

# **Inflation at Risk**

**David López-Salido and Francesca Loria**  
*Board of Governors of the Federal Reserve System*

**Inflation: Drivers and Dynamics Conference 2021**  
*October 8<sup>th</sup>, 2021*

These views are solely the responsibility of the authors and should not be interpreted as reflecting the view of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System.

# Inflation Risk – A Material Threat to Price Stability

Since global financial crisis, emergence of **downside risks to inflation outlook** increasing **source of macroeconomic concern**:

*“Monetary policy responded first in the summer of 2012 by acting to defuse the sovereign debt crisis, which had evolved from a **tail risk for inflation** into a material threat to price stability.”*

**Mario Draghi**, *ECB President, Sintra, June 2019.*

# Extending and Understanding the Inflation Outlook

- Yet, **most of the analysis** studied muted response of *conditional mean* of inflation to economic and financial conditions.
- Literature points to **quivering Phillips curve linkages**.
- **Are some macroeconomic factors in “Phillips curve umbrella” still at work in the *tails* of the inflation distribution?**

## “Inflation Distribution”

=

### Predictive Distribution of Inflation over the Next Year

- *What is the probability that inflation will be above or below 2% over the next year?*

# What We Do and What We Find

- **“Augmented” quantile Phillips curve - with financial conditions.**
- **Financial conditions carry substantial and persistent downside risks to inflation.**
- Findings consistent with evidence from **nonlinear DSGE model, survey data, inflation options and regime-switching model.**
- Offer a new empirical perspective to existing macroeconomic models and to policymakers.

# Inflation and Financial Conditions

## Where the Macro-Financial Literature Stands

- In models with **financial frictions** as:
  - Christiano, Eichenbaum and Trabandt (2015)
  - Del Negro, Giannoni and Schorfheide (2015)
  - Christiano, Eichenbaum and Trabandt (2015)

**Financial conditions may help to explain inflation dynamics.**

- However, focus on explaining response of conditional mean.
- **Implications for tails of inflation distribution fairly unexplored, with notable exceptions:**  
Andrade, Ghysels and Idier (2012), Kilian and Manganelli (2007, 2008), Cecchetti (2008), Manzan and Zerom (2013), Korobilis (2017), Galvão and Owyang (2018), Korobilis, Landau, Musso and Phella (2021), Banerjee, Contreras, Mehrotra and Zampolli (2020)

# Characterizing Inflation-at-Risk

# Quantile Regression

- **Linear model for the conditional inflation quantiles:**

$$\widehat{Q}_\tau(\bar{\pi}_{t,t+4}|x_t) = x_t \hat{\beta}_\tau,$$

- A determinant  $x_t$  may exert **non-linear effects** on inflation dynamics if it affects differently the median and the tails.
- Inflation quantiles  $\widehat{Q}_\tau(\bar{\pi}_{t,t+4}|x_t)$  can be constructed for each point in time  $t$ .
- We fit a flexible skewed- $t$  distribution by Azzalini and Capitanio (2003) on the estimated quantiles.



# Augmented Phillips–Curve Quantile Model

- **Quantiles conditional on economic and financial conditions:**

$$\widehat{Q}_\tau(\bar{\pi}_{t,t+4}|x_t) = (1 - \hat{\lambda}_\tau)\pi_{t-1}^* + \hat{\lambda}_\tau\pi_t^{LIE} + \hat{\theta}_\tau(u_t - u_t^*) + \hat{\gamma}_\tau(\pi_t^R - \pi_t) + \hat{\delta}_\tau F_t$$

where

$\bar{\pi}_{t,t+4}$ : average core CPI inflation between quarter  $t$  and  $t + 4$

$\pi_{t-1}^*$ : **average inflation over the previous four quarters**

$\pi_t^{LIE}$ : **long-term inflation expectations**

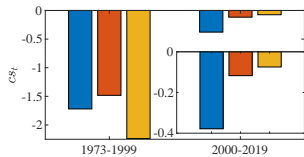
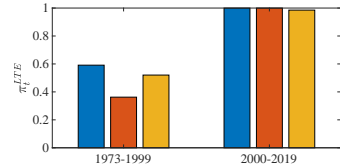
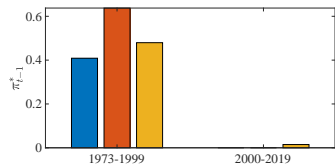
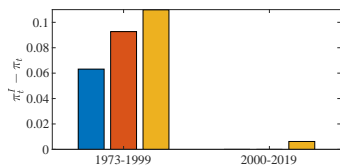
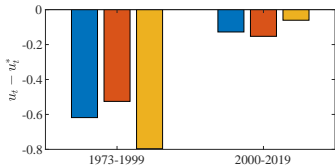
$(u_t - u_t^*)$ : **unemployment gap**

$(\pi_t^R - \pi_t)$ : **relative prices** (import/oil)

$F_t$ : **financial conditions** (credit spread)

# The Time Varying Dynamics of Inflation-at-Risk

# Quantile Regression Slopes Across Subsamples



■  $\tau = 0.1$ 
■  $\tau = 0.5$ 
■  $\tau = 0.9$

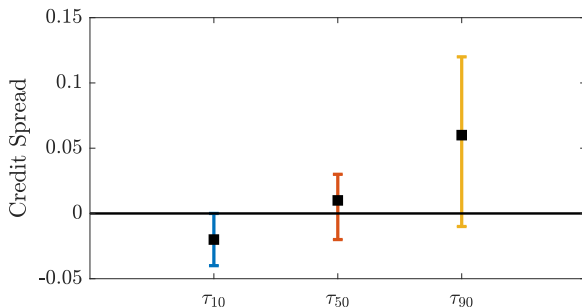
# Rationalizing our Results I

## A Macroeconomic Model with Financial Panics

- **Nonlinear DSGE model** of Gertler, Kiyotaki and Prestipino (2019).
  - Possibility of a severe financial crisis through a **bank run**.
  - There are **two equilibria**: One with and one without a financial panic.
  - **Asymmetry** in response of macro variables across two equilibria.
- We **simulate** the model and store the inflation rate, the credit spread, and the capital quality shock.
- **Estimate a QR using simulated data** of current inflation conditional on the credit spread and look at quantile slopes.

# Rationalizing our Results II

## A Macroeconomic Model with Financial Panics



Black squares are medians across simulations.

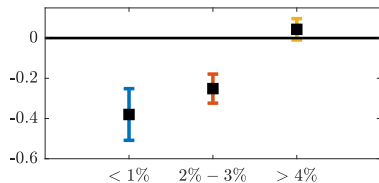
Shaded areas are 68% confidence bands.

**Quantile Slopes from Gertler, Kiyotaki and Prestipino (2019).**

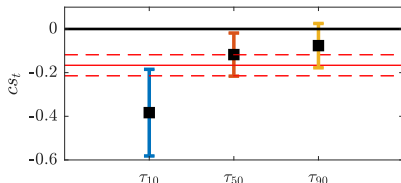
# Evidence from Financial Markets

## Coefficients on Credit Spread

### Financial Markets



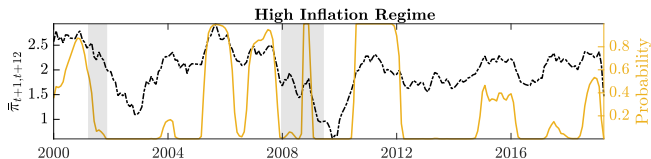
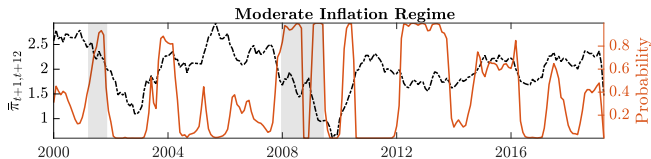
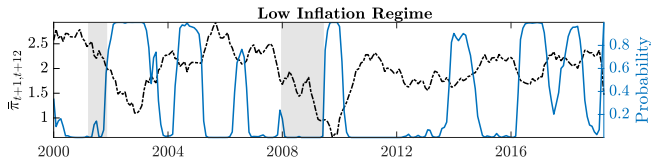
### Quantile Regression



NOTE: The left panel reports the slopes of separate regressions of inflation probabilities on the credit spread (at monthly frequency), along with their 95% confidence interval. The coefficient for the probability of future inflation being below 1% is rescaled to match the slope estimated on the lowest inflation quantile which arises from the quantile Phillips curve model (right panel). The coefficients are transformed from positive to negative for the probability of inflation being below 1% – as a positive correlation between the credit spread and this probability is equivalent to a negative relationship between the credit spread and the lowest inflation quantile.

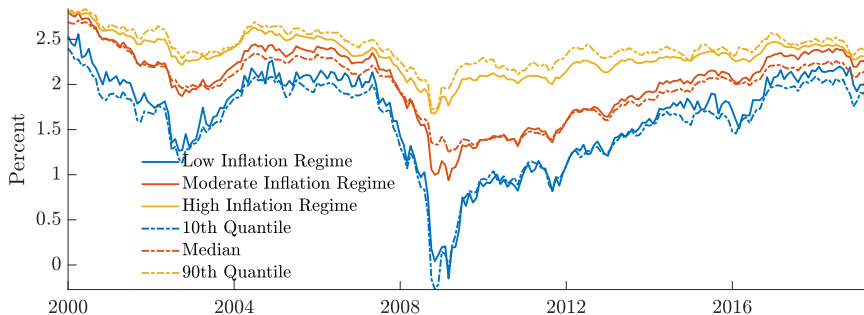
# Evidence from Regime-Switching Regressions

## Regime Probabilities



# Evidence from Regime-Switching Regressions

## Fitted Values - Comparison with Quantile Regression



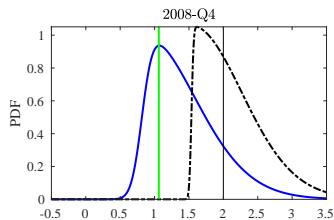
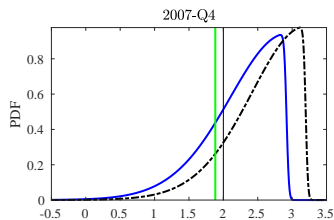


# Inflation-at-Risk During the Great Recession

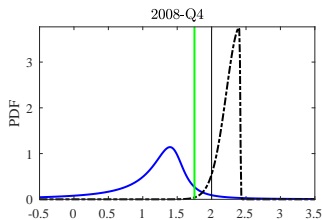
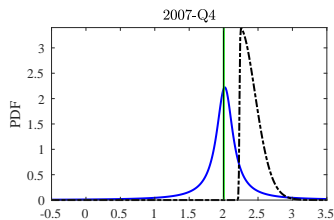
United States vs. Euro Area

# Euro Area vs. United States

## Euro Area Core HICP



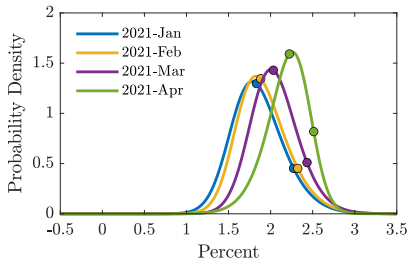
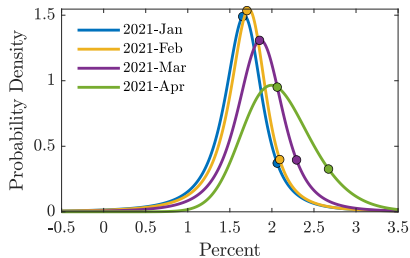
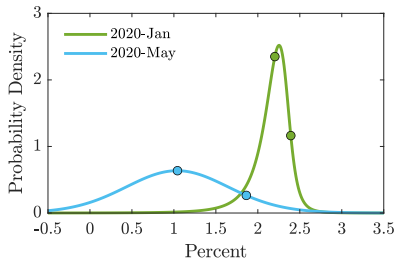
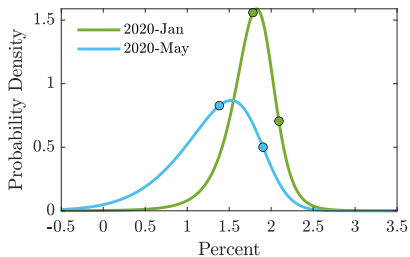
## United States Core CPI



—  $(u_t - u_t^*), \pi_{t-1}^*, (\pi_t^I - \pi_t), \pi_t^{LTE}, cs_t$     - - -  $(u_t - u_t^*), \pi_{t-1}^*, (\pi_t^I - \pi_t), \pi_t^{LTE}, cs_t = 0$     — Realized

# Inflation-at-Risk During Covid-19 (U.S.)

# Tracking Inflation Risks During Covid-19



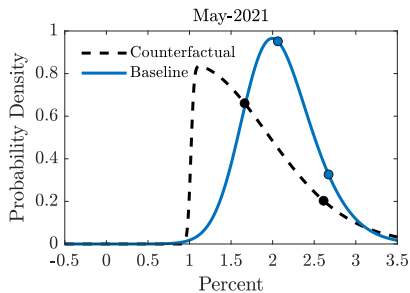
**Core PCE**

**Core CPI**

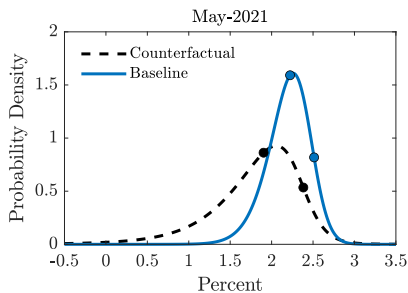
# Tracking Inflation Risks During Covid-19

## The Role of Credit Spreads

### Predictive Densities of One-Year-Ahead Inflation in May 2021



**Core PCE**



**Core CPI**

# Taking Stock

- Need to look beyond the *conditional mean* to **fully understand inflation dynamics.**
- **Ample variability in the tail risks to inflation**, even when focusing on the post-2000 period of stable and low mean inflation.
- **Financial conditions carry substantial and persistent downside risks to inflation.**
- **Offer new empirical perspective to macroeconomic models:**  
Credit conditions key to understand tail-risk inflation dynamics.

Thank You For Your Time!

# References

- ANDRADE, P., GHYSELS, E. and IDIER, J. (2012). *Tails of Inflation Forecasts and Tales of Monetary Policy*. Working papers, Banque de France.
- BANERJEE, R. N., CONTRERAS, J., MEHROTRA, A. and ZAMPOLLI, F. (2020). *Inflation at Risk in Advanced and Emerging Economies*. BIS Working Papers 883, Bank for International Settlements.
- CECCHETTI, S. G. (2008). Measuring the Macroeconomic Risks Posed by Asset Price Booms. *Asset Prices and Monetary Policy*, pp. 9–43.
- CHRISTIANO, L. J., EICHENBAUM, M. S. and TRABANDT, M. (2015). Understanding the Great Recession. *American Economic Journal: Macroeconomics*, 7 (1).
- DEL NEGRO, M., GIANNONI, M. P. and SCHORFHEIDE, F. (2015). Inflation in the Great Recession and New Keynesian Models. *American Economic Journal: Macroeconomics*, 7 (1), 168–96.
- GALVÃO, A. B. and OWYANG, M. T. (2018). Financial stress regimes and the macroeconomy. *Journal of Money, Credit and Banking*, 50 (7), 1479–1505.
- GERTLER, M., KIYOTAKI, N. and PRESTIPINO, A. (2019). A Macroeconomic Model with Financial Panics. *The Review of Economic Studies*, 87 (1), 240–288.
- KILIAN, L. and MANGANELLI, S. (2007). Quantifying the Risk of Deflation. *Journal of Money, Credit and Banking*, 39 (2-3), 561–590.
- and — (2008). The Central Banker as a Risk Manager: Estimating the Federal Reserve’s Preferences under Greenspan. *Journal of Money, Credit and Banking*, 40 (6), 1103–1129.
- KOROBILIS, D. (2017). Quantile Regression Forecasts of Inflation Under Model Uncertainty. *International Journal of Forecasting*, 33 (1), 11 – 20.
- , LANDAU, B., MUSSO, A. and PHELLA, A. (2021). The Time-Varying Evolution of Inflation Risks. *mimeo*.
- MANZAN, S. and ZEROM, D. (2013). Are Macroeconomic Variables Useful for Forecasting the Distribution of U.S. Inflation? *International Journal of Forecasting*, 29 (3), 469 – 478.