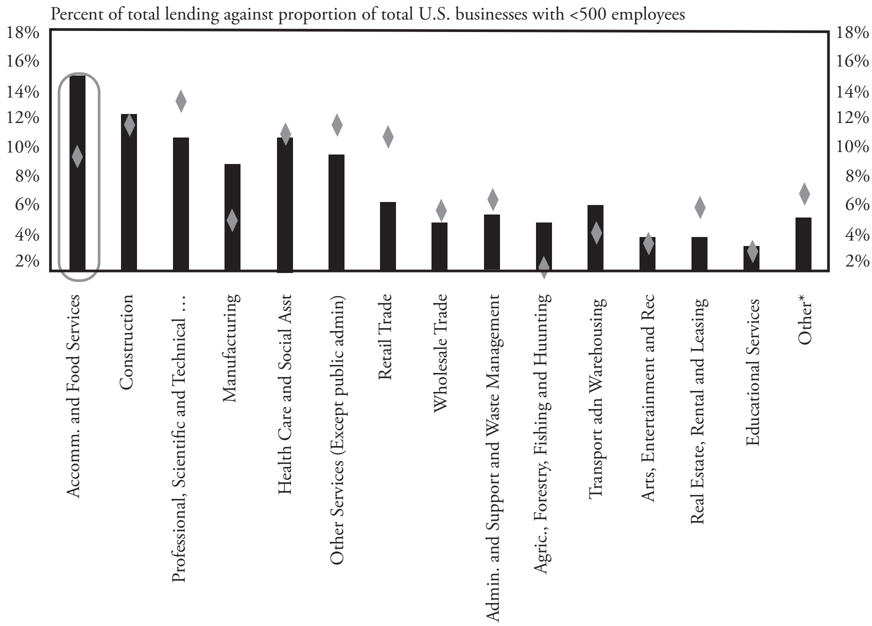


are the Main Street Lending programs of the Fed and the Paycheck Protection Program (PPP) of the Treasury; see Sims and Wu (2021b) for a comparison between these programs and QE.

In Chart 8, I take a chart from the U.S. Small Business Administration's report of the PPP on May 9, 2021. Diamonds mark the proportion of small businesses in the U.S. by industry, and bars show the percentage of total PPP lending for each industry. Sectors that are hit heavily by the COVID-19 crisis take up PPP loans disproportionately. For example, I highlight accommodation and food services on the chart. This industry consists of less than 9% of small businesses, but it accounts for 17% of total PPP lending.

PPP reallocates resources in the opposite direction from what GLSW suggest. They argue resources should shift away from the industry that faces a negative demand shock. The authors model the COVID shock as a permanent shock, but whether it is permanent or temporary is very much an open question. The nature of the shock directly leads to the question at hand: Which direction should reallocation go? Programs like PPP can facilitate reallocation, but how do policy makers pick winners and losers?

Chart 8
Paycheck Protection Program



*Other includes Information, Mining, Finance & Insurance, Public Admin., Management of Companies & Enterprises, Utilities, and Unclassified Establishments Industries
**Gray diamond markers detail the proportion of U.S. Businesses with < 500 employees by industry
Source: U.S. Census, SUSB, this is data for employer businesses and doesn't include independent contractors or farms.

IV. Conclusion

In summary, GLSW's paper is thought provoking, and the discussion on optimal monetary policy when multiple sectors face an asymmetric demand shock and resources can be reallocated between sectors is a highly relevant topic for policy makers. Whereas the authors focus on conventional monetary policy, my discussion highlights the potential usefulness of several alternative policy tools. I show that policymakers can resort to policy such as QE and AIT to improve the inflation-unemployment trade-off that is caused by the asymmetric demand shock. Their paper also argues conventional monetary policy generates inefficient reallocation. But policymakers can resort to new programs such as the Main Street Lending Programs or the Paycheck Protection Program to facilitate resource reallocation. The question is, which direction should reallocation go?

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