The Power of Forward Guidance Revisited

McKay, Nakamura, and Steinsson (2016, AER)

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Introduction

- Standard New Keynesian (NK) models imply that forward guidance (FG) has implausibly large effects on current outcomes (Carlstrom, Fuerst, and Paustian, 2015; Del Negro, Giannoni, and Patterson, 2023).
- This paper shows that this is due to highly forward looking nature of the consumption Euler equation.
- FG is much less effective at the effective lower bound (ELB) under incomplete markets.
  - Krusell and Smith (1998) found minimal differences between complete and incomplete markets models in response to [aggregate] productivity shocks.
  - But this changes when prices are sticky $\Longrightarrow$ Large difference between complete and incomplete markets model in response to FG about real interest rates.

Illustrating the FG Puzzle

Textbook New Keynesian Model

- Consider the canonical NK model (Woodford, 2003; Galí, 2015). The log-linearised dynamic IS equation (DISE) is:

$$x_t = \mathbb{E}_t x_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t \pi_{t+1} - r_t^n), \tag{1}$$

and the New Keynesian Phillips Curve (NKPC) is:

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \kappa x_t. \tag{2}$$

- Suppose the model is closed by a central bank (CB) which sets r_t:

$$r_t = i_t - \mathbb{E}_t \pi_{t+1} = r_t^n + \varepsilon_{t,t-j}, \tag{3}$$

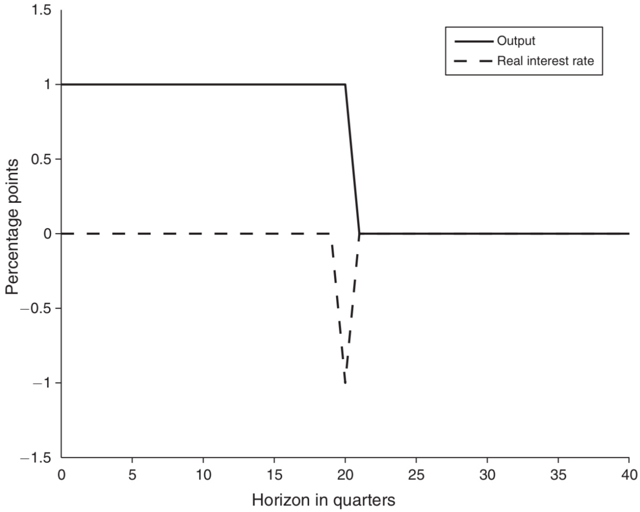
where $\varepsilon_{t,t-j}$ is a shock in t that becomes known in $t-j$.

Shock Announcement

- Suppose: CB announces that the real interest rate will be lower by 1 percent for a single quarter five years in the future: $\varepsilon_{t+20,t} = -0.01$.
- Results are what we have seen in class. But as a reminder:
  - Output increases by 1 percent immediately (assume $\sigma = 1$). Stays high until quarter 21.
  - Shock changes relative price of consumption between quarters 20 and 21.
  - Consumption can only deviate in quarter 20.
  - Monetary shocks have no effect on real economy in long run.
  - Mechanically see this by iterating the DISE (1) forward:

$$x_t = -\frac{1}{\sigma}\mathbb{E}_t \sum_{j=0}^{\infty} \left(i_{t+j} - \mathbb{E}_{t+j}\pi_{t+j+1} - r^n_{t+j} \right)$$

Illustration of Output Dynamics



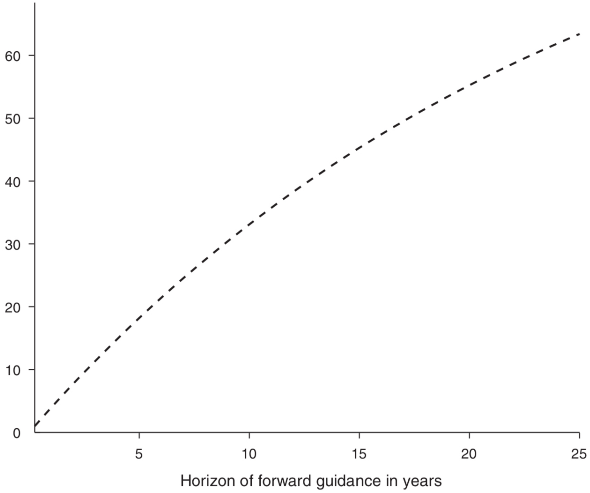
Strength of FG and NKPC Implications

- As seen, the further out the FG announcement, the higher the cumulative response in output.
- But this also applies to inflation. Iterating the NKPC (2) forward, we get:

$$\pi_t = \kappa \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j x_{t+j}.$$

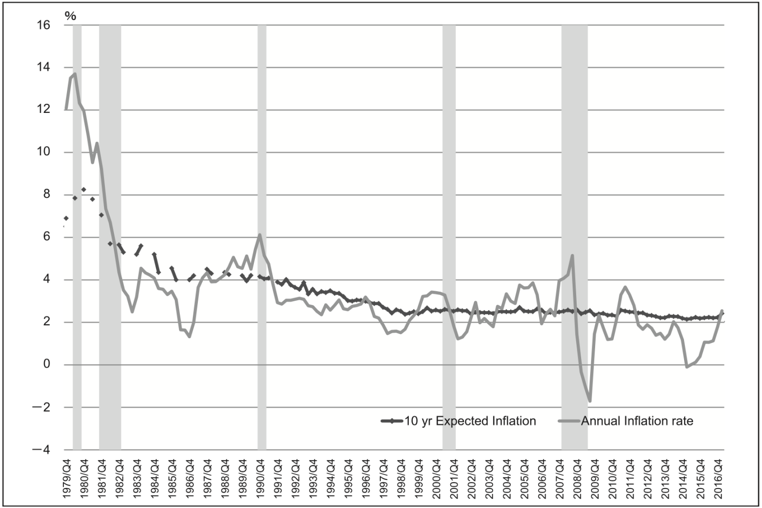
- As $j \rightarrow \infty$, response of inflation today for an FG announcement for the infinite future is: $\kappa\sigma/(1-\beta)$.

Current Inflation and the FG Horizon



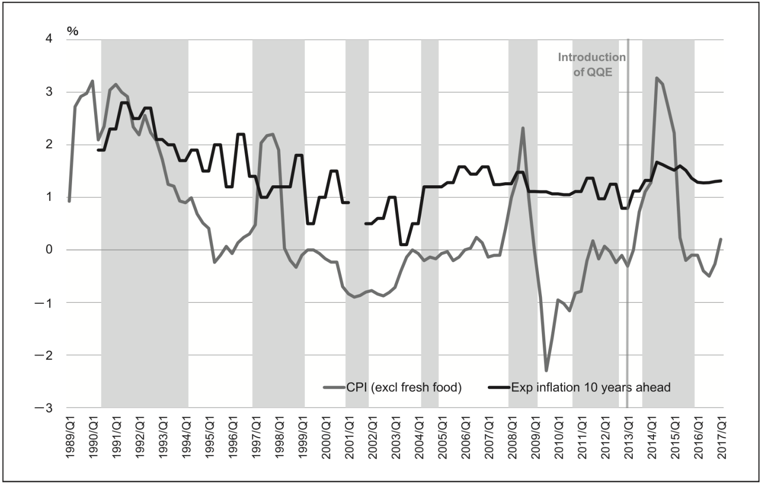
NOTE. Response of current inflation to FG about interest rates at different horizons relative to response to equally large change in current real interest rate.

Data on Long Run Forecasts: Inflation (US)



NOTE. Median SPF of headline CPI Inflation 10 years ahead and realised value. Source: Fed Philadelphia; Blue Chip Economic Indicators; US BLS.

Data on Long Run Forecasts: Inflation (Japan)



NOTE. Survey expectations of CPI Inflation 10 years ahead and actual inflation. Source: Consensus Economics Inc.; Japanese Ministry of Internal Affairs and Communication.

An Incomplete Markets Model

A Simplified Model

- McKay, Nakamura, and Steinsson (2016) describe an algorithm they use to compute the perfect foresight transition paths of the economy in response to monetary policy and demand shocks.
  - Not computationally straightforward.
- Here I consider a simplified version of their model as described in McKay, Nakamura, and Steinsson (2017).
  - Can compare to TANK and (T)HANK models we learnt in class and in Bilbiie (2020).
  - Contains most of the intuition and delivers the discounted Euler equation.

Model Assumptions

1. Idiosyncratic productivity shocks just takes two values: high ($z = 1$) and low ($z = 0$).
2. Idiosyncratic productivity is IID across time: $\Pr(z'|z) = \Pr(z')$.
3. The supply of government debt is zero: $B = 0$.
4. Tax system pays benefit m to low productivity households financed by lump-sum taxes on high productivity households.
5. Firm dividends are distributed only to the high-productivity households.
6. No wealth in the economy ("bondless limit" as in Bilbiie's THANK model).
7. Borrowing constraint on agents, $b' \geq 0$.

Households

- Household i maximises

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \exp(q_t) \left(\frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \frac{L_{i,t}^{1+\varphi}}{1+\varphi} \right), \tag{4}$$

  $q_t = q_{t-1} + r_{t-1}^n$: preference shock that determines the natural rate of interest.
- Households draw employment status each period $z_{i,t} \in \{0, 1\}$:
  - l-type with $\Pr(z_{i,t} = 0) = \rho$: receive m.
  - h-type with $\Pr(z_{i,t} = 1) = 1 - \rho$: earn $W_t L_{i,t}$.
- h-type funds m with $\rho m/(1-\rho)$.

Production and Equilibrium

- Standard: Final good, Y_t, produced from intermediate inputs (CES aggregate utilising the Dixit-Stiglitz aggregator), $Y_{j,t}$.
- Intermediate goods produced using linear technology in labour: $Y_{j,t} = N_{j,t}$.
- Final good firms are perfectly competitive; intermediate good firms are monopolistically competitive:
  - $P_{j,t}$ updated with probability θ each period.
- Bonds earn a real return of r_t between periods t and $t+1$.
- CB sets the nominal interest rate.

Intertemporal Euler Equations

- As studied in class, consumption of agents of a certain type are identical: $\{C_{h,t}, C_{l,t}\}$.
- Consumption is equal to income for all individuals. Euler equations are:

$$C_{h,t}^{-\sigma} \geq \beta \exp(r_t^n)(1+r_t)\mathbb{E}_t\left[(1-\rho)C_{h,t+1}^{-\sigma} + \rho m^{-\sigma}\right], \tag{5}$$

$$m^{-\sigma} \geq \beta \exp(r_t^n)(1+r_t)\mathbb{E}_t\left[(1-\rho)C_{h,t+1}^{-\sigma} + \rho m^{-\sigma}\right]. \tag{6}$$

- RHS of Euler equations are independent of $z_{i,t}$. Assume that $m < C_{h,t}, \forall t \implies l$-type are constrained and Euler equation will not hold with equality.
- Following Krusell, Mukoyama, and Smith (2011) and Ravn and Sterk (2017) assume that (5) holds with equality.

Discounted Euler Equation

- After using aggregate consumption identity to substitute into (5), log-linearising and using the Fisher equation gives:

$$c_t = \alpha \mathbb{E}_t c_{t+1} - \frac{\zeta}{\sigma}\left(i_t - \mathbb{E}_t \pi_{t+1} - r_t^n\right) \tag{7}$$

  with

$$\alpha \equiv \frac{1}{1 + \frac{\rho}{1-\rho}\left(\frac{C_h}{m}\right)^{\sigma}}, \tag{8}$$

$$\zeta \equiv 1 - \frac{\rho m}{C}. \tag{9}$$

- $\alpha = 0.97$ and $\zeta = 0.75$ matches dynamics produced by full model. But hard to match with reasonable calibrations for ρ, C_h, m and σ.

Comparison to Bilbiie's THANK

- Recall from Bilbiie (2020) we had:

$$c_t = \underbrace{\left[1 + \frac{(\chi-1)(1-s)}{1-\lambda\chi}\right]}_{\delta\text{: HANK}} \mathbb{E}_t c_{t+1} - \frac{1}{\sigma} \underbrace{\frac{1-\lambda}{(1-\lambda\chi)}}_{\text{TANK}} r_t, \tag{10}$$

  where $\Pr(S|S) = s$.

- Discounting ($\delta < 1$) iff $\chi < 1$ (procyclical inequality). Recall:

$$\chi = 1 + \varphi \left(1 - \frac{\tau^D}{\lambda}\right).$$

- We can nest MNS by assuming $\chi = 0 \implies \delta = s = 1 - h = 1 - \lambda$, where λ: mass of HtM households.

FG in THANK

- Use (10) to do some recursive substitution
- For any k from 0 to T, where k is the date of the FG announcement and T is the date of implementation of the interest rate change:

$$c_{t+k} = \delta^{T-k}\mathbb{E}_{t+k}c_{t+T} - \mathbb{E}_t\sum_{k=0}^{T}\delta^{T-k}\frac{1-\lambda}{\sigma(1-\lambda\chi)}r_{t+k}.$$

- Then, for any $k \in [0, T]$, the total effect of FG is

$$\Omega^{F(k)} \equiv \frac{dc_{t+k}}{d(-r_{t+T})} = \delta^{T-k}\frac{1-\lambda}{\sigma(1-\lambda\chi)}. \tag{11}$$

Direct and Indirect FG Effect

- After getting the PE curve (ommited here), you can get the **direct FG effect**:

$$\Omega_D^F \equiv \left.\frac{dc_{t+k}}{d(-r_{t+T})}\right|_{y_{t+k}=\bar{Y}} = \frac{(1-\lambda)\beta}{\sigma}\left[\delta\beta\left(1-\lambda\chi\right)\right]^T.$$

- **Indirect FG effect** is:

$$\begin{aligned}\Omega_D^F \equiv \left.\frac{dc_{t+k}}{d(-r_{t+T})}\right|_{r_{t+k}=\bar{r}} &= \left[1-\beta(1-\lambda\chi)\right]\mathbb{E}_{t+k}\sum_{i=0}^{T}\left[\beta\delta(1-\lambda\chi)\right]^i\frac{dc_{t+i}}{d(-r_{t+T})} \\ &= \frac{1-\lambda}{\sigma(1-\lambda\chi)}\left[1-\beta(1-\lambda\chi)\right]\mathbb{E}_{t+k}\sum_{i=0}^{T}\left[\beta\delta(1-\lambda\chi)\right]^i\delta^{T-i} \\ &= \frac{1-\lambda}{\sigma(1-\lambda\chi)}\delta^T\left\{1-\left[\beta(1-\lambda\chi)\right]^{1+T}\right\}.\end{aligned}$$

Multiplier of FG

- This gives us Proposition 4 in Bilbiie (2020): The multiplier of FG (an interest rate cut in T periods) and the MPC in an analytical HANK model are:

$$\Omega^F = \frac{1-\lambda}{\sigma(1-\lambda\chi)}\delta^T, \quad \omega^F = 1 - [\beta(1-\lambda\chi)]^{1+T}.$$

- FG puzzle resolved iff there is discounting, $\delta < 1$.
- In RANK ($s = 1, \lambda = 0$), $\Omega^F = 1$ and is invariant to time.
- In the TANK limit ($s = h = 1, \delta = 1$), FG is less ($\chi < 1$) or more $(\chi > 1)$ powerful than RANK.
- Again, in the MNS case: $\chi = 0$ and $1 - s = \lambda$.

Conclusion

- Paper provides two sufficient conditions to resolve the FG puzzle:
  - Analytically: $\chi = 0$ and $\delta = s = 1 - \lambda$.
  - Quantitatively: Transfer profits disproportionately from poor to wealthy households. Akin to making tax on firm dividends, $\tau^D > \lambda$, so $\chi < 1$.
- Other resolutions to the FG puzzle:
  - Sticky-information models (Kiley, 2000; Carlstrom, Fuerst, and Paustian, 2015).
  - Perpetual youth model of Blanchard and Yaari.
  - Incomplete markets with idiosyncratic income risk (this paper and Kaplan, Moll, and Violante (2018)).
  - Bounded rationality (Gabaix, 2020).
  - Lack of common knowledge (Angeletos and Lian, 2018).
- All of these approaches make the choices of the private sector (the DISE and NKPC) today less dependent on future economic outcomes.

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