GOOD INFLATION, BAD INFLATION: IMPLICATIONS FOR RISKY ASSET PRICES

Diego Bonelli [1] Berardino Palazzo [2] Ram Yamarthy [2]

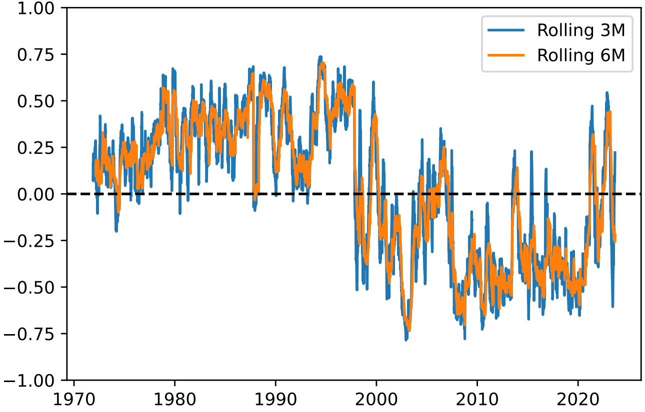
[1] Norwegian School of Economics

[2] Federal Reserve Board of Governors

MOTIVATION

- Global inflation rise post-COVID-19 sparked again research interest in inflation.
- Growing literature on **unconditional** pricing of inflation:
  - Bhamra, Dorion, Jeanneret, and Weber (2022), Fang, Liu, and Roussanov (2023), Knox and Timmer (2023), Chaudhary and Marrow (2023), Gil de Rubio Cruz et al. (2023).
- And on **conditional** pricing:
  - Boons, Duarte, de Roon, and Szymanowska (2020), Cieslak and Pflueger (2023), Elenev, Law, Song, and Yaron (2023), Kroner (2023), Gil de Rubio Cruz et al. (2023).
- We explore the **time-variation** of inflation beta in risky asset prices, induced by the inflation-growth relationship:
  - Use both firm-level, credit and equity prices to identify variation over time and across firms

INFLATION-GROWTH RELATIONSHIP OVER TIME



IN THIS PAPER

- Propose a long run risk model linking the inflation growth correlation to risky asset prices.
  - One-to-one mapping of inflation-growth shock covariance to stock-bond correlation.
  - Asset pricing implications for equity and credit, across different regimes of inflation
- Empirical strategy focuses on transmission of macro announcement news into inflation expectations.
  - Measure inflation expectations shocks using daily and intraday movements of inflation swaps
  - Interact swap changes with lagged stock-bond correlation
- **Unconditionally**: inflation expectation shocks reduce credit spreads and increase equity prices.
- **Main Findings**: time-varying sensitivity of financial markets to inflation expectations shocks.
  - In 'good' inflation regimes: shocks to expected inflation $\uparrow$ equity prices $\downarrow$ credit spreads
  - In 'bad' inflation regimes: shocks to expected inflation $\downarrow$ equity prices $\uparrow$ credit spreads
  - The time-varying sensitivity is larger for riskier firms.
  - Credit spreads movements largely due to risk-premia movements.

CONTRIBUTION

- **High frequency asset pricing literature**: Gürkaynak, Sack, and Swanson (2005), Bernanke and Kuttner (2005), Gürkaynak, Kisacikoğlu, and Wright (2020), Swanson (2021).
  - Δ Heteroskedasticity method applied to inflation swaps.
- **Inflation effects in equity and credit markets**: Bansal and Shaliastovich (2013), Kang and Pflueger (2015), Gomes, Jermann, and Schmid (2016), Bhamra, Dorion, Jeanneret, and Weber (2022), Fang, Liu, and Roussanov (2023), Bonelli (2023), Knox and Timmer (2023), Chaudhary and Marrow (2023), Gil de Rubio Cruz et al. (2023).
  - Δ Show risk-premia and heterogeneity channels in risky assets.
- **Conditional pricing of inflation**: Boons, Duarte, de Roon, and Szymanowska (2020), Cieslak and Pflueger (2023), Elenev, Law, Song, and Yaron (2023), Kroner (2023), Gil de Rubio Cruz et al. (2023).
  - Δ High-frequency time-variation of inflation beta in equity *and* credit markets.

Economic Model

LONG-RUN RISK MODEL SETUP

- The representative agent has Epstein and Zin (1989) recursive preferences:

$$V_t = \left[(1-\delta)C_t^{\frac{1-\gamma}{\theta}} + \delta\left(\mathbb{E}_t\left(V_{t+1}^{1-\gamma}\right)\right)^{\frac{1}{\theta}}\right]^{\frac{\theta}{1-\gamma}}$$

- δ the time discount factor, γ risk aversion, ψ intertemporal elasticity of substitution, and $\theta \equiv \frac{1-\gamma}{1-\frac{1}{\psi}}$ preference for the early resolution of uncertainty.
- The investor's (log) pricing kernel takes the form:

$$m_{t+1} = \theta \log \delta - \frac{\theta}{\psi}\Delta c_{t+1} - (1-\theta) r_{c,t+1},$$

$$r_{c,t+1} = \kappa_0 + \kappa_1 pc_{t+1} - pc_t + \Delta c_{t+1},$$

- Δc log-growth rate of consumption, pc log price-to-consumption ratio, and r_c the return on an asset that pays off the aggregate consumption tree as a dividend.

LONG-RUN RISK MODEL SETUP

- Long-run risks endowment economy (e.g., Bansal and Yaron (2004), Bansal and Shaliastovich (2013)).
- Consumption and inflation follow:

$$\Delta c_{t+1} = \mu_c + x_{ct} + \sigma_c \varepsilon_{c,t+1},$$

$$\pi_{t+1} = \mu_\pi + x_{\pi t} + \sigma_\pi \varepsilon_{\pi,t+1},$$

- x_{ct} (expected growth) and $x_{\pi t}$ (expected inflation) are persistent processes:

$$X_t \equiv \begin{pmatrix} x_{ct} \\ x_{\pi t} \end{pmatrix} = \Pi X_{t-1} + \Sigma_{t-1}\eta_t, \quad \Sigma_t = \begin{pmatrix} \sigma_{xc} & 0 & \sigma_{xc\pi}(s_t) \\ 0 & & \sigma_{x\pi} \end{pmatrix},$$

- Π transition matrix for X_t and η_t normal shocks.
- **Key difference**: Markov-switching covariance $\sigma_{xc\pi}(s_t)$
- Price-consumption ratio, expected equity return, risk-free rate are function of X_t and the state s_t

CDS PRICING

- CDS of maturity K periods is a rate C_t that satisfies:

$$\underbrace{\Delta C_t \sum_{k=1}^{K/\Delta} \mathbb{E}_t \left[\tilde{M}^{\$}_{t+k\Delta} \left(1 - D_{t,(k-1)\Delta}\right) \right]}_{\text{protection holder}} = \underbrace{\sum_{k=1}^{K/\Delta} \mathbb{E}_t \left[\tilde{M}^{\$}_{t+k\Delta} \times (1-R) \times D_{t+(k-1)\Delta,\Delta} \right]}_{\text{protection seller}}$$

  - Δ is the length of time between payments
  - $\tilde{M}^{\$}_{t+z}$ is the nominal SDF from t to $t+z$.
  - $D_{t,z}$ is a default indicator between t and $t+z$.

- We assume that default dynamics are exogenous and related to key state variables.
- Realized default at $t+1$ is given by:

$$D_{t,1} = \begin{cases} 0 & \text{w/probability } \exp(-\lambda_t), \\ 1 & 1 - \exp(-\lambda_t), \end{cases} \qquad \text{where } \lambda_t = \beta_{\lambda 0}(s_t) + \beta'_{\lambda x} X_t.$$

CDS PRICING

- Assuming a quarterly frequency and that payments are made each quarter ($\Delta = 1$), we can write the 5-year model-implied CDS as:

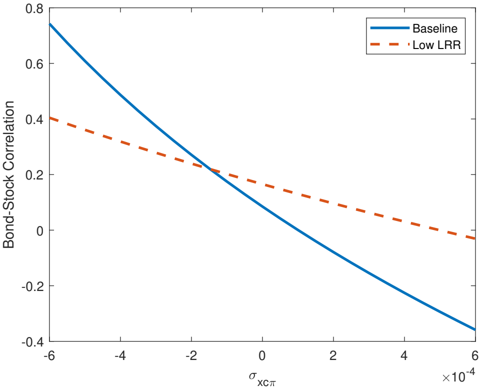
$$C_t = \frac{\sum_{k=1}^{20} \mathbb{E}_t \left[\tilde{M}^{\$}_{t+k} \times (1-R) \times D_{t+k-1,1} \right]}{\sum_{k=1}^{20} \mathbb{E}_t \left[\tilde{M}^{\$}_{t+k} \left(1 - D_{t,k-1}\right) \right]} = (1-R) \times \left(1 - \frac{\sum_{k=1}^{20} \exp\left(B_1^{k\prime} X_t + B_2^k(s_t) \right)}{\sum_{k=1}^{20} \exp\left(C_1^{k\prime} X_t + C_2^k(s_t) \right)} \right)$$

- The coefficients $\left\{ B_1^k, B_2^k(s_t), C_1^k, C_2^k(s_t) \right\}$ depend on the fundamental parameters of the model and are solved using a recursive numerical algorithm.

STOCK-BOND CORRELATION

- We solve the model for the nominal returns on the consumption claim, $r_{c,t+1} + \pi_{t+1}$, and on a long-term risk-free bond, $r^{5Y,\$}_{f,t+1}$, to compute the bond-stock return correlation.

Bond-stock correlation as a function of $\sigma_{xc\pi}$



- The covariance parameter $\sigma_{xc\pi}(s_t)$
  - Governs expected inflation and growth shocks.
  - Directly links to stock-bond correlation: $\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$.
- In the model, N=2 asymmetric Markov states:
  - "good" inflation regime: $\sigma_{xc\pi}(s_1) > 0$
  - "bad" inflation regime: $\sigma_{xc\pi}(s_2) < 0$

MODEL RESULTS

	Value	Notes
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$	-0.148	Bond-stock correlation
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$ – Regime 1	-0.451	–
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$ – Regime 2	0.284	–
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$	0.231	Excess return regression coefficient
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$ – Regime 1	0.933	
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$ – Regime 2	-0.475	
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ (b.p.)	-1.603	Spread change regression coefficient
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ – Regime 1	-6.265	
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ – Regime 2	3.073	

Last 6 rows report coefficients of simulated regressions: $r_{ct} - r_{ft} = \beta_0 + \beta_1 \Delta x_{\pi t} + \varepsilon_t$ or $\Delta s^{5Y}_t = \beta_0 + \beta_1 \Delta x_{\pi t} + \varepsilon_t$

Moments Parameters

COMPARATIVE STATICS

Model performance under different parameter configurations.

	$\sigma_{xc\pi} = 0$	Symmetric $\sigma_{xc\pi}$	$\Pi_{cc} = 0.85$	Baseline
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$	0.085	0.073	0.162	-0.148
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$ – Good Regime	0.084	-0.289	-0.007	-0.451
$\rho(r^{\$}_{ct}, r^{5Y,\$}_{ft})$ – Bad Regime	0.086	0.501	0.349	0.284
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$	-0.009	-0.006	-0.007	0.231
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$ – Good Regime	-0.015	0.692	0.227	0.933
$\beta(r_{ct} - r_{ft} \sim \Delta x_{\pi t})$ – Bad Regime	-0.003	-0.705	-0.241	-0.475
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ (b.p.)	-0.005	-0.017	0.011	-1.603
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ – Good Regime	0.042	-4.673	-2.417	-6.265
$\beta(\Delta s^{5Y}_t \sim \Delta x_{\pi t})$ – Bad Regime	-0.052	4.641	2.439	3.073

KEY TAKEAWAYS FROM THE MODEL

- **Stock–bond correlation is a one-to-one function of inflation–growth correlation.**
  - Good empirical proxy for inflation growth correlation
- **Theoretically show time-varying inflation sensitivities in equity and credit markets.**
  - Empirically testable implications

Empirical Results

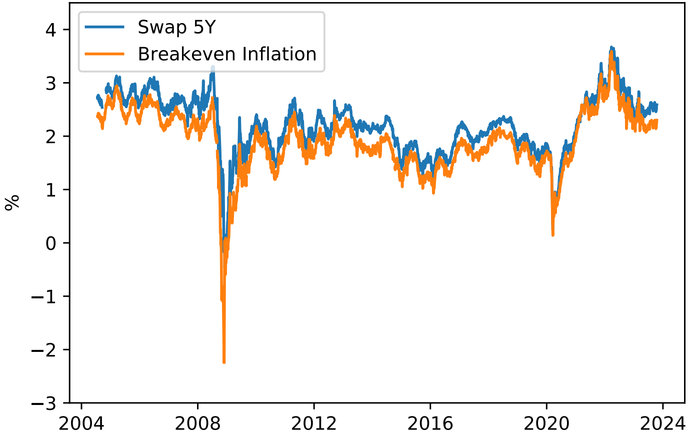
KEY DATA

- **Corporate CDS and Equity Returns:**
  - Firm-level CDS quotes from Markit at the 5-year maturity
  - Daily equity returns are from CRSP
- **Stock-Bond Correlation**
  - Rolling 3-month (3M) and 6-month (6M) correlations of daily stock returns and bond returns
    - Value-weighted stock returns are taken from Ken French's database
    - Daily US Treasury bond returns are computed using zero-coupon 5-year yields.
- **Zero coupon Inflation Swaps**
  - Daily swap spreads from Bloomberg, 5-year horizon to match the maturity of CDSs.
  - Minute-by-minute data from Refinitiv Tick History available from October 2007 (1-10 year maturity).

Table

TIME SERIES: INFLATION SWAP VS BREAKEVEN RATES

Diercks, Campbell, Sharpe, and Soques (2023): inflation swaps provide better forecasts of realized inflation than survey-based measures.



EMPIRICAL STRATEGY: DAILY FREQUENCY ANALYSIS

- Focus on days when there are macroeconomic announcement related to:
  - Key price movements (CPI, core CPI, PPI, core PPI).
  - Economic activity (nonfarm payroll, initial GDP release).

- **Idea**: Greater sensitivity to information about the future path of inflation on these days.
  - The variance of swap movements on announcement days is from 2 to 3.5 times larger. ▸ Plot

- Our baseline specification is:

$$\Delta s_{it} = \beta_i + \beta_\pi \Delta\pi_{\text{swap}} + \beta_s s_{i,t-1} + \epsilon_{it}$$

- The dependent variable, $\Delta s_{it} \equiv s_{it} - s_{i,t-1}$, indicates the 1, or 5-day change in CDS spreads or equity returns.
- $\Delta\pi^{\text{swap}}$ is the 1-day change in inflation swaps during announcement days (normalized to have sd of 1)
- We control for firm fixed effects (β_i) and lagged CDS spreads ($s_{i,t-1}$).

UNCONDITIONAL PRICING OF INFLATION RISK

- 1 sd movement in $\Delta\pi^{swap,5Y}$ implies a 0.90 basis point reduction in CDS
- Five days out, the response more than doubles up to 2.15 basis points.
- 1 sd movement in $\Delta\pi^{swap,5Y}$ implies a 0.38% increase in equity prices

	(1)	(2)	(3)	(4)
$\Delta\pi^{swap,5Y}$	-0.90***	-2.15***	0.38***	0.42**
	(-5.19)	(-3.85)	(3.91)	(2.31)
$s_{i,-1}$	0.18***	0.61**	-0.00	0.02
	(3.12)	(2.49)	(-0.10)	(0.50)
$(R_i - R_f)_{-1}$			0.00	0.00
			(0.22)	(0.09)
Dependent Variable	Δs_i (b.p.)		$R_i - R_f$ (%)	
Change Horizon	1D	5D	1D	5D
Firm FE	Y	Y	Y	Y
Clustering	Firm-Time		Firm-Time	
Obs	418,777	417,179	207,717	207,570
$Adj.R^2$	0.019	0.024	0.028	0.009

TIME VARIATION IN INFLATION BETA

- We relate the time-variation in asset price responses to inflation shocks to the inflation-growth relationship.
- We translate the model regression into empirically testable regression:

$$
\begin{aligned}
\Delta s_t &= \beta_0 + \beta_1 \left(\sigma_{xc\pi,t-1}\right) \Delta x_\pi \\
&\approx \beta_0 + \beta_1 \left(\tilde{\rho}_{t-1}\right) \Delta x_\pi \,,
\end{aligned}
$$

- We augment the baseline specification and include an interaction term:

$$
\Delta s_{it} = \beta_i + \beta_\pi \Delta\pi_t^{swap} + \beta_\rho \tilde{\rho}_{t-1} + \beta_{\rho\pi} \left(\tilde{\rho}_{t-1} \times \Delta\pi_t^{swap}\right) + \beta_X' X_{i,t-1} + \varepsilon_{it}
$$

- Proxy for inflation-growth relationship ($\tilde{\rho}_{t-1}$): stock and Treasury bond return correlation at 3-6m horizon.

▸ Plot

PRICING OF INFLATION RISK AND THE INFLATION-GROWTH CORRELATION

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\pi^{swap,5Y}$	-0.90***	-0.81***	-0.79***	0.38***	0.35***	0.35***
	(-5.19)	(-5.27)	(-5.27)	(3.91)	(3.82)	(3.92)
$\tilde{\rho}_{-1}^{bond-mkt,3M}$		-0.03			0.05	
		(-0.38)			(1.00)	
$\tilde{\rho}_{-1}^{bond-mkt,6M}$			-0.12			0.07
			(-1.57)			(1.59)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{swap,5Y}$		0.61***			-0.22***	
		(5.05)			(-2.58)	
$\tilde{\rho}_{-1}^{bond-mkt,6M} \times \Delta\pi^{swap,5Y}$			0.52***			-0.16**
			(4.48)			(-2.02)
$s_{i,-1}$	0.18***	0.18***	0.18***	-0.00	-0.00	0.00
	(3.12)	(3.21)	(3.14)	(-0.10)	(-0.01)	(0.12)
$\left(R^i - R^f\right)_{-1}$				0.00	0.00	0.00
				(0.22)	(0.17)	(0.15)
Dependent Variable		Δs_i (b.p.)			$R^i - R^f$ (%)	
Correlation Horizon	–	3M	6M	–	3M	6M
Firm FE	Y	Y	Y	Y	Y	Y
Clustering		Firm-Time			Firm-Time	
Obs	418,777	410,129	410,129	207,717	205,837	205,837
$Adj.R^2$	0.019	0.024	0.023	0.028	0.036	0.034

- When inflation is more positive for growth ($\downarrow \tilde{\rho}$), credit spreads (equity returns) reduce (increase) at greater rate following inflation shock

RISK PREMIA EFFECTS AND THE INFLATION-GROWTH CORRELATION

- We decompose CDS rates into expected losses and risk premia ($s_{it} = ExpLoss_{it} + RiskPrem_{it}$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta\pi^{swap,5Y}$	-0.89***	-0.27***	-0.58***	-0.82***	-0.25***	-0.53***	-0.79***	-0.25***	-0.51***
	(-5.16)	(-3.15)	(-3.89)	(-5.28)	(-3.07)	(-3.97)	(-5.24)	(-3.14)	(-3.93)
$\tilde{\rho}_{-1}^{bond-mkt,3M}$				-0.06	-0.02	-0.04			
				(-0.85)	(-0.67)	(-0.63)			
$\tilde{\rho}_{-1}^{bond-mkt,6M}$							-0.15**	-0.03	-0.12*
							(-1.97)	(-0.98)	(-1.90)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{swap,5Y}$				0.63***	0.16**	0.44***			
				(5.15)	(2.48)	(4.16)			
$\tilde{\rho}_{-1}^{bond-mkt,6M} \times \Delta\pi^{swap,5Y}$							0.54***	0.13**	0.38***
							(4.56)	(2.01)	(3.85)
$s_{i,-1}$	0.10	0.05	0.00	0.11	0.05	0.01	0.10	0.05	-0.00
	(1.13)	(1.37)	(0.02)	(1.21)	(1.35)	(0.08)	(1.12)	(1.33)	(-0.01)
$ExpLoss_{i,-1}$	0.32***	-0.18***	0.54***	0.31***	-0.18***	0.53***	0.32***	-0.18***	0.54***
	(3.38)	(-3.22)	(5.18)	(3.26)	(-3.22)	(5.13)	(3.36)	(-3.19)	(5.25)
Dep. Var.	Δs_i (b.p.)	$\Delta ExpLoss_i$	$\Delta RiskPrem_i$	Δs_i (b.p.)	$\Delta ExpLoss_i$	$\Delta RiskPrem_i$	Δs_i (b.p.)	$\Delta ExpLoss_i$	$\Delta RiskPrem_i$
Corr. Horizon		–			3M			6M	
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Clustering		Firm-Time			Firm-Time			Firm-Time	
Obs	204,172	204,150	204,148	200,303	200,281	200,279	200,303	200,281	200,279
$Adj.R^2$	0.020	0.008	0.011	0.026	0.010	0.013	0.025	0.009	0.013

- Close to two-thirds of the overall sensitivity is attributable to changes in risk premia.

TIME VARYING INFLATION BETA ACROSS RISK GROUPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\pi^{swap,5Y}$	-0.81***	-0.18***	-0.62***	-1.99***	0.35***	0.26***	0.34***	0.42***
	(-5.27)	(-5.18)	(-5.35)	(-4.86)	(3.82)	(3.47)	(3.70)	(3.60)
$\tilde{\rho}_{-1}^{bond-mkt,3M}$	-0.03	-0.01	0.00	0.03	0.05	0.04	0.04	0.03
	(-0.38)	(-0.65)	(0.01)	(0.13)	(1.00)	(1.07)	(0.87)	(0.55)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{swap,5Y}$	0.61***	0.13***	0.44***	1.45***	-0.22***	-0.18**	-0.21**	-0.29***
	(5.05)	(5.11)	(4.64)	(4.66)	(-2.58)	(-2.47)	(-2.55)	(-2.79)
$s_{i,-1}$	0.18***	0.17	0.48	0.22***	-0.00	0.17	0.07	-0.00
	(3.21)	(0.61)	(1.27)	(3.59)	(-0.01)	(0.52)	(0.31)	(-0.10)
$\left(R_i - R_f\right)_{-1}$					0.00	-0.02	-0.02	0.03
					(0.17)	(-0.73)	(-0.74)	(1.44)
Dependent Variable	Δs_i (b.p.)				$R_i - R_f$ (%)			
Which Risk Group	–	1	3	5	–	1	3	5
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	410,129	82,300	82,007	81,701	205,837	41,453	41,166	40,862
$Adj.R^2$	0.024	0.048	0.048	0.032	0.036	0.044	0.043	0.029

- Baseline results: CDS decline by 0.81 basis points following an increase in inflation expectations.
- For a risky firm (G5): when $\tilde{\rho} = -2$ the overall response is more than 6 times as large.

EMPIRICAL STRATEGY: INTRADAY FREQUENCY ANALYSIS

- Focus on inflation swap movements in 60 minute window surrounding macro announcements.
- In a tight window, inflation swaps movements can interpreted as exogenous shocks to expected inflation.
- We use the same 6 macro announcements as before, all released at 8.30AM.
  - Inflation swap movements measured in the 8:15AM to 9:15AM window from October 2007.
- Our new specification:

$$\Delta s_{it} = \beta_i + \beta_\pi \Delta\pi_t^{idswap} + \beta_\rho \tilde{\rho}_{t-1} + \beta_{\rho\pi} \left(\tilde{\rho}_{t-1} \times \Delta\pi_t^{idswap}\right) + \beta_X' X_{i,t-1} + \varepsilon_{it}, \tag{1}$$

- $\Delta\pi_t^{idswap}$ is the 60-minute change in inflation swaps during announcements (normalized to have sd of 1)

▸ Announcements ▸ Validation

INTRADAY SWAPS AND RISKY ASSET PRICES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\pi^{swap,5Y}$	-1.00***		-0.85***		0.42***		0.37***	
	(-5.41)		(-5.12)		(3.91)		(3.78)	
$\Delta\pi^{idswap,5Y}$		-0.22		-0.28*		0.14		0.19*
		(-1.55)		(-1.79)		(1.45)		(1.65)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{swap,5Y}$			0.59***				-0.21**	
			(4.34)				(-2.14)	
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{idswap,5Y}$				0.37***				-0.28***
				(2.77)				(-2.95)
$\tilde{\rho}_{-1}^{bond-mkt,3M}$			-0.02	-0.04			0.05	0.06
			(-0.28)	(-0.39)			(0.92)	(0.98)
$s_{i,-1}$	0.17***	0.17**	0.17***	0.18***	0.00	0.00	0.00	-0.00
	(2.67)	(2.58)	(2.75)	(2.67)	(0.22)	(0.13)	(0.21)	(-0.05)
$(R^i - R^f)_{-1}$					0.00	0.02	0.00	0.02
					(0.16)	(0.64)	(0.18)	(0.71)
Dependent Variable	Δs_i (b.p.)		Δs_i		$R^i - R^f$ (%)		$R^i - R^f$	
Firm FE	Y		Y		Y		Y	
Clustering	Firm-Time		Firm-Time		Firm-Time		Firm-Time	
Obs	358,035	358,035	350,067	350,067	172,046	172,046	170,166	170,166
$Adj.R^2$	0.024	0.011	0.028	0.012	0.035	0.004	0.042	0.019

GÜRKAYNAK, KISACIKOĞLU, AND WRIGHT (2020) DECOMPOSITION

- **Problem**: High-frequency event studies struggle to fully explain the movements in asset prices:
  - Regression of intraday swaps onto macro surprises: R^2 of 12%.
  - Focus on headline surprises overlooking non-headline information contained in announcements.
- **Solution**: Heteroskedasticity method from Gürkaynak, Kisacikoğlu, and Wright (2020).
- We use the cross-section of intraday inflation swaps over the same time window on announcement and non-announcement days, to estimate the following model:

$$y_t^i = \beta_i' s_t + \gamma_i d_t f_t + \eta_t^i \tag{2}$$

- y_t^i is the vector of 60-minute window changes in inflation swaps across maturities i.
  - $i \in (1, 2, 3, 5, 7, \text{ and } 10 \text{ years})$
- s_t is the vector of surprises, d_t is an announcement day dummy.
- f_t is an I.I.D. $\mathcal{N}(0, 1)$ latent variable that captures the unobserved surprise component.

▶ Estimation

SOURCES OF INTRADAY EFFECTS

- We break down intraday changes in inflation swaps into headline (surprises) and non-headline (latent factor) components for a maturity i:

$$\begin{aligned} \Delta\pi_t^{idswap,i} &= \beta_i' s_t + \gamma_i d_t f_t + \eta_t^i, \\ &= \Delta\pi_t^{surp,i} + \Delta\pi_t^{latent,i} + \eta_t^i, \end{aligned}$$

- Focusing on the 5-year maturity, we modify our previous regression:

$$\Delta s_{it} = \beta_i + \beta_{\pi_s}\Delta\pi_t^{surp} + \beta_{\pi_l}\Delta\pi_t^{latent} + \beta_\rho\tilde{\rho}_{t-1} + \\ \beta_{\rho\pi_s}\left(\tilde{\rho}_{t-1} \times \Delta\pi_t^{surp}\right) + \beta_{\rho\pi_l}\left(\tilde{\rho}_{t-1} \times \Delta\pi_t^{latent}\right) + \beta_X' X_{i,t-1} + \varepsilon_{it}.$$

INTRADAY SWAP DECOMPOSITION AND RISKY ASSET PRICES

	(1)	(2)	(3)	(4)
$\Delta\pi^{surp,5Y}$	-0.12	-0.20	-0.03	0.03
	(-0.89)	(-1.31)	(-0.36)	(0.38)
$\Delta\pi^{latent,5Y}$	-0.34***	-0.39***	0.16*	0.18*
	(-2.64)	(-2.76)	(1.76)	(1.80)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{surp,5Y}$		0.23***		-0.18***
		(2.64)		(-3.59)
$\tilde{\rho}_{-1}^{bond-mkt,3M} \times \Delta\pi^{latent,5Y}$		0.33**		-0.15*
		(2.58)		(-1.93)
$\tilde{\rho}_{-1}^{bond-mkt,3M}$		-0.05		0.08
		(-0.59)		(1.43)
$s_{i,-1}$	0.17***	0.18***	0.00	0.00
	(2.62)	(2.71)	(0.10)	(0.03)
$(R^i - R^f)_{-1}$			0.01	0.01
			(0.59)	(0.55)
Dependent Variable	Δs_i (b.p.)		$R^i - R^f$ (%)	
Firm FE	Y		Y	
Clustering	Firm-Time		Firm-Time	
Obs	358,035	350,067	172,046	170,166
$Adj.R^2$	0.012	0.015	0.005	0.020

CONCLUSION

- **We theoretically and empirically explore the importance of time-variation in inflation beta.**

- **Theory**:
  - Construct a parsimonious long-run risk model with time-varying growth-inflation covariance
  - Draws clear link between real-nominal relationship and endogenous bond-stock correlation
  - Generates regime-specific inflation beta for risky assets through cash flow channel

- **Empirics**:
  - Study transmission of macro announcement news into inflation swaps at the daily and intra-day frequency.
  - Display time-varying sensitivity of financial markets to inflation expectations movements.
  - Highlight cross-sectional dispersion and risk premia effects

MODEL PARAMETERS

	Value	Notes
γ	20	Bansal and Shaliastovich (2013)
ψ	2.5	Help with risk-free rate
δ	0.998	Bansal and Shaliastovich (2013)
μ_C	0.00474	Target consumption growth mean
μ_π	0.009	Bansal and Shaliastovich (2013)
Π_{CC}	0.95	Bansal and Yaron (2004)
$\Pi_{\pi\pi}$	0.988	Bansal and Shaliastovich (2013)
σ_{xc}	0.0000583	Target expected growth vol
$\sigma_{x\pi}$	0.000986	Target expected inflation vol
$\sigma_{xc\pi}(s_1)$	0.0008	"Good Inflation" regime
$\sigma_{xc\pi}(s_2)$	-0.0004	"Bad Inflation" regime
p_{11}	0.9	–
p_{22}	0.9	–
σ_C	0.00359	Target consumption growth vol
σ_π	0.00557	Target inflation vol

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MODEL MOMENTS

	Value	Notes
$E\left[pc_t\right]$	7.607	Log price-consumption ratio
$E\left[r_{ct}\right]$	2.011	Real return on consumption
$E\left[r_{ct}^{\$}\right]$	5.538	Nominal return on consumption
$E\left[r_{ft}^{\$}\right]$	4.629	Nominal risk-free rate
$E\left[r_{ct} - r_{ft}\right]$	0.908	Risk premium
$E\left[r_{ft}^{5Y,\$}\right]$	3.466	Nominal return on 5Y risk-free bond
$E\left[s_t^{5Y}\right]$	1.337	5Y CDS spread
$\sigma\left[\Delta s_t^{5Y}\right]$ (b.p.)	5.371	Volatility of spread changes

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SUMMARY STATS

	Count	Mean	Std. Dev.	Min	Max
	Panel A: Aggregate Measures				
$\pi^{swap,1Y}$	730	1.903	1.168	-4.274	5.856
$\pi^{swap,5Y}$	730	2.222	0.533	-0.515	3.593
$\pi^{swap,10Y}$	734	2.423	0.379	0.992	3.190
$\Delta\pi^{swap,5Y}$	728	0.000	0.049	-0.285	0.191
$\rho\left(R_{bond}, R_{mkt}\right)^{3M}$	819	-0.293	0.280	-0.778	0.544
$\rho\left(R_{bond}, R_{mkt}\right)^{6M}$	819	-0.291	0.248	-0.733	0.433
$\rho\left(\Delta\pi^{swap}, R_{mkt}\right)^{3M}$	701	0.292	0.218	-0.348	0.746
$\rho\left(\Delta\pi^{swap}, R_{mkt}\right)^{6M}$	691	0.297	0.185	-0.167	0.704
	Panel B: Firm-Level Data				
Spread	418911	2.257	3.767	0.101	33.054
Δ*Spread* (b.p.)	418808	0.139	8.359	-52.475	65.279
ExpLoss	204936	0.639	1.529	0.029	14.191
RiskPrem	204757	1.206	1.922	-2.686	16.365
R_i (%)	207853	0.032	2.276	-9.615	9.253
$R_i - R_f$ (%)	207853	0.027	2.276	-9.619	9.250
	Panel C: Intraday Swaps				
$\Delta\pi^{idswap,5Y}$	622	0.116	3.364	-28.000	24.500
$\Delta\pi^{surp,5Y}$	622	0.052	1.208	-5.279	10.559
$\Delta\pi^{latent,5Y}$	622	0.097	2.703	-29.574	22.233

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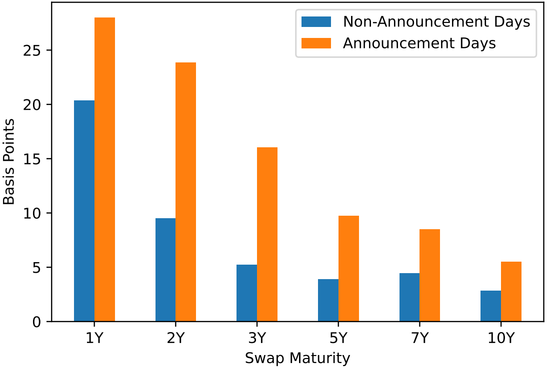
HETEROSKEDASTICTY OF INTRADAY SWAP RESIDUALS



	1Y	2Y	3Y	5Y	7Y	10Y
var(η_t^A)	28.00	23.83	16.02	9.72	8.49	5.49
var(η_t^{NA})	20.37	9.50	5.23	3.90	4.44	2.84
F-test Statistic	1.37***	2.51***	3.06***	2.49***	1.91***	1.93***

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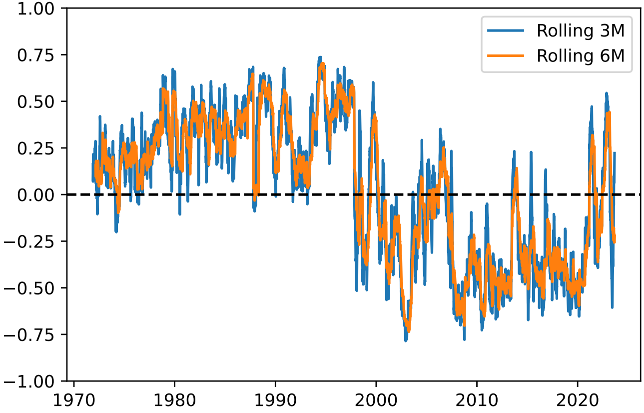
INFLATION-GROWTH RELATIONSHIP OVER TIME



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MACROECONOMIC ANNOUNCEMENTS FOR INTRADAY ANALYSIS

Announcement	Time	Frequency	Observations	Unit	Std. Dev.
Core CPI	8:30	Monthly	184	% MoM	0.12
CPI	8:30	Monthly	184	% MoM	0.13
Nonfarm Payrolls	8:30	Monthly	196	Change	740.817k
GDP	8:30	Quaterly	54	% QoQ ann.	0.72
Core PPI	8:30	Monthly	188	% MoM	0.23
PPI	8:30	Monthly	188	% MoM	0.37

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INTRADAY SWAP PRICES AND MACROECONOMIC SURPRISES

- Regression of 60-minute changes in inflation swaps onto standardized surprise measures.
- Surprises are defined as the difference between a realized value and the Bloomberg median economist

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\varepsilon^{corecpi}$	1.75***						0.91***
	(8.18)						(2.95)
ε^{cpi}		1.89***					1.28***
		(9.13)					(4.17)
$\varepsilon^{nonfarm}$			0.42**				0.45**
			(2.04)				(1.98)
ε^{gdp}				1.18			1.18***
				(1.47)			(2.71)
$\varepsilon^{coreppi}$					0.40**		0.13
					(2.00)		(0.45)
ε^{ppi}						0.54***	0.46
						(2.72)	(1.63)
Dependent Variable	Intraday $\Delta\pi^{swap,5y}$ (b.p.)						
Obs	184	184	196	54	188	188	622
$Adj.R^2$	0.265	0.310	0.016	0.022	0.016	0.033	0.120

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LATENT FACTOR ESTIMATION FROM INTRADAY SWAPS

	(1)	(2)	(3)	(4)	(5)	(6)
$\varepsilon^{corecpi}$	3.35***	2.79***	1.71***	0.90***	1.04***	0.65***
	(4.55)	(4.26)	(5.53)	(2.82)	(5.76)	(4.68)
ε^{cpi}	2.68***	2.41***	1.12***	1.30***	0.69***	0.79***
	(4.04)	(4.73)	(3.22)	(4.07)	(3.27)	(4.84)
$\varepsilon^{nonfarm}$	-0.11	0.01	0.06*	0.45***	0.38***	0.28***
	(-1.29)	(0.23)	(1.66)	(23.57)	(15.17)	(16.01)
ε^{gdp}	-0.19	-0.26	0.86	1.18***	-0.40	0.11
	(-0.23)	(-0.39)	(1.29)	(3.34)	(-1.08)	(0.42)
$\varepsilon^{coreppi}$	0.42	-0.71	0.73***	0.13	0.39***	-0.25
	(1.42)	(-0.98)	(2.78)	(1.19)	(2.61)	(-1.24)
ε^{ppi}	0.47**	0.41	0.48***	0.47***	0.44***	0.74***
	(2.34)	(1.42)	(2.92)	(3.56)	(3.27)	(3.28)
$\Delta\pi^{latent}$	2.56***	2.64***	3.46***	2.70***	2.33***	1.94***
	(4.09)	(6.32)	(21.15)	(29.57)	(17.21)	(16.23)
Dependent Variable			Intraday $\Delta\pi^{swap}$			
Horizon	1Y	2Y	3Y	5Y	7Y	10Y
Observations	622	622	622	622	622	622
R^2 without latent	0.235	0.208	0.119	0.120	0.091	0.096
R^2 with latent	0.410	0.434	0.769	0.771	0.665	0.709

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