Fiscal Multipliers, Trend Inflation and Endogenous Price Stickiness: Evidence from the U.S.

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Motivation & Research Aim

Motivation I

- The developed economies have seen a period of Great Moderation after the 1980s $\rightarrow$ a gradual decrease in trend inflation across the globe
- **Trend inflation**: the long-run level of inflation to which it converges in the absence of shocks
- COVID-19 brought about a persistent increase in inflation $\rightarrow$ wage-setting behaviour strongly affected (Jorda & Nechio, 2022) $\rightarrow$ harder to re-anchor inflation expectations
- Trend inflation may become persistently higher again

Motivation II

- Trend inflation alters the transmission of monetary policy:
  - Reduces stabilizing effects (Ascari & Ropele, 2007)
  - Changes determinacy properties of New Keynesian models (Coibion & Gorodnichenko, 2011)
  - Leads to welfare losses (Ascari & Sbordone, 2014)
  - Affects the price-setting mechanism (Ascari & Haber, 2022)
- Fiscal policy during the GFC and the COVID-19 pandemic: stimuli of $800 bln and more than $3 tln respectively
- Little is known about the fiscal transmission under different trend inflation levels:
  - Monetary-fiscal interactions under non-zero trend inflation and learning (Florio & Gobbi, 2015)
  - Role of fiscal foresight during fiscal- and monetary-led regimes (Ascari et al., 2022)
  - Multiplier estimates contingent on inflation *and* unemployment (Ghassibe & Zanetti, 2022)

Paper Overview

- I aim to fill this gap and **analyze how trend inflation impacts the fiscal transmission and the size of fiscal multiplier**
- The paper proceeds in the following manner:
  1. **A theoretical framework** to study fiscal policy under non-zero trend inflation: NK model with habits in consumption and endogenous price stickiness $\rightarrow$ testable predictions
  2. **Empirical assessment** of the predictions: smooth transition local projections method for the U.S. macro data over XX and XXI centuries $\rightarrow$ inconsistencies between theory and data
  3. **Discussion** of relevant features of the transmission mechanism absent from the baseline model

Contribution to the Literature

This study contributes to three major strands of literature

1. Empirical estimates of U.S. fiscal multipliers (Blanchard & Perotti, 2002; Mountford & Uhlig, 2009; Ramey, 2011b)
   - **Contribution**: extended estimates which consider the effects on consumption, investment and inflation over the XX century
2. State-dependent effects of fiscal policy (Auerbach & Gorodnichenko, 2011, 2012; Ghassibe & Zanetti, 2022; Goemans, 2022; Ramey & Zubairy, 2018)
   - **Contribution**: state dependence with respect to trend inflation, which was previously overlooked
3. Theoretical modelling of trend inflation (Ascari & Ropele, 2007, 2009; Coibion & Gorodnichenko, 2011)
   - **Contribution**: impact of trend inflation on fiscal transmission in a NK model

Theoretical Model

Modelling Choices

1. **Habit formation** in consumption:
   - Explains the humped-shaped response and supported by data (Fuhrer, 2000; Havranek et al., 2017; Smets & Wouters, 2007)
   - Superficial habits for the sake of tractability and to avoid supply-side effects (Leith et al., 2009)
2. **Non-zero steady-state inflation** as in Ascari & Sbordone (2014)
3. **Endogenous price stickiness** modeled as a decreasing function of trend inflation as in Kurozumi (2016):
   - Consistent with empirical evidence (Alvarez et al., 2019; Gagnon, 2009; Nakamura et al., 2018)
   - Easy to implement in a Calvo (1983) setting
   - Restores equilibrium determinacy in a NK model with trend inflation
4. **Other features** closely follow Ascari & Sbordone (2014)

Model Overview: Households

- A representative household maximizes lifetime utility:

$$\max_{X_t^k, N_t^k, B_t^k} E_t \sum_{s=0}^{\infty} \beta_{t+s} \left(\frac{(X_{t+s}^k)^{1-\sigma}}{1-\sigma} - \chi \frac{(N_{t+s}^k)^{1+\nu}}{1+\nu} \right) \tag{1}$$

s.t.

$$X_t^k + \tau_t + \frac{B_t^k}{P_t} = w_t N_t + \frac{R_{t-1} B_{t-1}^k}{P_t} + \Phi_t \tag{2}$$

- Consumption in the utility function is habit-adjusted:

$$X_t^k = \left[\int_0^1 (C_{i,t}^k)^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}} - \theta^C S_{t-1}^C \tag{3}$$

$$S_t^C = \rho^C S_{t-1}^C + (1-\rho_S^C) C_t \tag{4}$$

Model Overview: Firms

Firm's maximization problem is two-step (see Kurozumi (2016) for derivation)

1. Choose the optimal reset price
   - Conincides with the usual Calvo result
2. Given optimal reset price, choose the contract duration θ
   - In equilibrium optimal θ depends on trend inflation, price elasticity, discount factor and the price-setting cost:

$$\omega_p \eta(1-\theta)(1-\theta\beta\bar{\pi}^{\eta-1})^2(1-\theta\beta\bar{\pi}^{\eta})- \tag{5}$$
$$(1-\theta\bar{\pi}^{\eta-1})\left(\eta\bar{\pi}^{\eta-1}(\bar{\pi}-1)(1-\theta\beta)-(\bar{\pi}^{\eta}-1)(1-\theta\beta\bar{\pi}^{\eta-1})\right)=0$$

Endogenous Price Stickiness: Illustration

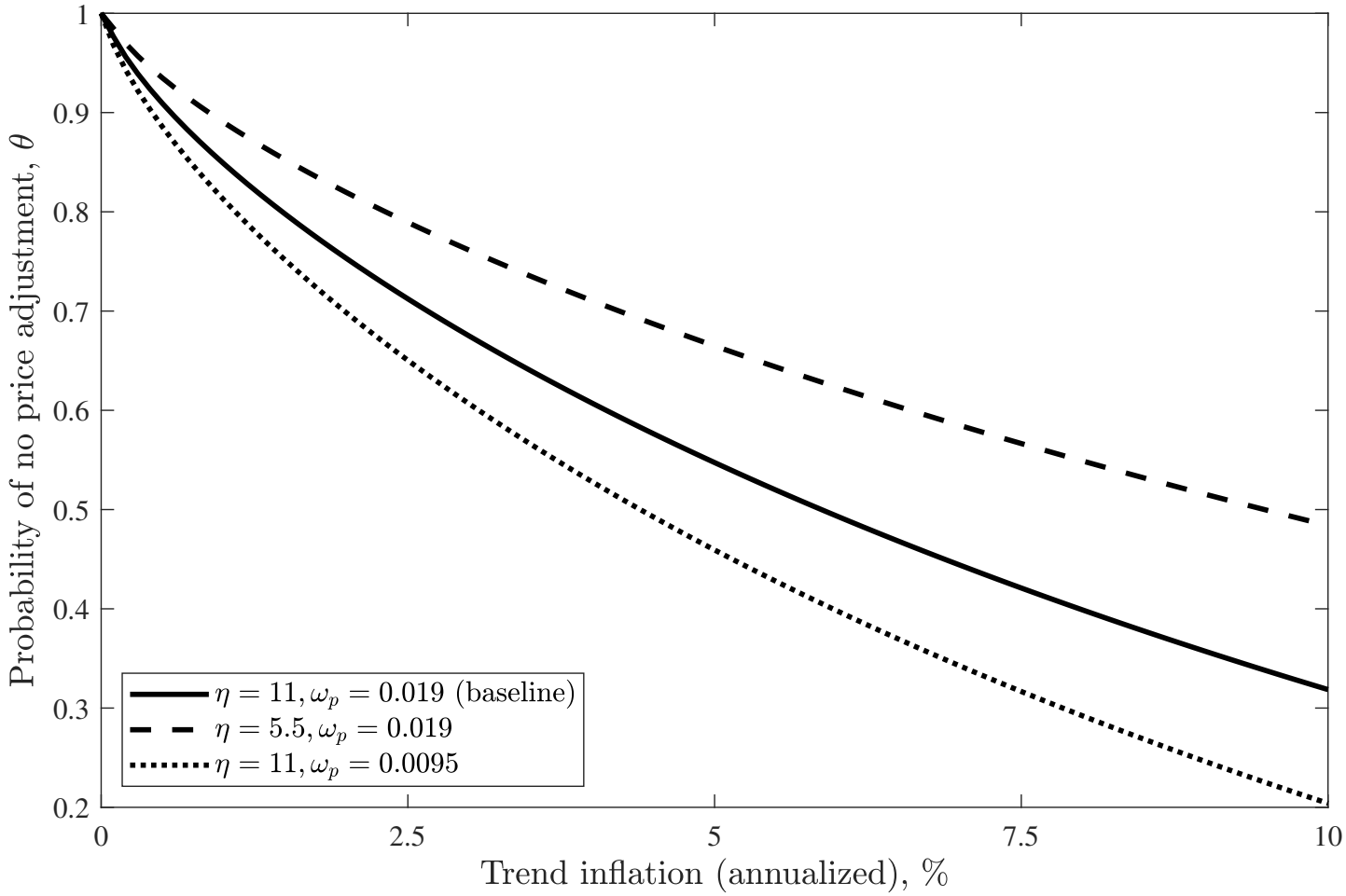

Figure 1: Optimal degree of price stickiness and trend inflation

Model Overview: Policy

- Government spending follows an exogenous process:

$$\log G_t = (1 - \rho^G) \log \omega \bar{Y} + \rho^G \log G_{t-1} + \epsilon_t^G, \tag{6}$$

- Spending is financed by a lump-sum tax:

$$G_t = \tau_t \tag{7}$$

- The Central Bank follows a Taylor rule:

$$\frac{1 + i_t}{1 + \bar{i}} = \left(\frac{\pi_t}{\bar{\pi}}\right)^{\phi_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\phi_Y} e^{\epsilon_t^i} \tag{8}$$

Fiscal Policy Transmission: IRFs

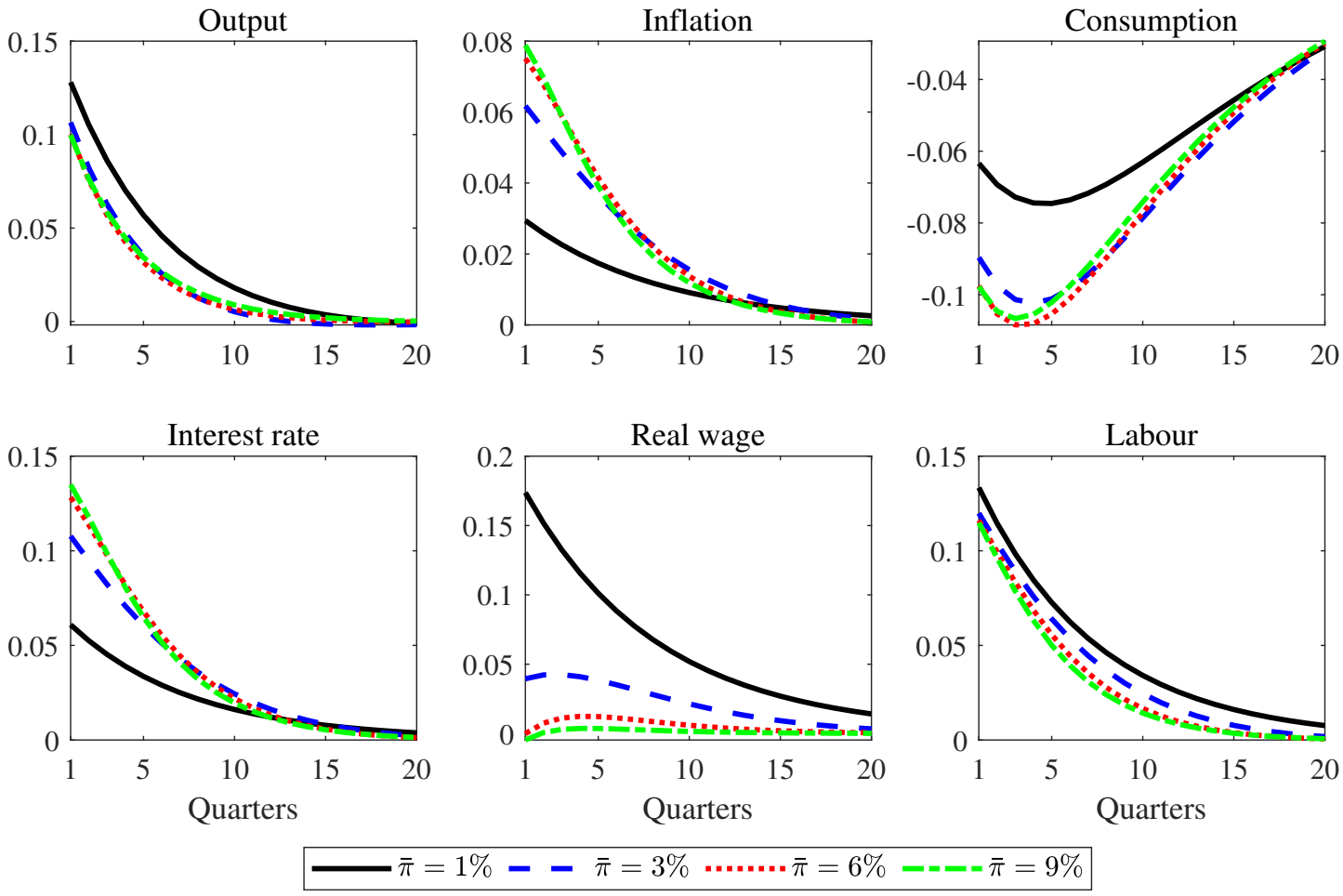

Figure 2: IRFs to a 1% positive government spending shock

Fiscal Policy Transmission: Key Insights

The main features of the mechanism:

- **Inflation rises more strongly in a high inflation regime** following a spending shock because of more flexible prices. This dampens real wage dynamics and causes a greater increase in the interest rate
- **Consumption falls** because of a **negative wealth effect** regardless of trend inflation. Higher interest rates dampen consumption more during high trend inflation
- Labour demand increases stronger than labour supply, leading to **an increase in equilibrium wage and hours**
- **Output increase is smaller** in a high inflation regime

Fiscal Multiplier

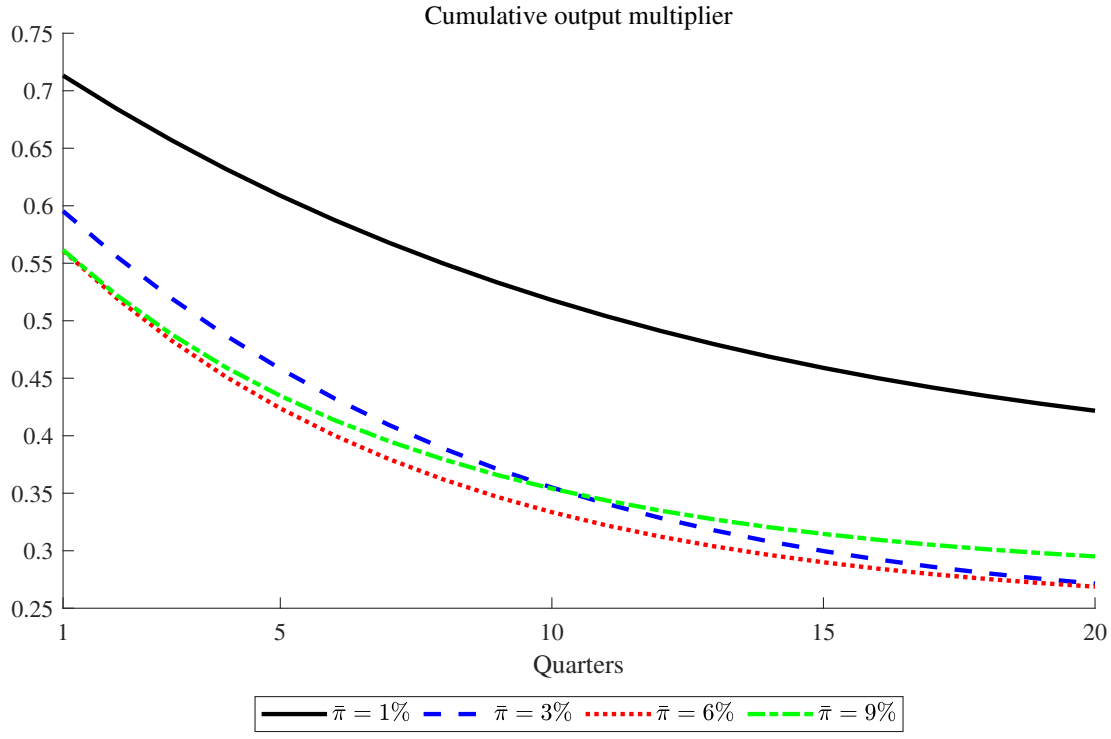

Figure 3: Cumulative output multiplier in different inflation regimes

$$\text{mult}_G^h = \frac{\sum_{s=1}^{h}(1+\bar{i})^{-(s-1)} \cdot \text{IRF}_s^Y \cdot \bar{Y}}{\sum_{s=1}^{20}(1+\bar{i})^{-(s-1)} \cdot \text{IRF}_s^G \cdot \bar{G}}$$

Testable Predictions

Prediction 1

The output multiplier of fiscal policy does not exceed 1 in periods of both low and high trend inflation.

Prediction 2

The output multiplier of fiscal policy is greater when the economy is in a low trend inflation regime.

Prediction 3

Consumption crowding out is more pronounced when the economy is in a high trend inflation regime.

Prediction 4

A government spending shock is more inflationary in a high trend inflation regime.

Empirical Results

Estimation Framework

- Smooth transition local projections following Ramey & Zubairy (2018) and Ascari & Haber (2022)[1]:

$$y_{t+h} = F(z_t)\left(\alpha_h^{HI} + \beta_h^{HI}\epsilon_t + \sum_{k=1}^{K}\gamma_{h,k}^{HI} w_{t,k}\right) \tag{9}$$
$$+ (1 - F(z_t))\left(\alpha_h^{LO} + \beta_h^{LO}\epsilon_t + \sum_{k=1}^{K}\gamma_{h,k}^{LO} w_{t,k}\right) + u_{t,h}$$

- z_t is the z-score of 4-year MA of GDP deflator inflation
- $F(z_t)$ is a logistic smooth transition function
- y_{t+h} is the outcome variable at horizon h (output, consumption, investment, inflation)
- $w_{t,k}$ is a vector of control variables

[1] Empirical results in this paper are produced using the kindly provided replication package

Data and Identification

- Quarterly dataset by Ramey & Zubairy (2018) spanning 1889–2015
- Dataset extended by adding consumption expenditure and fixed investment using historical data and interpolation
- All national accounts variables are normalized by potential GDP to avoid conversion to logs
- Government spending shock identified with the narrative *news* series from Ramey (2016b) representing changes in the expected present value of U.S. military spending $\rightarrow$ controls for anticipation and endogeneity
- Control variables: 4 lags of GDP, taxes, government debt, government spending and *news* shock, policy rate

Trend Inflation Regimes

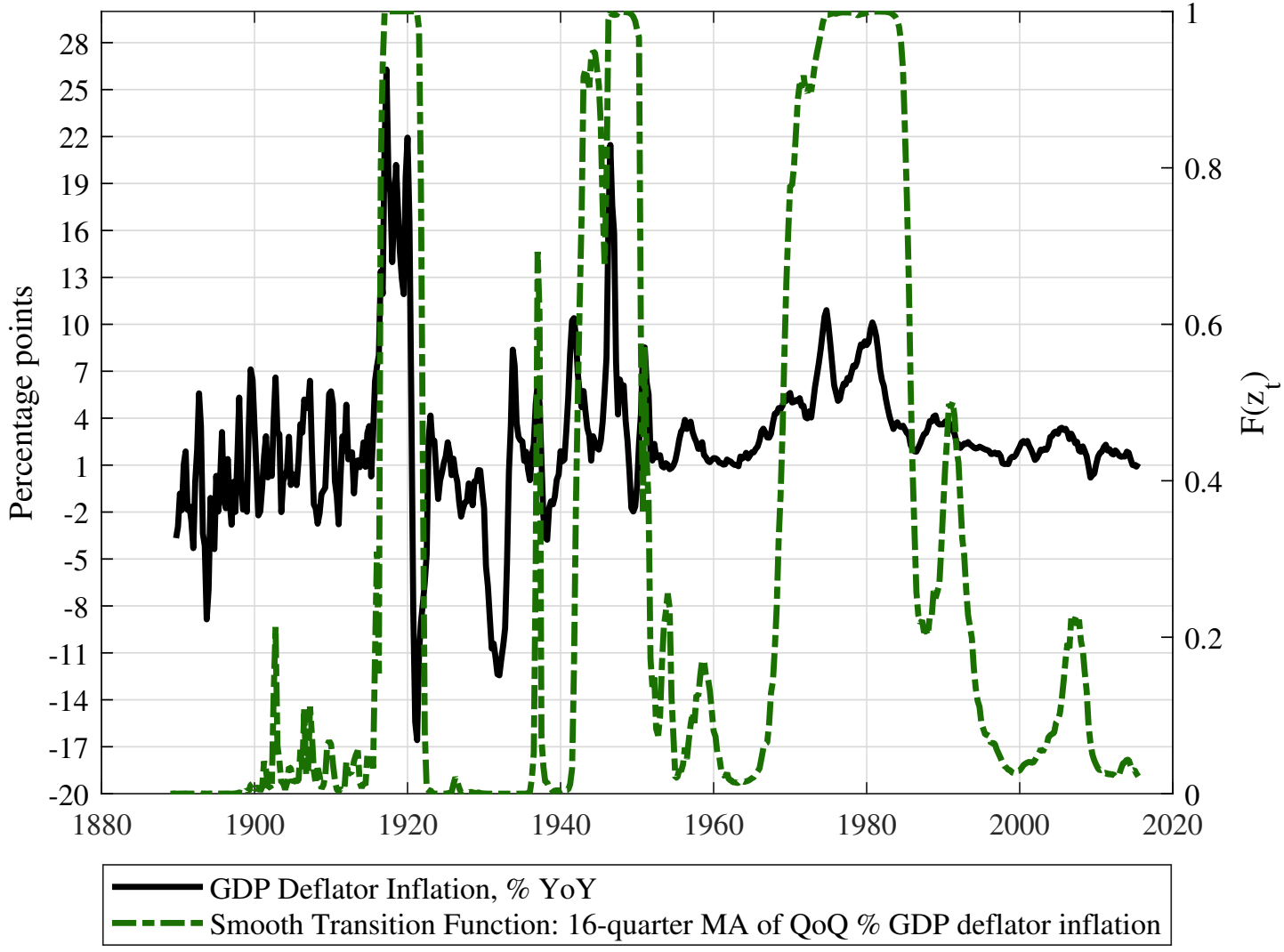

Figure 4: Inflation and the smooth transition function for the U.S. in 1890Q1 - 2015Q4

Empirical Results: Output Multiplier

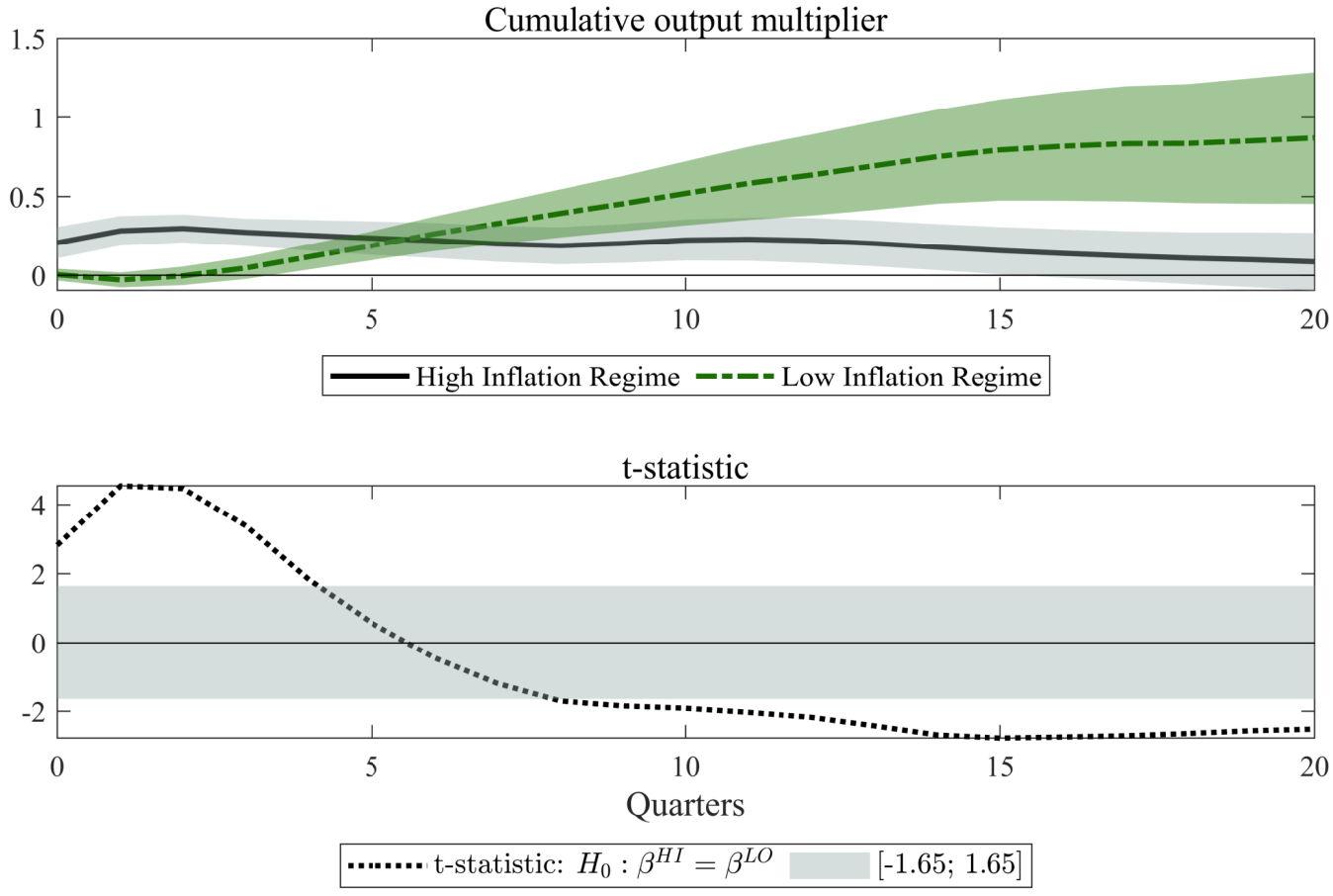

Figure 5: Cumulative output multiplier in different inflation regimes

Empirical Results: Consumption Response

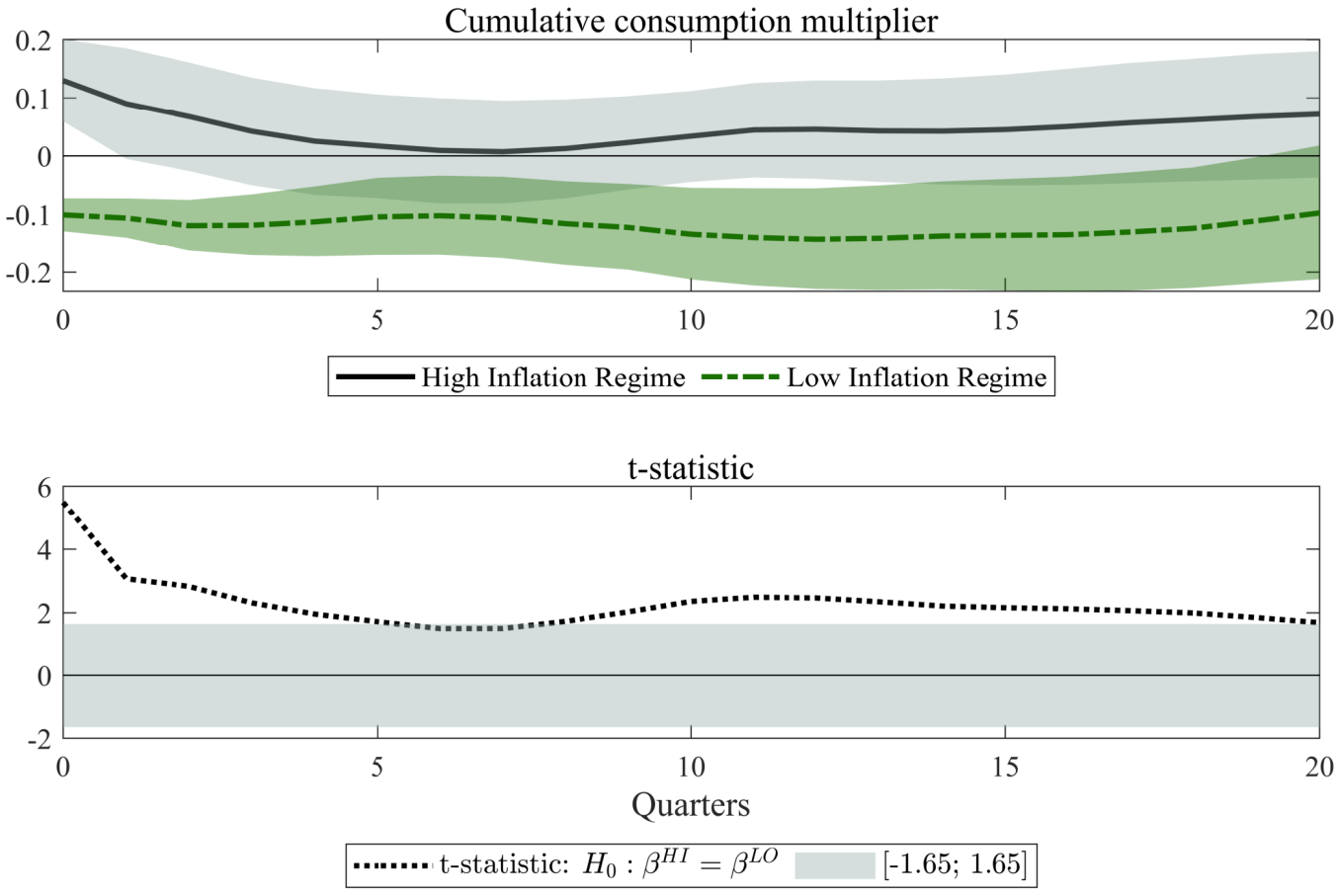

Figure 6: Cumulative consumption response in different inflation regimes

Empirical Results: Inflation Response

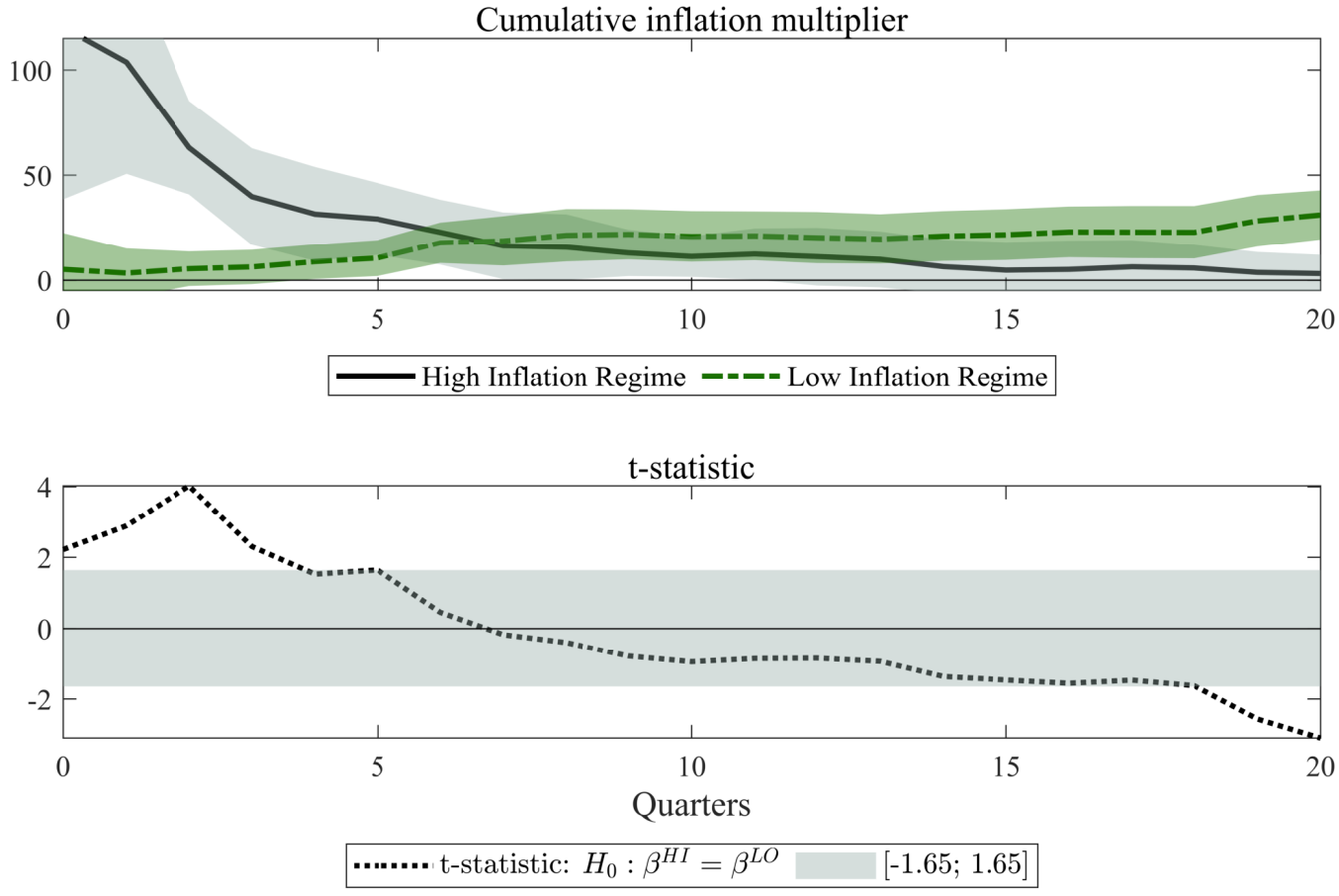

Figure 7: Cumulative inflation response in different inflation regimes

Impact of Fiscal Shocks: NK model vs Empirics

Results consistent, broadly consistent and inconsistent with the theoretical model

- The multiplier is greater in a low inflation regime. Peak impact is 0.87 after 20 quarters vs 0.28 after 1 quarter in the other regime
- The inflationary impact of a spending shock is stronger in a high inflation regime. Peak cumulative response is 3 times higher, although a change in inflation is more short-lived
- The output multiplier does not exceed 1 in a high trend inflation regime, but reaches 1 after 14 quarters in a low inflation regime
- Consumption is crowded-in in a high trend inflation regime, and crowding-out is observed during periods of low inflation

Conclusions

- An unconditional fiscal multiplier is an ill-suited statistic when designing stimulus packages
- Trend inflation alters fiscal transmission and the size of the fiscal multiplier. The peak impact of spending shocks is 3 times smaller during times of high inflation
- Price-setting has state-dependent characteristics and is affected by the prevailing inflation rate
- A standard NK model fails to capture the differences in fiscal transmission across inflation regimes
  - Work in progress: heterogenous cognitive discounting of inflation depending on the inflation regime
- Fiscal (as well as monetary) policy is less effective in a high-inflation environment: caution against raising inflation targets

Appendices

Sensitivity Analysis: Habit Formation

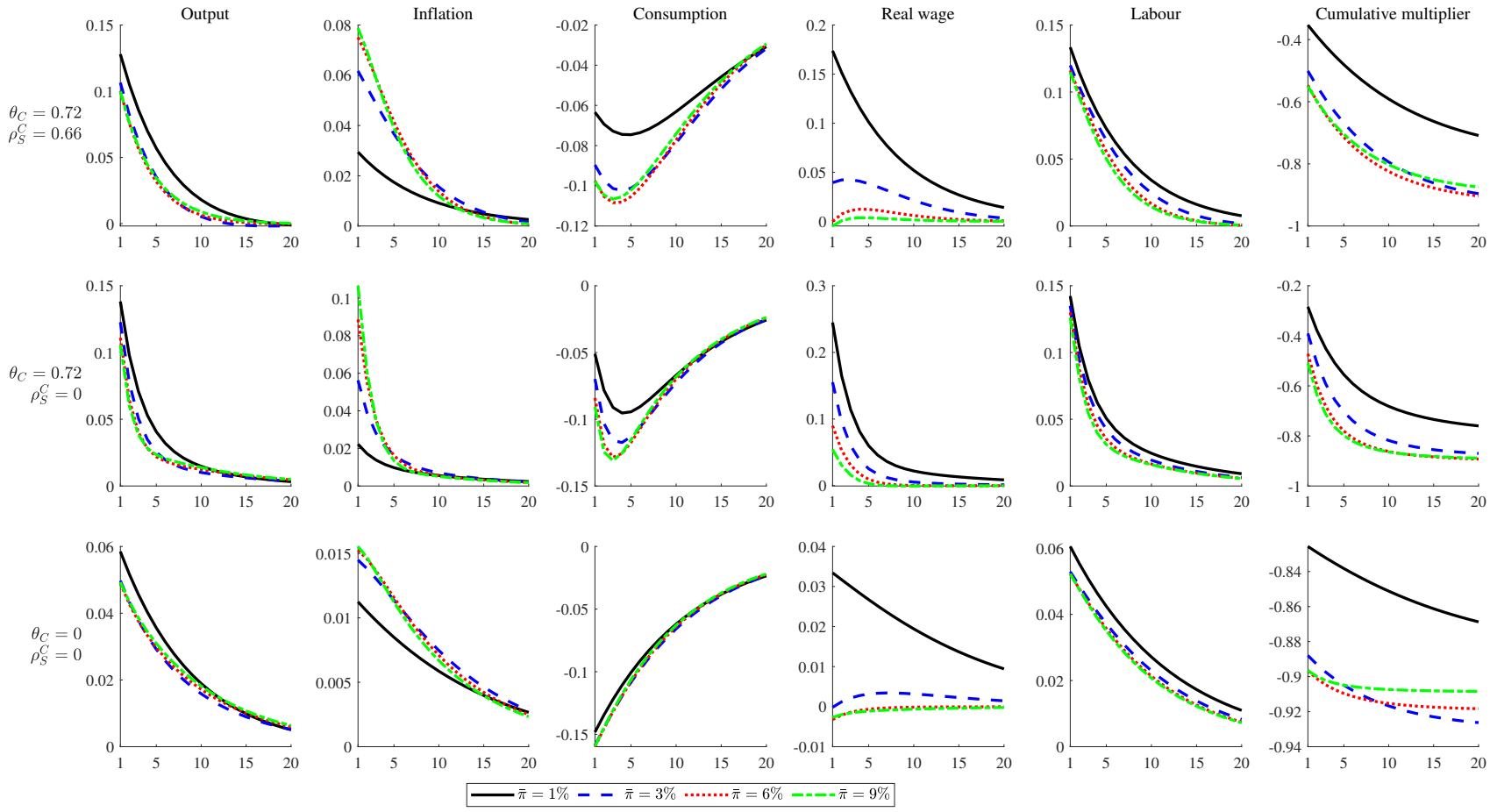

Figure 8: IRFs to a 1% positive government spending shock under different habit parametrisations

Sensitivity Analysis: Labour Supply Elasticity

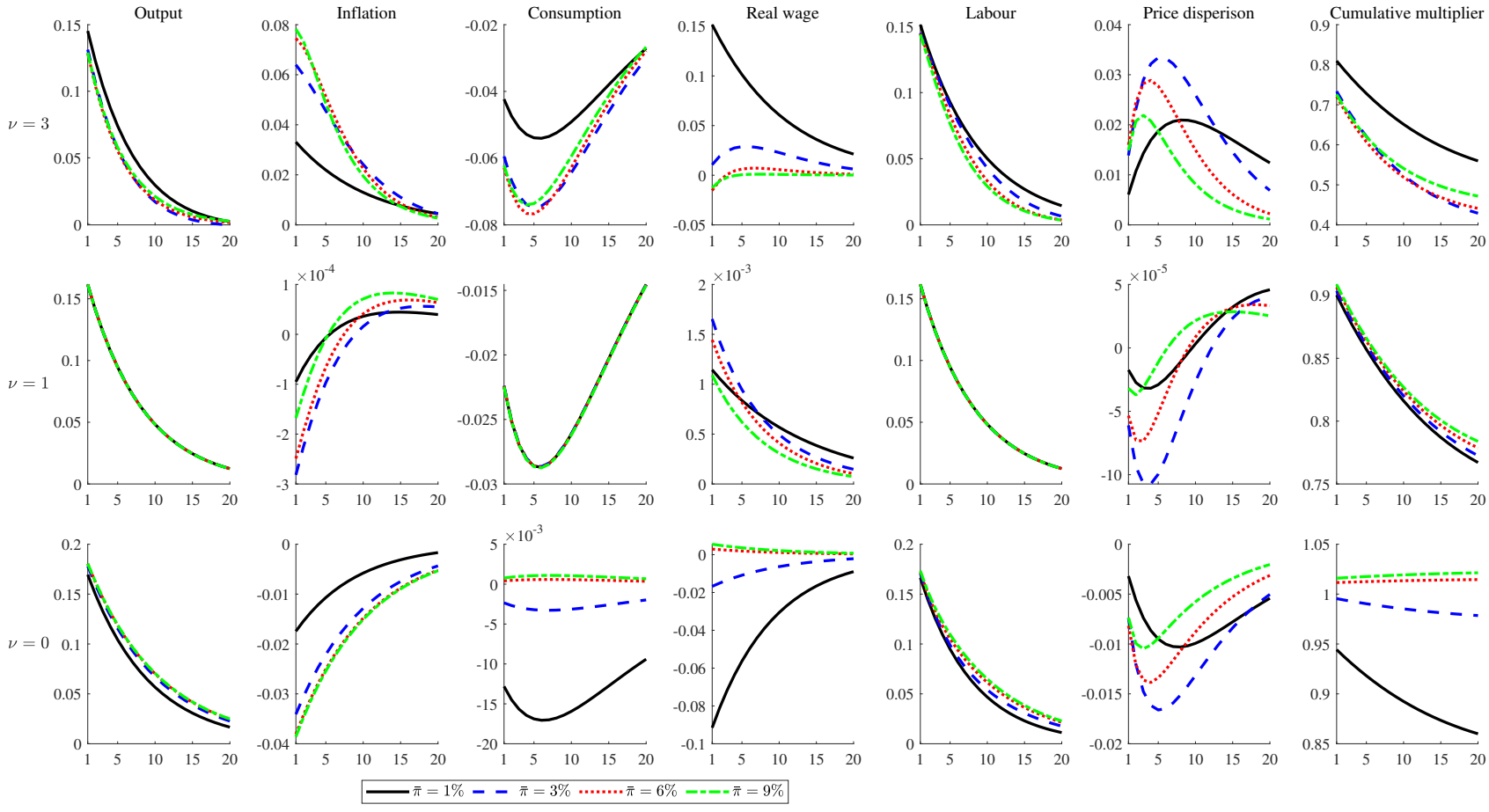

Figure 9: IRFs to a 1% positive government spending shock under different labour supply elasticities

State Variable: Comparison to Ramey & Zubairy (2018)

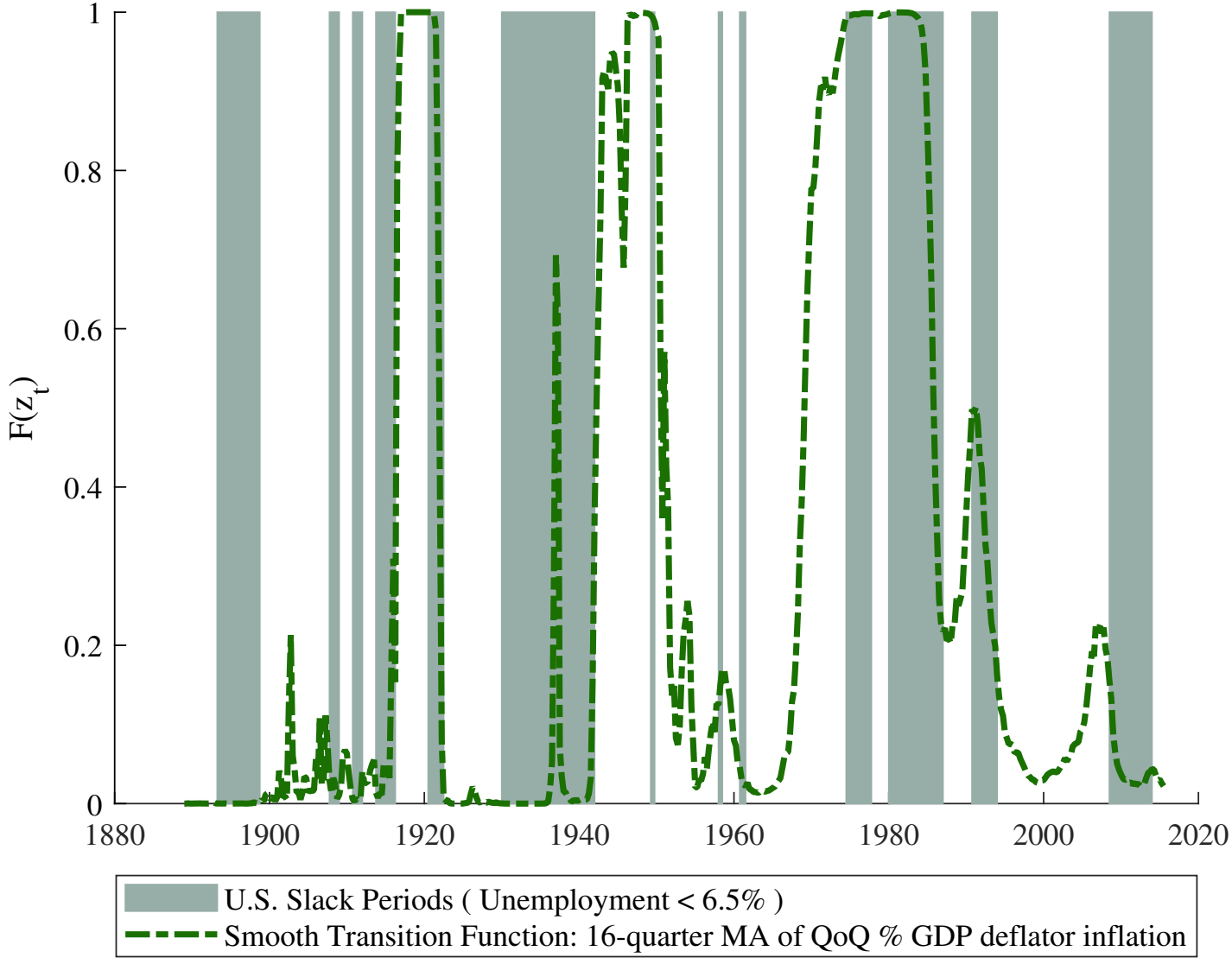

Figure 10: Slack states (Ramey & Zubairy, 2018) vs high inflation periods

State Variable: Comparison to Goemans (2022)

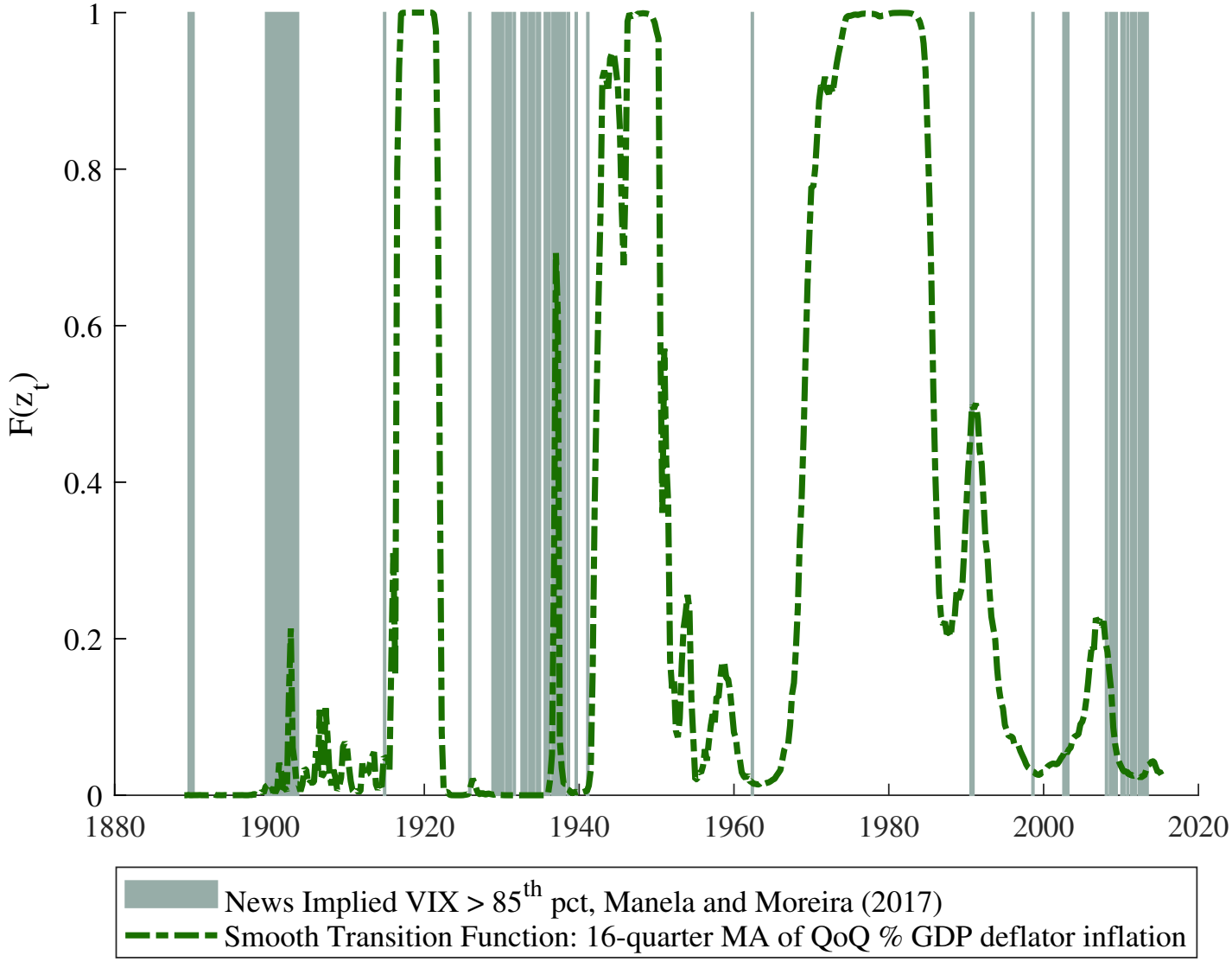

Figure 11: Uncertain times (Goemans, 2022) vs high inflation periods

IRFs conditional on the Inflation Regime

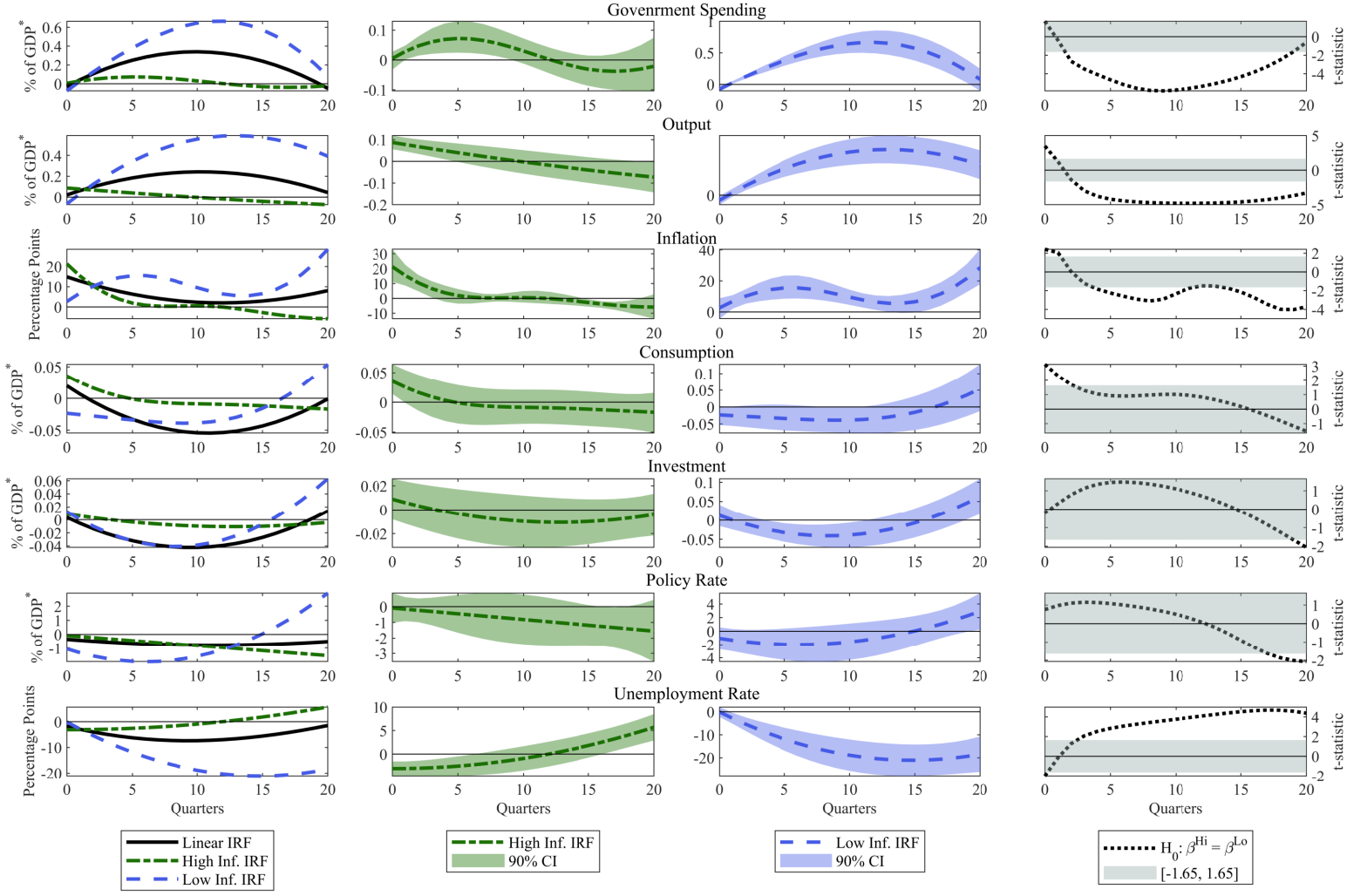

Figure 12: Conditional impulse responses to a government spending shock

Fiscal Transmission: Stylized Facts

In a high trend inflation regime:

- Government spending shocks are less persistent: related to instrument nature (Ramey, 2011a)
- Output reacts quicker and consumption is crowded in: inflation expectations channel, rationing fear during the Korean War (Crump et al., 2022; Ramey, 2016a)
- Inflation occurs faster, but is less persistent: state-dependent pricing, similar to the findings of Ascari & Haber (2022) for monetary policy
- Private investment is *not* crowded out significantly, contrary to low inflation regime

These results are complementary to existing literature on state-dependent fiscal multipliers: no direct correspondence of the state variable to slack states (Ramey & Zubairy, 2018) or the uncertainty index (Goemans, 2022)

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