# Can Inflation and Monetary Policy Predict Asset Prices?

Carina Fleischer[1]

[1]University of Luxembourg

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# Research Question

- Traditional asset pricing models such as long-run risk build on *latent* risk factors with no *real* meaning unlike inflation, unemployment, etc.
- In this paper we are interested in the asset pricing implications of observable macroeconomic variables, namely *inflation* and the *federal funds rate*.

## Research Questions

1. Have inflation and central bank rates explanatory power for consumption growth?
2. Can they explain the historical variation in key asset pricing moments?
3. How can the strong price reactions in stock and bond markets after interest rate announcements be explained?

- To answer those questions, I develop, calibrate, and solve a reduced-form consumption-based asset pricing model taking the dynamics of inflation and central bank rates into account.

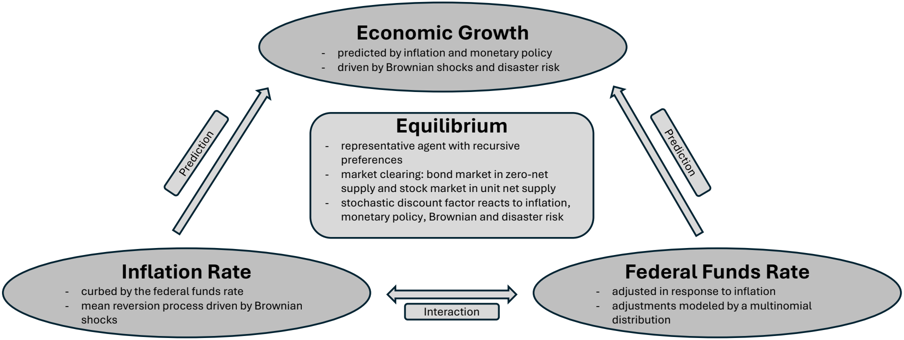
# Empirical Evidence: Impulse Response Functions


- Positive interest rate shocks
  - tend to have a negative short-term impact on real on economic growth but a positive effect on the long run.
  - gradually diminish over time reflecting the FED's tendency to adjust rates back towards a neutral level after addressing temporary shocks.
  - may signal stronger inflationary pressures or more persistent inflation expectations but help curb inflation rates on the long run.

# Empirical Evidence: Impulse Response Functions


- Positive inflation shocks
  - tend to reduce real economic growth in both the short and long run.
  - cause the federal reserve to raise interest rates to curb inflation.
  - temporarily drive inflation rates higher. However, this increase is usually transitory, as inflationary pressures dissipate over time.

# Model Setup


Economic Growth
- predicted by inflation and monetary policy
- driven by Brownian shocks and disaster risk
Prediction
Prediction
Equilibrium
- representative agent with recursive preferences
- market clearing: bond market in zero-net supply and stock market in unit net supply
- stochastic discount factor reacts to inflation, monetary policy, Brownian and disaster risk
Inflation Rate
- curbed by the federal funds rate
- mean reversion process driven by Brownian shocks
Interaction
Federal Funds Rate
- adjusted in response to inflation
- adjustments modeled by a multinomial distribution

# Model Setup: Key Variables

- Consumption dynamics:

$$\frac{\mathrm{d}c_t}{c_{t-}} = \mu_c(\pi_t, i_t)\,\mathrm{d}t + \sigma_c \mathrm{d}W_t^c - \ell_t \mathrm{d}N_t$$

- Inflation dynamics:

$$\mathrm{d}\pi_t = \mu_\pi(\pi_t, i_t)\mathrm{d}t + \sigma_\pi \left(\rho_{c\pi}\mathrm{d}W_t^c + \sqrt{1-\rho_{c\pi}^2}\mathrm{d}W_t^\pi\right)$$

- Federal funds rate is adjusted at regularly scheduled FOMC meetings (8 per year):

$$i_T = i_{T-} + \Delta_i,$$

where $\mathbb{P}(\Delta_i \mid i, \pi)$ is modeled by the historical distribution of interest rate adjustments.

# Semi-Analytical Results: Risk-free Rate

- I first calculate the indirect utility function $G$ for recursive utility ($\gamma =$RRA, $\psi =$EIS, $\delta =$time preference rate, $\theta = \frac{1-\gamma}{1-1/\psi}$) numerically.
- I then determine the pricing kernel and calculate several asset pricing moments.
- The real risk-free rate is

$$r^f = \underbrace{\delta}_{\text{discounting}} + \underbrace{\frac{1}{\psi}\mu_c(\pi, i)}_{\text{smoothing}} - \underbrace{\frac{1}{2}\gamma\Big(\frac{1}{\psi}+1\Big)\sigma_c^2}_{\text{standard diffusion risk}}$$

$$+ \underbrace{\lambda_c\Big(\frac{\theta-1}{\theta}\mathbb{E}\big[(1-\ell)^{1-\gamma}\big] - \mathbb{E}\big[(1-\ell)^{-\gamma}\big] + \frac{1}{\theta}\Big)}_{\text{macroeconomic disaster risk}}$$

$$+ \underbrace{\frac{\theta-1}{2\theta^2}\frac{G_\pi^2}{G^2}\sigma_\pi^2}_{\text{inflation risk}} + \underbrace{\frac{\theta-1}{\theta}\frac{G_\pi}{G}\sigma_\pi\sigma_c\rho_{c\pi}}_{\text{interaction risk}}$$

# Semi-Analytical Results: Equity Premium

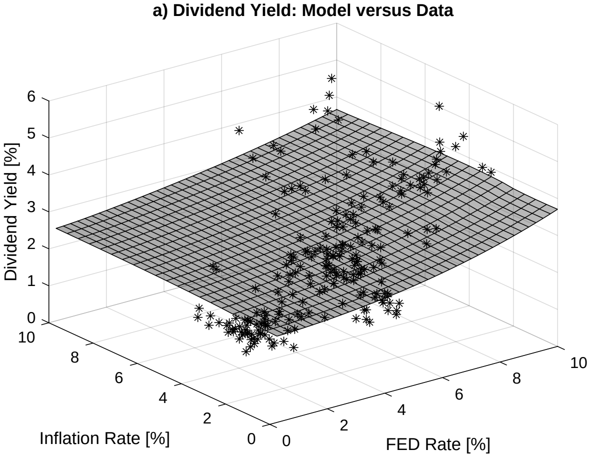
- The price-dividend ratio $\Omega(t, \pi, i)$ satisfies the following PDE between two FOMC meetings

$$0 = 1 + \Omega_t + \Omega\left(\mu_{\widehat{D}} + \lambda_c \mathbb{E}\left[(1-\ell)^{\phi-\gamma} - 1\right]\right) + \Omega_\pi \left(\mu_\pi(\pi, i) + \Sigma_\pi^\top \Sigma_{\widehat{D}}\right) + \Omega_{\pi\pi} \frac{1}{2} \sigma_\pi^2.$$

- The equity premium is

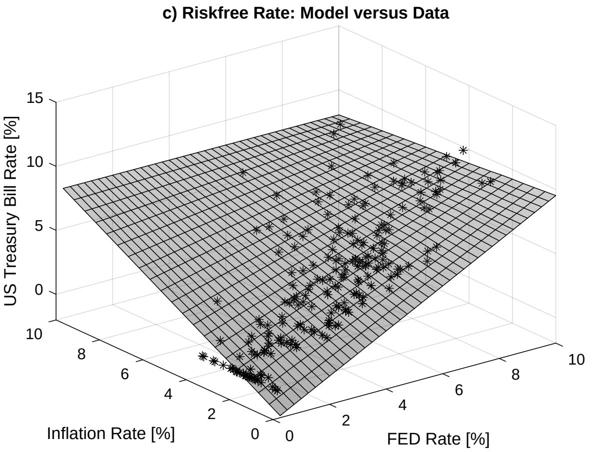
$$r^s - r^f = \underbrace{\gamma \sigma_c \sigma_d \rho_{cd}}_{\text{Diffusion Risk}} + \underbrace{\lambda_c \mathbb{E}\left[\left(1 - (1-\ell)^{-\gamma}\right)\left((1-\ell)^\phi - 1\right)\right]}_{\text{Macroeconomic Disaster Risk}} - \underbrace{\frac{\theta - 1}{\theta} \frac{G_\pi}{G} \frac{\Omega_\pi}{\Omega} \sigma_\pi^2}_{\text{Inflation Risk}} - \underbrace{\frac{\theta - 1}{\theta} \frac{G_\pi}{G} \Sigma_\pi^\top \Sigma_d + \gamma \frac{\Omega_\pi}{\Omega} \sigma_c \sigma_\pi \rho_{c\pi}}_{\text{Interaction Risk}}.$$

# Simulation Results: Dividend Yield



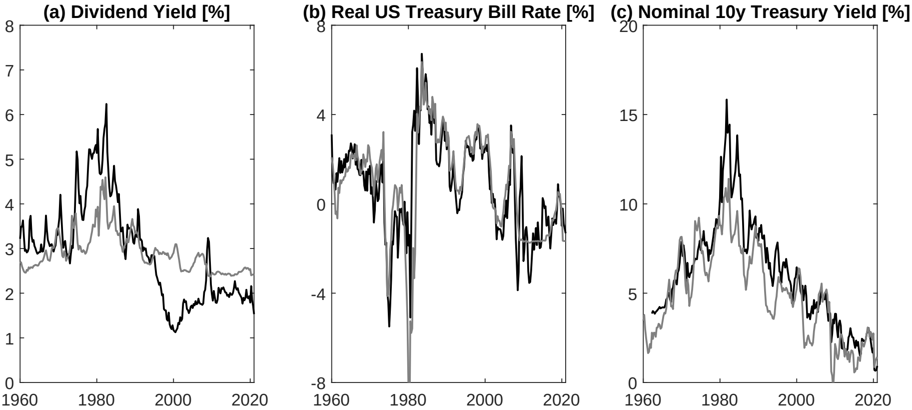

- Dividend yield increases in the federal funds rate.
- Inflation has a minor effect.

# Simulation Results: Nominal Risk-free Rate




- The nominal risk-free rate increases in both inflation and the federal funds rate.
- The effect of inflation on the real risk-free rate is ambiguous.

# Simulation Results: Historical Performance




- Black lines: historical data
- Gray lines: model simulation

# Unconditional Moments

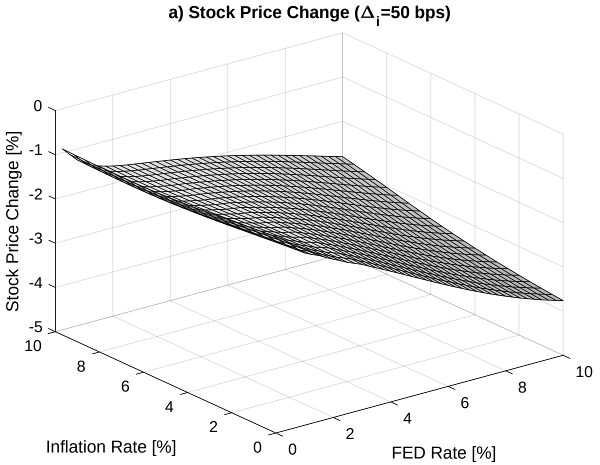
*(a) Stock Market*

| Moment | Model | US Data |
|---|---|---|
| $\mathbb{E}[y_d]$ | 2.91 | 2.91 |
| $\sigma(y_d)$ | 0.45 | 1.13 |
| $AC(y_d)$ | 89.53 | 97.58 |
| $\mathbb{E}[r_s - r_f]$ | 5.49 | 5.52 |
| $\sigma(r_s)$ | 11.43 | 16.03 |
| $\mathrm{SR}$ | 48.00 | 34.44 |

*(b) Bond Market*

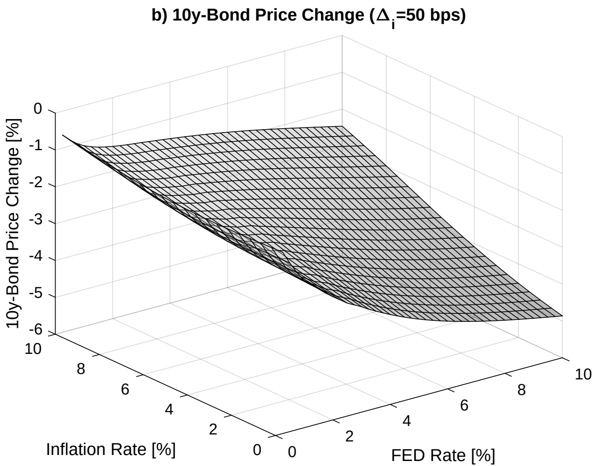
| Moment | Model | US Data |
|---|---|---|
| $\mathbb{E}[r_f]$ | 4.46 | 4.45 |
| $\sigma(r_f)$ | 2.97 | 3.17 |
| $AC(r_f)$ | 95.76 | 96.62 |
| $\mathbb{E}[r^{10}]$ | 4.90 | 6.01 |
| $\sigma(r^{10})$ | 2.55 | 2.99 |
| $AC(r^{10})$ | 97.11 | 97.05 |

# Price Impact of Monetary Policy




- Restrictive monetary policy has a negative impact on stock prices.

# Price Impact of Monetary Policy




- An increase in the federal funds rate leads to an increase in its yield resulting in a lower bond price.

# Conclusion

- I show that inflation and the federal funds rate predict consumption growth although I need a disaster component to match the dynamics of crises.
- My model matches historical asset pricing moments and
  - replicates several stylized facts inferred from vector-autoregressions.
  - produces an unconditional equity premium of 5.49% and a real risk-free rate of 0.79% under reasonable values for the preference parameters.
  - explains significant changes in asset prices following the FED's interest rate announcements.
  - replicates the historical pattern of the price-dividend ratio and the risk-free rate.
  - produces reasonable shapes of the nominal term structure of interest rates, which is normal most of the time but can also be inverse.
- I have also performed several robustness checks, which confirm my results for alternative model specifications.