Three theories of natural rate dynamics

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*The views expressed in this presentation are those of the author and **do not** necessarily represent the views of the Bank of Spain, or thlonge Eurosystem.*

Natural rate: why does it matter

- Natural rate is the short-term real interest rates that would hold “in the long run” (after shocks peter out)
  - Neutral rate?
- It matters because it constitutes a reference for the monetary policy stance and provide a guide for the long segment of the yield curve (which also reflects term premium)
- The traditional view is that it depends exclusively on structural factors such as demographics or TFP growth
- Here we challenge that view

The traditional view on the natural rate

- Imagine a Blanchard-Yaari economy with TFP growth g, survival probability η, risk aversion γ and discount rate β.
- In the absence of shocks, the natural rate r^* corresponds to the steady-state real interest rate:

$$r^* = \frac{g^\gamma}{\beta\eta} - 1.$$

- In the presence of shocks, real interest rate will be clustered around r^*.

This talk

1. A fiscal theory of the natural rate
2. Inflation, the ZLB, and the natural rate
3. Persistent supply shocks and the natural rate
4. Implications for monetary policy design

1. A fiscal theory of the natural rate

The stock of debt affects the natural rate

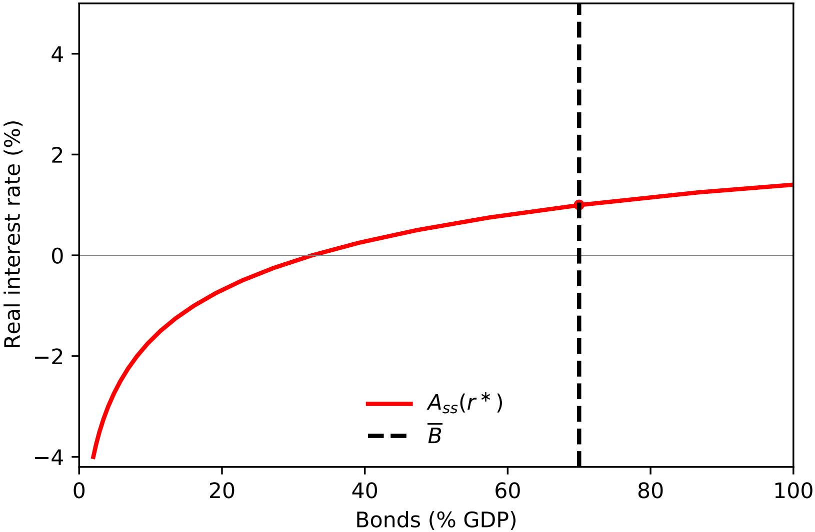
- More explored of all theories discussed today (Rachel and Summers, 2019; Bayer, Born and Luetticke, 2023; Kaplan, Nikolakoudis and Violante, 2023; Mian, Straub and Sufi, 2024).
- In the baseline neoclassical model with complete markets, the demand for debt is perfectly elastic and the natural rate does not depend on debt
- However, if markets are incomplete (as in HANK models) or households derive utility from holding wealth, there is a downward-slope demand for debt. The standard mechanism is through precautionary savings.

Example: a HANK model with a fiscal block

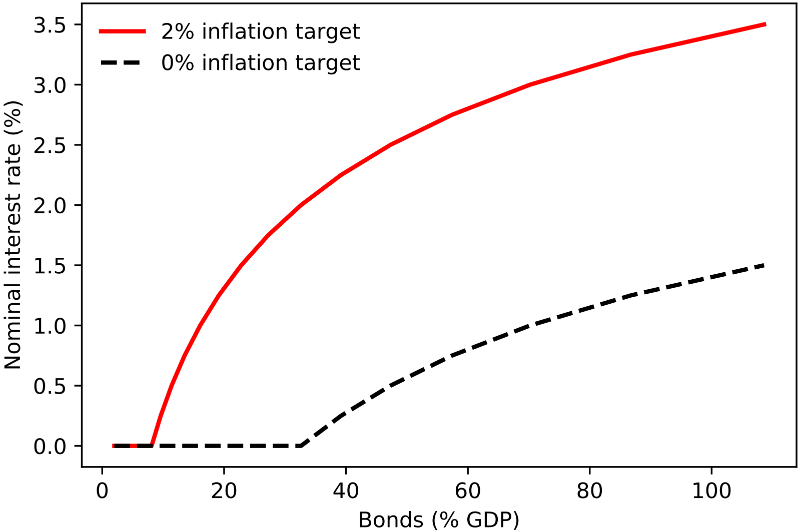
- Model in Campos, Fernandez-Villaverde, Nuno and Paz (2024). ▸ Model

1. Heterogeneous households
   - Unit mass of households, subject to idiosyncratic labor productivity.
2. New Keynesian block
   - Unions are similar to intermediate goods producers in a NK model.
   - Sticky wages: they set wages on behalf of workers.
   - Yields a simple wage Phillips curve.
3. Monetary and Fiscal Policy
   - Central bank follows a Taylor rule.
   - Treasury follows a fiscal rule.
4. Firms
   - Representative firm with aggregate production function.
   - Flexible prices.

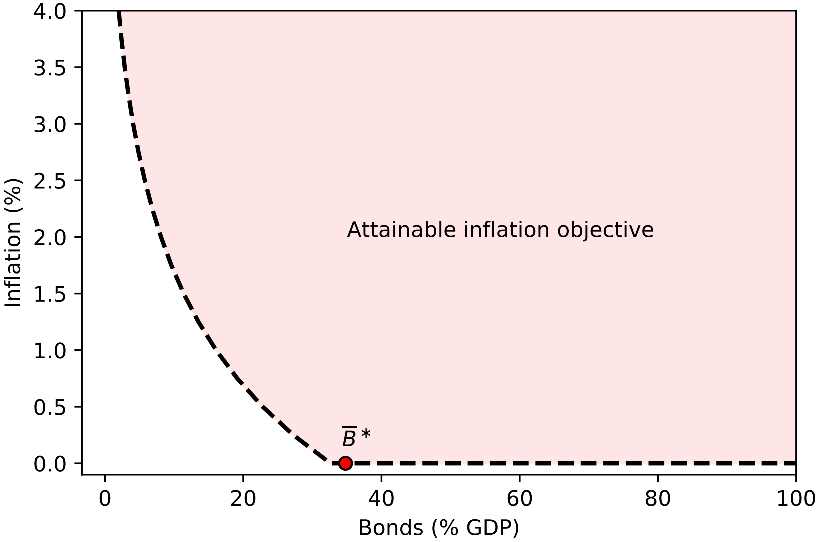
The natural rate depends the stock of debt



Nominal rates can be limited by the ZLB...



... so that there is a minimum debt level compatible with price stability



2. Inflation, the ZLB, and the natural rate

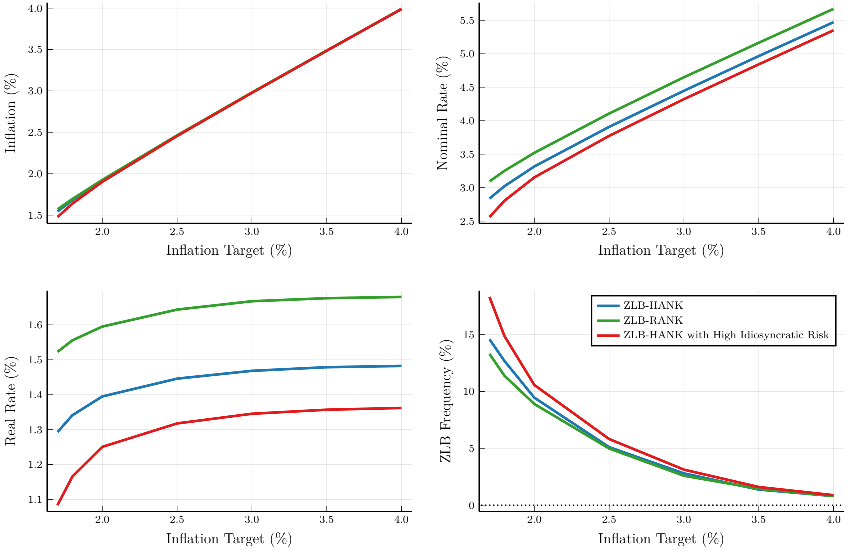
Long-term inflation affects the natural rate

- A complementary mechanism links the natural rate with long-term inflation
- The link operates via ZLB occurrences: lower long-run inflation implies lower nominal rates ($i = r + \pi$) and thus more likely ZLB episodes
- Monetary policy is less effective during ZLB episodes, which are more deflationary and contractionary
- If households anticipate ZLB in the future, they increase their demand for safe asses out of precautionary motives, thus depressing the natural rate

Example: a HANK model with a ZLB

- Model in Fernandez-Villaverde, Marbet, Nuno, and Rachedi (2024)
- HANK model similar to the previous one, with constant debt and an occasionally binding ZLB
- As the main channel is ex-ante precautionary savings, we solve it using global methods to compute the stochastic steady state (SSS)

Market incompleteness amplifies this mechanism



3. Persistent supply shocks and the natural rate

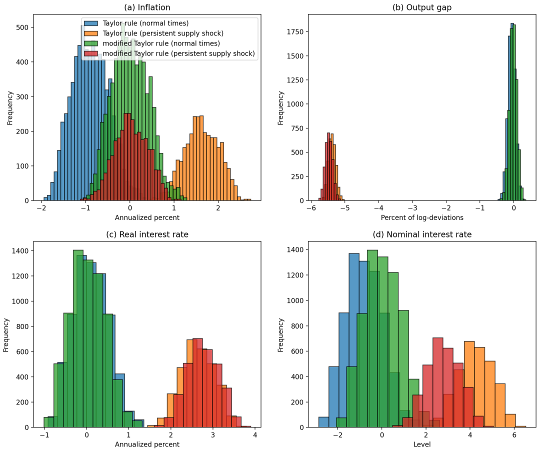
Persistent periods of negative supply shocks also drive natural rates

- The precautionary savings motive does not necessary need to come from the ZLB (which pushes the natural rate down)
- For instance, a persistent period of negative cost-push shocks can lead to big swings in natural rates
  - In normal times, the natural rate is depressed as agents save in anticipation of the period of negative cost-push shocks...
  - ..but when the supply-shocks regime arrives, agents dissave as they are aware that the shocks will eventually fade out, increasing the natural rate

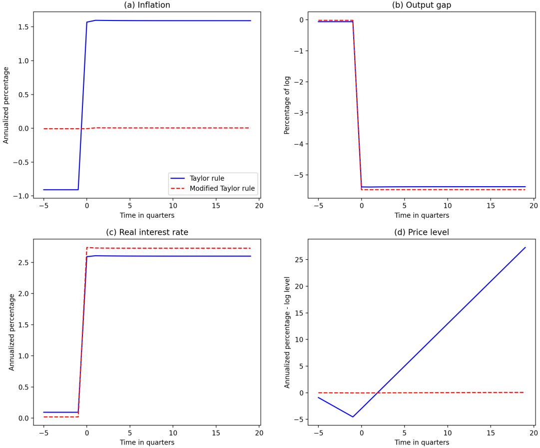
Example: a RANK model with Markov switching costs

- Model in Nuno, Renner, and Scheidegger (2024)
- Standard RANK model with autoregressive shocks plus cost-push shocks following a 2-state Markov chain
- Two SSS: one (normal times) with a lower real rate than $1/\beta$ and the other (persistent supply shocks) with a higher rate.

Interest rates are clustered around the regime-specific natural rates



These rates jump with a regime change



4. Implications for monetary policy design

If natural rates can change abruptly, it affects long-term inflation expectations

- Consider a simplified central bank reaction function captured by a Taylor rule

$$i_t = \overline{r} + \overline{\pi} + \phi_\pi \left(\pi_t - \overline{\pi}\right),$$

- In steady state, the Fisher equation holds: $i_{ss} = r^* + \pi_{ss}$, and thus long-run inflation depends on the policy gap between natural rates and central bank intended long-term rates

$$\pi_{ss} \approx \overline{\pi} + \frac{r^* - \overline{r}}{\phi_\pi - 1}.$$

Market-based long-term inflation expectations based on ILS have traditionally been different from central bank´s target

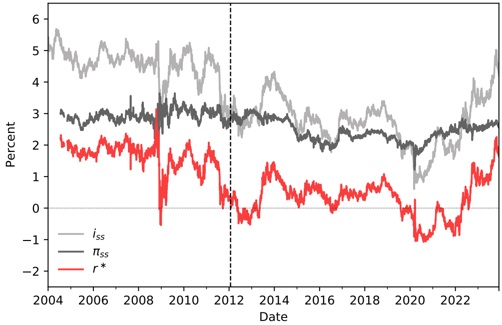


Figure: Long-term nominal and real rates and inflation *Note*: Daily data. i_{ss} is the 5y5y forward nominal rate obtained from the zero-coupon U.S. yield curve. π_{ss} is the 5y5y ILS. r^* is computed as the difference $i_{ss} - \pi_{ss}$. The dashed vertical line marks the date when the 2% inflation target was announced (January 24, 2012).

That suggests a policy gap between natural rates and central bank expected future rates

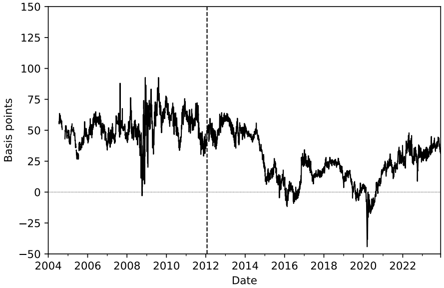


Figure: Policy gap $r^* - \overline{r}$

Thank you!

Appendix

Households

- Households solve:

$$V(a_{i,t}, z_{i,t}) = \max_{c_{i,t}, a_{i,t+1}} u(c_{i,t}) - v(n_{i,t}) + \beta \mathbb{E}_t[V(a_{i,t+1}, z_{i,t+1})]$$

$$\text{s.t. } c_{i,t} + a_{i,t+1} = (1 + r_t)a_{i,t} + (1 - \tau)\frac{W_t}{P_t} z_{i,t} n_{i,t} + T_t,$$

$$a_{i,t+1} \geq 0.$$

- They choose $c_{i,t}$ and $a_{i,t+1}$. Their labor choice $n_{i,t}$ is is performed by unions.
  - G_t : government consumption
  - $\mathcal{T}_t$: tax collection
  - B_t : public debt
  - $\overline{B}$: debt target

Central bank: Monetary Policy

- The central bank follows a Taylor rule:

$$\log(1+i_t) = \max\left\{\log(1+\bar{r}) + \log(1+\bar{\pi}) + \phi_\pi \log\left(\frac{1+\pi_t}{1+\bar{\pi}}\right), 0\right\}. \quad (1)$$

  - $\bar{r}$: real rate intercept
  - i_t : nominal rate
  - $\bar{\pi}$: inflation target
  - π_t : inflation

Firms

- Representative firm with linear aggregate production function:

$$Y_t = \Theta N_t.$$

- Flexible prices: $W_t/P_t = \Theta$.
- Y_t : output
- Θ : constant productivity
- N_t : aggregate labor

Unions

- Wage Phillips curve:

$$\log\left(\frac{1+\pi_t^w}{1+\overline{\pi}}\right) = \kappa_w\left[-\frac{\epsilon_w - 1}{\epsilon_w}(1-\tau)\frac{W_t}{P_t}\int u'(c_{it})z_{it}di + v'(N_t)\right]N_t + \beta\log\left(\frac{1+\pi_{t+1}^w}{1+\overline{\pi}}\right) \tag{2}$$

- Proportional allocation of labor: $n_{i,t} = N_t$
  - π_t^w : wage inflation
  - N_t : aggregate labor
  - W_t : nominal wage
  - P_t : price level

Aggregation and market clearing

Back

- In equilibrium all agents optimize and the labor, bond, and good markets clear:

$$G_t + C_t = Y_t,$$
$$A_t = B_t,$$

where aggregates are:

$$N_t = \int_0^1 z_{i,t} n_{i,t} di,$$
$$A_t = \int_0^1 a_{i,t+1} di,$$
$$C_t = \int_0^1 c_{i,t} di.$$