AEA Papers and Proceedings 2022, 112: 496–502
https://doi.org/10.1257/pandp.20221094

Persistent Monetary Policy in a Model with Labor Market Frictions†

By Roman Goncharenko and Elizaveta Lukmanova*

Central banks' effort to stimulate economies during the Great Recession pushed policy rates to zero. Consequently, this limited the central banks' capacity to raise excessively low inflation using the conventional monetary policy tools. As such, central banks had to employ alternative monetary policy instruments that instead target the households' long-term inflation expectations.[1] In this paper, we study the transmission of persistent monetary policy shocks, which target long-term inflation expectations, using a New Keynesian (NK) model with labor market frictions. We show that labor market frictions play important role in the transmission of persistent monetary policy shocks and, thus, should be taken into account by policymakers. In the full version of the paper we further provide empirical evidence, based on the US data, consistent with the predictions of our theoretical model.

Empirical studies find that highly persistent monetary policy shocks that increase inflation in the long run boost production already in the short run (Mumtaz and Theodoridis 2018; Uribe, forthcoming; Lukmanova and Rabitsch 2020). Intuitively, when economic agents expect higher prices in the future they optimally increase current consumption at prices lower relative to the future, which consequently stimulates aggregate demand and improves economic activity. However, to sustain output increase, production inputs must increase as well. Firms' ability to increase labor input, however, depends on the underlying labor market conditions. In a standard NK model, labor markets are frictionless and, thus, readily accommodate the increased demand for labor. Thus, to fully understand the transmission of persistent monetary shocks to output it is important to account for labor market imperfections that could either limit or increase the firm production capacity and, thus, affect the transmission of the shock.

We construct a stylized NK model with unemployment and persistent monetary policy shocks. We employ the model from Galí (2010), who introduces search and matching frictions, similar to those found in the Diamond-Mortensen-Pissarides search and matching model of unemployment, into otherwise standard basic NK model. We model persistent monetary policy shocks as shocks to the time-varying inflation target (Ireland 2007; Cogley, Primiceri, and Sargent 2010; Lukmanova and Rabitsch 2020).[2] The model is calibrated to the US data.

Our analysis predicts that labor market conditions, which are shaped by labor market frictions, play an important role in the transmission channel of the persistent inflation target shock. The inflation target shock transmits primarily through the demand channel (Lukmanova and Rabitsch 2020). Upon the positive inflation target shock, households adjust their inflation expectations upward, leading to a fall in the real interest rate and a consequent increase in the current consumption relative to savings, which in turn creates an expansionary effect on output. The

*Goncharenko: KU Leuven, Belgium (email: roman.goncharenko@kuleuven.be); Lukmanova: KU Leuven, Belgium (email: elizaveta.lukmanova@kuleuven.be). For insightful comments, we would like to thank Ferre De Graeve, Nir Jaimovich, Philipp Kircher, Rigas Oikonomou, Katrin Rabitsch, and the participants of the 31st Annual Congress of the European Economic Association and the Allied Social Science Associations Annual Meeting 2022.

†Go to https://doi.org/10.1257/pandp.20221094 to visit the article page for additional materials and author disclosure statement(s).

[1] There have been several indications by the Federal Reserve (Fed) to employ long-term monetary policy measures: for example, in 2011 it officially adopted a 2 percent inflation target, and in August 2020 the Fed explicitly announced a course to increase long-run inflation expectations aiming to achieve inflation moderately above the 2 percent target for some time (Powell 2020).

[2] Alternatively, more recent contributions explicitly include permanent nominal interest rate shocks in the theoretical model framework (Uribe, forthcoming; Cochrane 2018).

expansionary effect on output, however, depends on the firm's capacity to increase the production input, which is labor in our analysis. A priori the effect of labor market friction on the transmission of inflation target shock is not obvious. On the one hand, because of the persistent nature of the inflation target shock, firms would want to maintain their increased production for multiple periods. This, however, sustaining a high level of employment for an extended period of time could be costly in the frictional labor market environment. On the other hand, the frictional labor market environment implies the presence of a pool of unemployed that can be readily used to extend production. Our model predicts that under the realistic value of labor market frictions the second effect dominates so that the expansionary effect of inflation target shock on output is around 40–50 percent larger in the model with labor market frictions than in the model without.

While we do find that labor market frictions are important for the transmission of the inflation target shock in the model, they do not appear so for the transmission of the standard temporary nominal interest rate shock. As in Galí (2010), at least quantitatively, the presence of labor market frictions has little impact on the economy's response to a standard temporary nominal interest rate shock. Because of the short-term nature of the nominal interest rate shock, quantitatively realistic labor market frictions are not sufficiently large to have a significant effect on the response of the real variables. Intuitively, following an expansionary nominal interest shock, firms increase their production only for a few periods, which is not long enough for the labor market frictions to have a meaningful effect. In contrast, due to the persistency of the inflation target shock even moderate firms need to increase their production for many periods to accommodate increased demand.

This paper contributes to the literature studying the effect of persistent monetary shocks. Ireland (2007) estimates a New Keynesian model to examine the behavior of the Federal Reserve's unobserved inflation target. Cogley, Primiceri, and Sargent (2010) estimate a VAR model with drifting coefficients and stochastic volatility to investigate the changes in the persistence of the US inflation. More recently, employing a SVAR analysis, Mumtaz and Theodoridis (2018) indemnify shocks to the FED's inflation target as VAR innovations that make the largest contribution to future movements in long-horizon inflation expectations. Uribe (forthcoming) estimates an empirical and a New Keynesian model with transitory and permanent monetary shocks. His main finding is that permanent monetary shocks that increase both the nominal interest rate and inflation in the long run already in the short run cause increases in interest rates, inflation, and output and explain about 45 percent of inflation changes. Lukmanova and Rabitsch (2020) estimate a New Keynesian model with a standard nominal interest rate shock and a highly persistent inflation target. Assuming imperfect information about the nature of monetary shocks, they show that the Neo-Fisherian effects arise only with a lag effect and not in the immediate short run, because, in such a case, inflation expectations do not adjust immediately to the target shock. We contribute to this strand of the literature by examining how labor market conditions affect the transmission of persistent monetary shocks.

Our paper further contributes to the literature on the interactions between nominal rigidities and labor market frictions. Early work in this area includes Walsh (2005); Trigari (2009); and Blanchard and Galí (2010) (see further Galí 2010 for the survey). While unemployment plays a central role in the policy debate, it is typically absent in the formal analysis of monetary policy. One of the reasons behind this is the lack of quantitative importance of labor market frictions in the transmission of monetary policy shocks, which has been shown in the previous literature. For example, Galí (2010) studies the interaction between labor market frictions and nominal rigidities in a New Keynesian DSGE model with involuntary unemployment. One of his main findings is that, quantitatively, the presence of labor market frictions has little impact on the economy's response to standard short-term monetary policy shocks. Our paper contributes to this strand of the literature showing that realistic labor market fictions do play role in the transition of persistent monetary shocks such as inflation target shocks.

The results of our analysis are relevant to the current policy debate. For example, in a recent speech, Chairman of the Fed J. Powell announced a course to higher long-run inflation expectations aiming to stimulate employment and inflation in the United States (Powell 2020). Our results indicate that such a policy may have only little effect on output due to

labor market frictions. On the other hand, in the post-COVID-19 pandemic world, which is, at least temporarily, characterized by an enlarged pool of unemployed, many advanced and developing countries could try to stimulate their economies by raising inflation expectations (for example, through increasing inflation target). However, again this policy could be less effective in those countries that have less efficient labor markets (i.e., countries with higher hiring costs).

I. New Keynesian Model with Labor Market Frictions

To study the transmission of the inflation target shock in a model with labor market frictions, we employ a New Keynesian model with labor market frictions developed in Galí (2010). In this model, households consume final good, supply labor to intermediate good producers, and save. Final good producers are monopolistically competitive firms, which use the intermediate good as the only factor of production and are subject to nominal rigidities. Intermediate producers are competitive firms, which use labor as the only impact of production. Every period, a fraction of workers exogenously separates from the firm and to hire new workers the firm must pay the hiring cost proportional to the aggregate labor market tightness. The wages are determined through a Nash bargaining protocol. In calibrating the model, we follow closely Galí (2010) and Lukmanova and Rabitsch (2020).

To model inflation expectations, which are affected by persistent monetary shocks, we introduce a time-varying inflation target into an otherwise standard generalized Taylor rule (the setup of the Taylor rule follows Cogley, Primiceri, and Sargent 2010). Therefore, rather than adjusting the nominal policy rate as a response to the change in inflation, the monetary authority makes adjustments to the change in the inflation gap, which is defined as the difference between current inflation and inflation target.

II. Equilibrium Dynamics: The Effects of Monetary Policy Shocks

We begin our analysis by examining the transmission of the inflation target shock in the model when wages are flexible. Figure 1 presents the impulse responses of the various endogenous variables of the model to a positive inflation target shock of one standard deviation in the model with flexible wages. The impulse responses generated by the model with the labor market frictions are depicted by the blue dotted line, while the responses from the model without the labor market frictions are depicted by the black solid line.[3]

Figure 1 shows that under flexible wages the labor market frictions in the model generate qualitatively similar results with the exception of the response of the unemployment rate. Quantitatively, however, the presence of the labor market frictions in the model results in substantially larger magnitudes of the responses of the variables to the shock. Upon a persistent increase in the inflation target, households anticipate that the monetary authority will aim at stabilizing the economy around the new inflation target (via the Taylor rule). Thus, expecting a persistent price growth in the future, households increase their consumption relative to savings resulting in a persistent growth in the aggregate demand. To accommodate the increased aggregate demand, the production sector responds by increasing output leading to the expansionary effect on the aggregate output. The firms' capacity to increase production, however, depends on their ability to raise the production input, i.e., labor. Intuitively, it is easier for firms to hire when there is a pool of unemployed looking for a job—which is the case in the model with labor market frictions. It is easy to see that even if the labor market participation were kept at a fixed level, the model with labor market friction would still produce an expansionary effect on output following the shock: with a surge in the number of new vacancies, the market tightness would decline, leading to a higher probability of finding a job and, consequently, to lower unemployment and higher aggregate output.

While our analysis suggests that the labor market frictions significantly magnify the effect of output to the inflation target shock, this is not the case for a standard nominal interest rate shock. Figure 2 depicts the impulse responses of the various endogenous variables of the model to a *negative* nominal interest rate shock of one standard deviation in the model with flexible

[3] The model without labor market frictions has perfectly competitive labor market so that $W_t/P_t = MRS_t$.

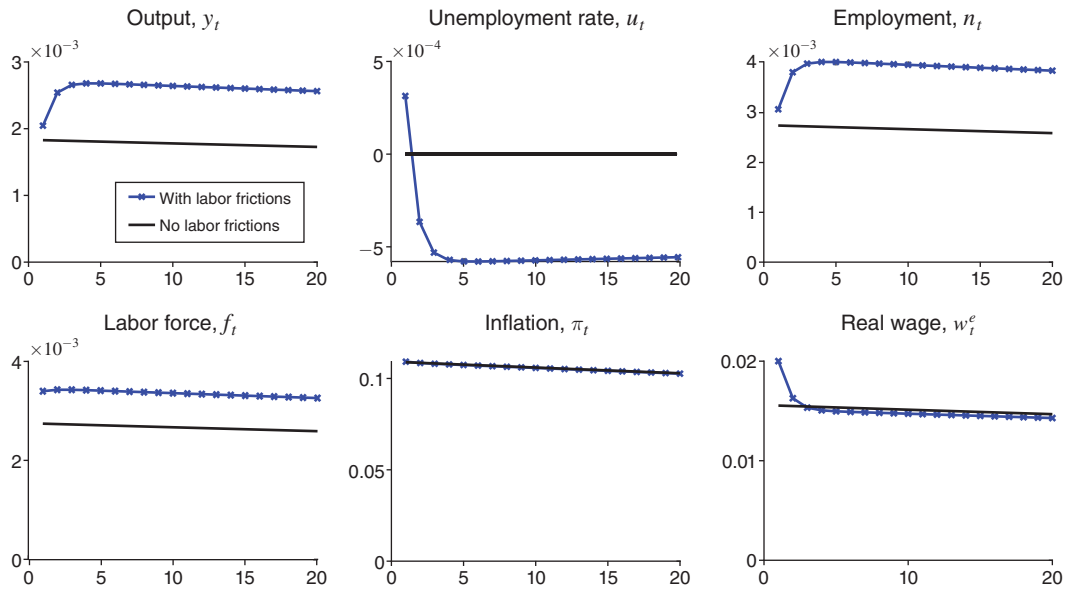

FIGURE 1. INFLATION TARGET SHOCK: EFFECT OF LABOR MARKET FRICTIONS UNDER FLEXIBLE WAGES

Notes: This figure presents the impulse responses of various endogenous variables of the model to a positive inflation target shock of one standard deviation in the model with flexible wages. The blue dotted line is the model with the labor market frictions, and the black solid line is the model without the labor market frictions (perfectly competitive labor market). All *x*-axes are in quarters.

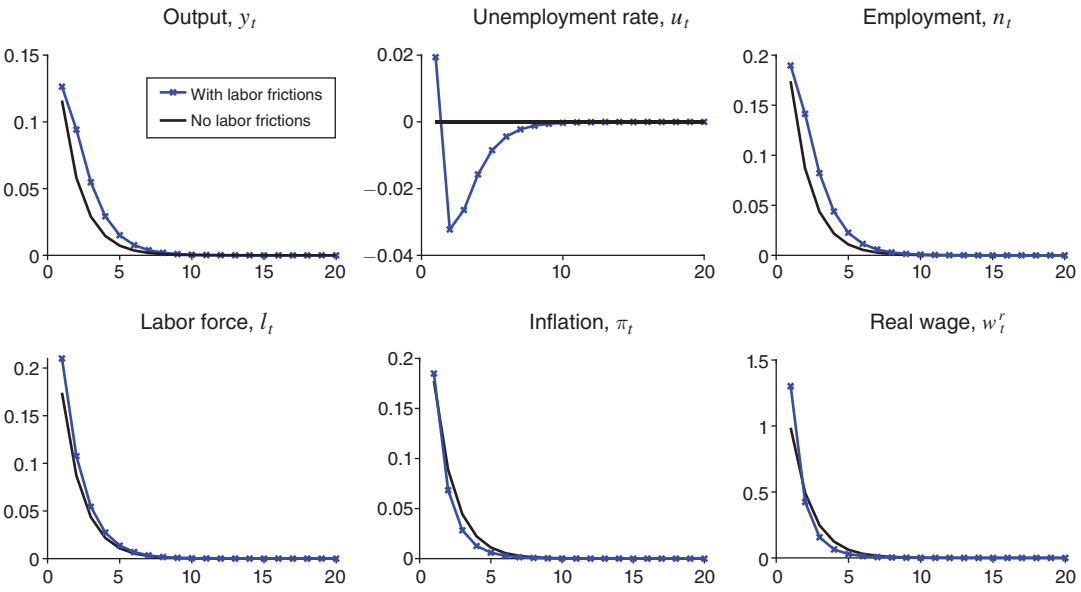

FIGURE 2. NOMINAL INTEREST RATE SHOCK: EFFECT OF LABOR MARKET FRICTIONS UNDER FLEXIBLE WAGES

Notes: This figure presents the impulse responses of various endogenous variables of the model to a positive nominal interest rate shock of one standard deviation in the model with flexible wages. The blue dotted line is the model with the labor market frictions, and the black solid line is the model without the labor market frictions (perfectly competitive labor market). All *x*-axes are in quarters.

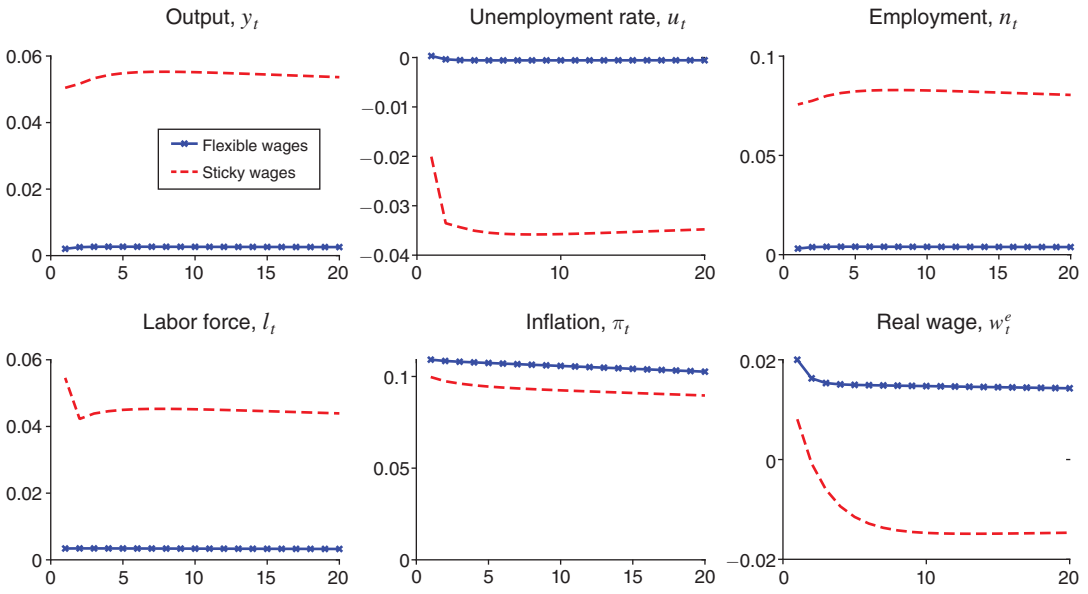

FIGURE 3. INFLATION TARGET SHOCK AND LABOR MARKET FRICTIONS: EFFECT OF STICKY WAGES

Notes: This figure presents the impulse responses of various endogenous variables of the model with labour market frictions to a positive inflation target shock of one standard deviation. The red dashed line is the model with sticky wages, and the blue dotted line is the model with flexible wages. All x-axes are in quarters.

wages. Figure 2 replicates the result from Galí (2010), showing that under quantitatively realistic labor market frictions the responses of the real variables to the nominal shock are not significantly altered by the presence of the frictions. Because of the short-term nature of a standard monetary shock, quantitatively realistic labor market frictions are not sufficiently large enough to affect the dynamics in the model. Intuitively, following a negative standard monetary shock firms increase their production only on impact without the need to sustain it for multiple periods—this appears to be not long enough for the labor market frictions to have a meaningful effect. In contrast, due to the persistence of the inflation target shock firms need to increase their production for a long period to accommodate the increased demand.

We note that the effect of the inflation target shock on the real variables in the model with flexible wages is rather quantitatively small. The reason is that most of the shock is completely absorbed by inflation. Therefore, next, we assume sticky wages and examine the effect of this assumption on the transmission of the inflation target shock in the model with the labor market frictions. Figure 3 depicts the impulse responses of the various endogenous variables of the model with labor market frictions to a positive inflation target shock of one standard deviation under sticky wages by setting $\theta_w = 0.75$. We contrast these results to the case with flexible wages—that is, when $\theta_w = 0$. As seen from the figure, assuming sticky wages substantially magnifies the effect of the shock on real variables. Intuitively, since wages cannot quickly adjust upward under the increased aggregate demand, the firms are able to hire more workers, which results in a stronger increase in the output. Interestingly, the model predicts a simultaneous decline in real wage and unemployment following the shock to the inflation target shock. The reason is that under persistently high inflation and sticky wages the real wages are deflating making reducing the marginal cost and allowing for more hiring.

Note that the labor force increases relatively less employment under sticky wages than under flexible ones, which can be seen by comparing Figures 1 and 3. This is because the marginal

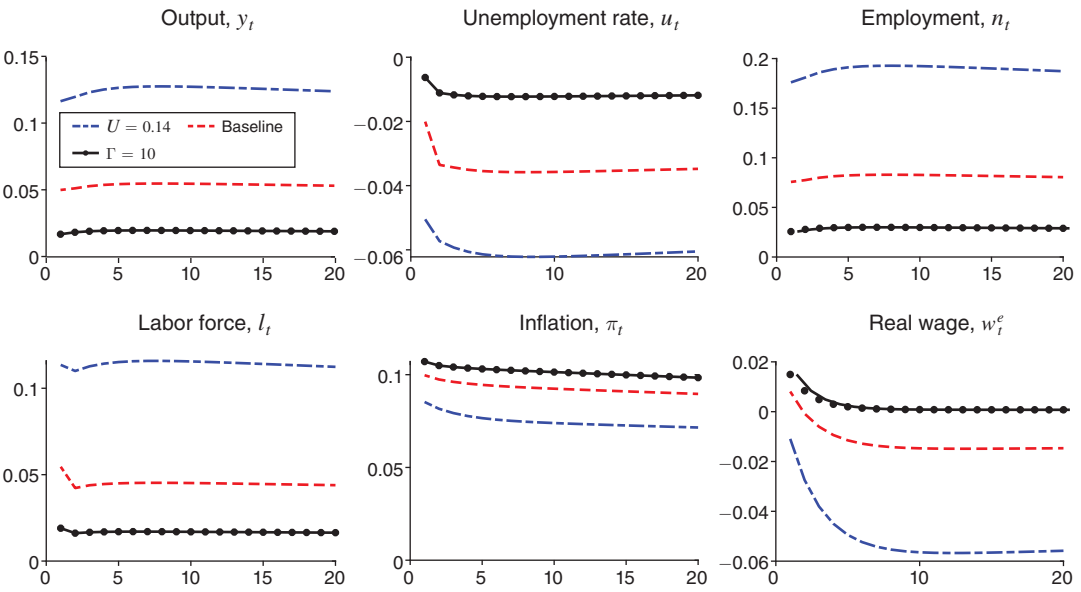

FIGURE 4. IMPULSE RESPONSES TO AN INFLATION TARGET SHOCK: VARYING LABOR MARKET CONDITIONS

Notes: This figure presents the impulse responses of various endogenous variables of the model to an inflation target shock of one standard deviation under different labor market conditions. The blue dashed line with dots corresponds to the model with higher unemployment, the red dotted line is the baseline model, and the black line with dots is the model with lower job finding rate. All x-axes are in quarters.

expected benefit of job market participation is decreasing in wage inflation. Intuitively, when wages cannot readily readjust, the benefit of participation declines due to wage inflation since once in the market and employed a worker gets a deflating real wage without a possibility to promptly reset it. As a result, when wages are sticky, employment grows relatively more from the pool of unemployed than from the pool of those who do not participate in the labor market.

Finally, Figure 4 offers some sensitivity analysis by plotting the impulse responses of the various endogenous variables of the model with the labor market frictions and sticky wages under different values for (steady-state value of) unemployment and the cost of hiring. These results are, in general, in line with our intuition. For example, by recalibrating the model so that it has larger steady-state unemployment (which is equivalent to assuming either a larger separation rate δ or a lower rate of filling a vacancy x), we find that the real effect of the inflation target shock increases. On the other hand, by increasing the cost of hiring, we find that the real effects of the shock decline and the shock itself is more absorbed by inflation.

III. Conclusion

In this paper, we study the transmission of persistent monetary policy shocks, which target long-term inflation expectations, using a New Keynesian (NK) model with labor market frictions. Our analysis predicts that labor market conditions, which are shaped by labor market frictions, play important role in the transmission channel of the persistent inflation target shock. Results from the NK model indicate that: (i) quantitatively reasonable labor market frictions amplify the real effect of the inflation target shock, (ii) increasing the pool of unemployed further increases the real effect of the inflation target shock, while (iii) more restricted access to labor (e.g., higher hiring costs) leads to a smaller reaction of real output but a higher reaction of inflation.

The results of our analysis are relevant to the current policy debate. For example, in a recent speech, Chairman of the Fed J. Powell announced a course to higher long-run inflation expectations aiming to stimulate employment and inflation in the United States (Powell 2020). Our results indicate that such a policy may have

only little effect on output due to labor market frictions.

REFERENCES

Blanchard, Olivier, and Jordi Galí. 2010. "Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment." *American Economic Journal: Macroeconomics* 2 (2): 1–30.

Cochrane, John H. 2018. "Michelson-Morley, Fisher, and Occam: The Radical Implications of Stable Quiet Inflation at the Zero Bound." In *NBER Macroeconomics Annual 2017*, Vol. 32, edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

Cogley, Timothy, Giorgio E. Primiceri, and Thomas J. Sargent. 2010. "Inflation-Gap Persistence in the US." *American Economic Journal: Macroeconomics* 2 (1): 43–69.

Galí, Jordi. 2010. "Monetary Policy and Unemployment." In *Handbook of Monetary Economics*, Vol. 3, edited by Benjamin M. Friedman and Michael Woodford, 487–546. Amsterdam: Elsevier.

Ireland, Peter N. 2007. "Changes in the Federal Reserve's Inflation Target: Causes and Consequences." *Journal of Money, Credit and Banking* 39 (8): 1851–82.

Lukmanova, Elizaveta, and Katrin Rabitsch. 2020. "New Evidence on Monetary Transmission: Interest Rate versus Inflation Target Shocks." Unpublished.

Mumtaz, Haroon, and Konstantinos Theodoridis. 2018. "The Federal Reserve's Implicit Inflation Target and Macroeconomic Dynamics: A SVAR Analysis." Cardiff Economics Working Paper E2018/1.

Powell, Jerome H. 2020. "New Economic Challenges and the Fed's Monetary Policy Review." Speech at "Navigating the Decade Ahead: Implications for Monetary Policy." Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming. https://www.federalreserve.gov/newsevents/speech/powell20200827a.htm.

Trigari, Antonella. 2009. "Equilibrium Unemployment, Job Flows, and Inflation Dynamics." *Journal of Money, Credit and Banking* 41 (1): 1–33.

Uribe, Martìn. Forthcoming. "The Neo-Fisher Effect: Econometric Evidence from Empirical and Optimizing Models." *American Economic Journal: Macroeconomics*.

Walsh, Carl E. 2005. "Labor Market Search, Sticky Prices, and Interest Rate Policies." *Review of Economic Dynamics* 8 (4): 829–49.