Inflation Expectations and Consumption in New Keynesian Models: The Role of Heterogeneity

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*The views expressed here are the author's and do not necessarily reflect those of the National Bank of Slovakia or the Eurosystem.

Summary

- I carry forward the evidence of an **ambiguous** (possibly negative) consumption response to change in inflation expectations (Coibion et al., 2023) into the **New Keynesian (NK)** framework.
- The important channel goes through the effect on the **real expected income** (Hajdini et al., 2022).
- I put emphasis on it in the **NK framework**.
- I show that it is **impossible** to obtain negative consumption response in the **Rational Agent NK (RANK)** model due to the profits income channel.
- The consumption response may become negative in the **Heterogeneous Agent NK (HANK)** framework if we **attenuate** the profits income channel.

Consumption and inflation expectations

NK framework

- The relationship is assumed to be positive (if we control for the policy rate response).
- Heavily exploited in the ELB literature.
- **RANK**: The key mechanism builds on the elasticity of intertemporal substitution (EIS) to consume given that higher inflation expectations decrease ex-ante real interest rate.
- **Deviations from RANK**: The same mechanism applies also in HANK models.
- If the constrained households are sufficiently sensitive to changes in the aggregate output, any change in the real interest rate is even amplified.
- Behavioral deviations from the rational expectation equilibrium (REE) only attenuate the positive consumption response.

Empirics

- While Ito and Kaihatsu (2016), D'Acunto et al. (2018), Duca-Radu et al. (2023) or Marencak (2023) find results in line with the common narrative, Bachman et al. (2015), Burke and Ozdagli (2023) or Coibion et al. (2023) show no or negligible effects.
- The latter set of articles highlights a negative real income effect.
- Hajdini et al. (2022) show that U.S. consumer project expected increase in inflation to their nominal salaries only up to 20 percent.

Standard RANK model

- I fix an environment to be only two periods, $s = \{t, t+1\}$:

$$c_t = \mathbb{E}_t c_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t \pi_{t+1} - \rho), \tag{1}$$

$$w_s = \varphi n_s + \sigma c_s \quad \forall s = \{t, t+1\} \tag{2}$$

- We are in the **perfect foresight** world: $\mathbb{E}_t x_{t+1} = x_{t+1} \ \forall x$.
- The agent faces a flow **budget constraint** for each s: $C_t + B_t = W_t N_t + D_t$ and $C_{t+1} = W_{t+1}N_{t+1} + D_{t+1} + \frac{1+i_t}{1+\pi_{t+1}}B_{t+1}$.
- Given the zero net supply, we have a linearised **resource constraint**: $c_s = w_s + n_s + d_s$.
- Imposing the **optimal subsidy** to invoke the marginal cost pricing results in $d_s = -w_s$.
- Substituting behind d_s generates: $c_s = n_s$

Consumption response decomposition

- Substituting into the **labour supply** and writing it in period $t+1$ gives:

$$c_{t+1} = \frac{w_{t+1}}{\sigma+\varphi} = \frac{w^n_{t+1} - p_{t+1}}{\sigma+\varphi} \tag{3}$$

- After utilizing the relationship for inflation, equation 1 becomes:

$$c_t = \frac{w^n_{t+1} - p_{t+1}}{\sigma+\varphi} - \frac{i_t - \rho + p_t}{\sigma} + \frac{p_{t+1}}{\sigma} \tag{4}$$

- I stay **ambiguous** on the exact functional form of w^n_{t+1}, yet I assume that it is a **function of expected price level**; i.e., $w^n_{t+1} = f(p_{t+1})$.
- Note we are in the **indeterminate** system, given that $i_s = 0 \forall s$.
- I focus on **minimum state variable (MSV)** of McCallum (1998).
- The **effect** of change in the expected price level can be written as:

$$\frac{\partial c_t}{\partial p_{t+1}} = \underbrace{\frac{\partial c_t}{\partial w^n_{t+1}}\frac{\partial w^n_{t+1}}{\partial p_{t+1}} - \frac{1}{\sigma+\varphi}}_{\text{real income effect}} + \overbrace{\frac{1}{\sigma}}^{\text{EIS}} \tag{5}$$

- It is undemanding to see that $\frac{\partial c_t}{\partial w^n_{t+1}} = \frac{1}{\sigma+\varphi}$. The **question** is what happens to $\frac{\partial w^n_{t+1}}{\partial p_{t+1}}$.

Rational expectations equilibrium

Sticky prices NK model

- The **general equilibrium (GE)** effects amplify the response of consumption on change to inflation expectations.
- If we utilize the usual NK PC $\pi_s = \beta\pi_{s+1} + \lambda(w^n_s - p_s)$ and focus on the **MSV equilibrium** of McCallum (1998) to write $\pi_{s+1} = \eta\pi_s$, total consumption reaction becomes:

$$\frac{\partial c_t}{\partial p_{t+1}} = \underbrace{\frac{1-\beta\eta}{(\sigma+\varphi)\lambda}}_{\text{real income effect}} + \overbrace{\frac{1}{\sigma}}^{\text{EIS}} \tag{6}$$

- There is not only full propagation; usually we have even $\frac{\partial w^n_{t+1}}{\partial p_{t+1}} > 1$.
- The **GE effects strengthen** the positive consumption response.
- Households read the positive effect on aggregate demand and therefore **expect real wages to increase**.

Sticky wages NK model

- If I assume that we have flexible prices and **sticky wages** model, the wage PC (again focusing on the MSV equlibrium with $\pi^w_{s+1} = \eta\pi^w_s$) is: $\pi^w_s = \pi_s = \frac{\lambda_w(\sigma+\varphi)}{(1-\beta\eta_w)}c_s$, given that $w_s = w^n_s - p_s = 0$ and $\pi_s = \pi^w_s$ must always hold.
- Therefore, the total consumption response arises as:

$$\frac{\partial c_t}{\partial p_{t+1}} = \underbrace{\frac{1-\beta\eta_w}{(\sigma+\varphi)\lambda_w}}_{\text{real income effect}} + \overbrace{\frac{1}{\sigma}}^{\text{EIS}} \tag{7}$$

- The difference between 7 and 6 is **purely quantitative** and is driven by slopes of the Phillips curves.
- In this regard, I relate to the equivalence result of Bilbiie and Trabandt (2024).

Incomplete passthrough into nominal wages

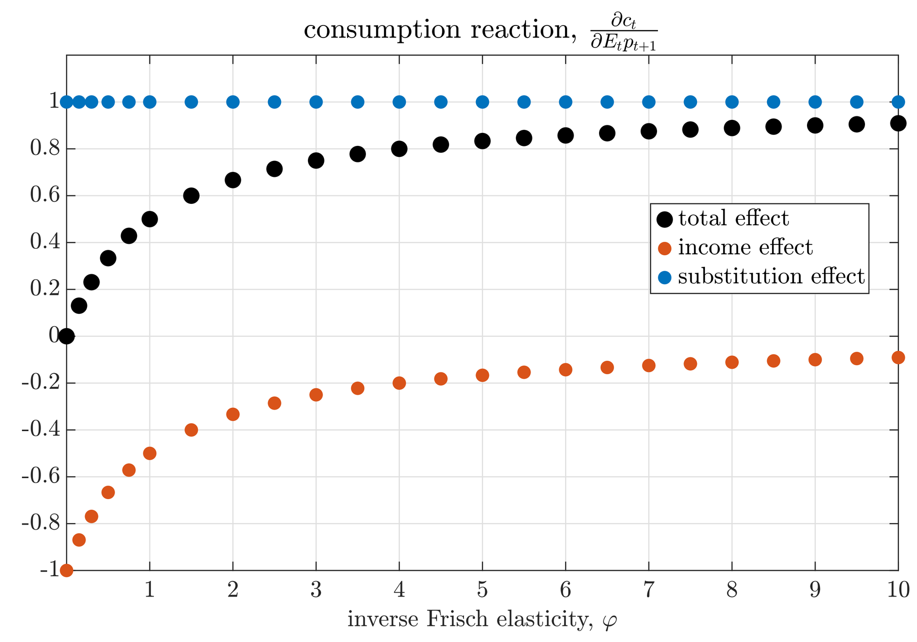
- I **dampen the GE effects** and also assume that households **do not fully relate** changes in inflation expectations to changes of their nominal income.
- These two aspects may be seen as a **joint problem**.
- If GE effects are large enough, propagation is not only full, but there is even **amplification**.
- To obtain an **incomplete propagation** may be seen also as **dampening of GE effects** if assuming that agents reason in terms of GE effects on **nominal salaries**.
- Once GE positive effects are dampened strongly, the propagation may be **below one**.
- I assume that households are myopic in line with the **cognitive discounting** of Gabaix (2020) while their myopia is related to the nominal wage expectations, which automatically yields into the **GE effects discounting**.

$$\frac{\partial c_t}{\partial p_{t+1}} = \underbrace{\frac{\overline{m}}{\sigma+\varphi}\overbrace{\left(\frac{1-\beta\eta+\lambda}{\lambda}\right)}^{\text{GE effects}} - \frac{1}{\sigma+\varphi}}_{\text{real income effect}} + \overbrace{\frac{1}{\sigma}}^{\text{EIS}} \tag{8}$$

- To reveal problematic aspects of profits in the RANK model, I **shut down the GE effects** completely by setting $\overline{m} = 0$.
- Increase in inflation expectations result in expectations of **real wage decrease**, in line with Hajdini et al. (2022).
- This transforms equation 8 into:

$$\frac{\partial c_t}{\partial p_{t+1}} = -\frac{1}{\sigma+\varphi} + \frac{1}{\sigma} \tag{9}$$

Figure 1. The consumption reaction as a function of φ



- The consumption response in the RANK framework can **never** be negative.
- The reason is that labour income and **dividends** go to the **same household** and offset each other.

Heterogeneity - dampening profits

- Considering that **profits** play a key role, the results may differ if we use the **TANK** or the **THANK** framework (e.g. see Bilbiie, 2008 and Bilbiie, 2024).
- It is the **distribution of profits** between HHs that drives the **direction** of consumption response.
- We have the equilibrium conditions of the **unconstrained HHs** (u):

$$c^u_t = s c^u_{t+1} + (1-s)c^H_{t+1} - \frac{1}{\sigma}(i_t - \pi_{t+1} - \rho), \tag{10}$$

$$w_s = \varphi n^u_s + \sigma c^u_s \quad \forall s = \{t, t+1\} \tag{11}$$

$$c^u_s = n^u_s + w_s + \frac{1-\tau^d}{1-\lambda}d_s \quad \forall s = \{t, t+1\} \tag{12}$$

- I assume $s = 1$ and thus boil down the model to Bilbiie (2008).
- This results in the following **effect of inflation expectations on consumption** if I assume $\frac{\partial w^n_{t+1}}{\partial p_{t+1}} = 0$ (due to $\overline{m} = 0$):

$$\frac{\partial c^u_t}{\partial p_{t+1}} = \underbrace{-\left[\frac{(1+\varphi)(1-\lambda) - \varphi(1-\tau^d)}{(\sigma+\varphi)(1-\lambda)}\right]}_{\text{real income effect}} + \overbrace{\frac{1}{\sigma}}^{\text{EIS}} \tag{13}$$

- It is not difficult to show that $\frac{\partial c^u_t}{\partial p_{t+1}} > 0$ **iff**:

$$\frac{(1-\tau^d)}{(1-\lambda)} > 1 - \frac{1}{\sigma} \tag{14}$$

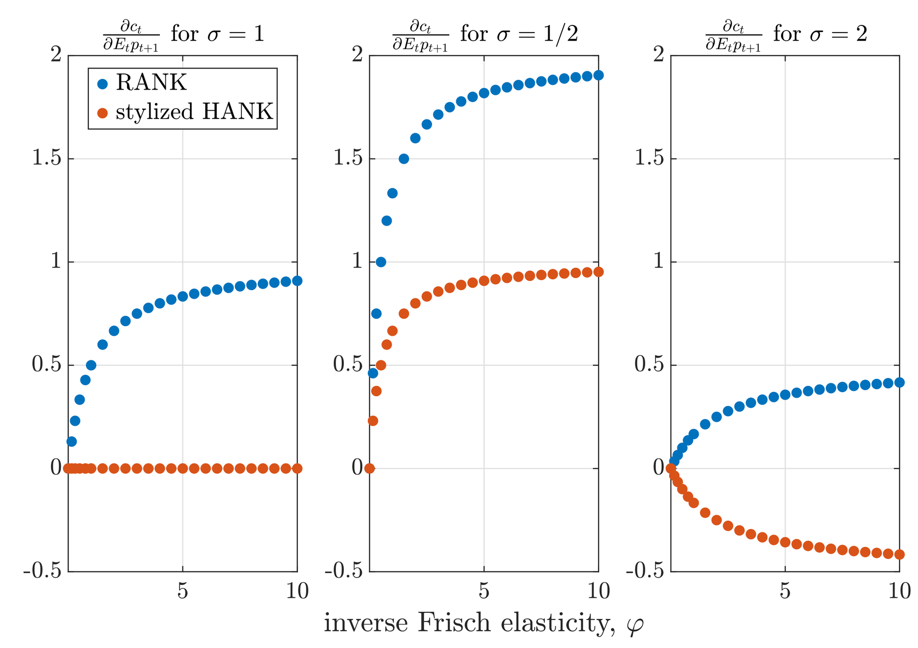
- There is a threshold of τ^d beyond which $\frac{\partial c^u_t}{\partial p_{t+1}} < 0$.
- In case of King et al. (1988) preferences, the consumption response is **always positive** unless $\tau^d = 1$
- When we assume $\sigma \neq 1$, we get the following **threshold** of τ^d below which the **consumption response is still positive**:

$$\tau_d < \frac{1-\lambda(1-\sigma)}{\sigma} \tag{15}$$

- If I fully shut down the profits income channel by $\tau^d = 1$, the consumption response becomes equivalent to the ***workers*** and ***capitalists*** stylized version of a HANK model of Broer et al. (2020).
- In Broer et al. (2020), agents capable of intertemporally smoothing consumption **are not the same** ones receiving profits.
- Conditioning again on $\overline{m} = 0$, we get $\frac{\partial c_t}{\partial p_{t+1}}$ to be:

$$\frac{\partial c^W_t}{\partial p_{t+1}} = -\frac{1+\varphi}{\sigma+\varphi} + \frac{1}{\sigma} \tag{16}$$

Figure 2. The consumption reaction in RANK and HANK



Necessary passthrough threshold

- I define Ω to be the **relative passthrough** and write **expected nominal wages** formation as follows:

$$w^n_{t+1} = \Omega p_{t+1} = \overline{m}\left(\frac{1-\beta\eta+\lambda}{\lambda}\right)p_{t+1} \tag{17}$$

- Which allows us to compute the minimum **necessary threshold** of the **passthrough** to obtain $\frac{\partial c^W_t}{\partial p_{t+1}} > 0$:

$$\Omega > 1 - \frac{1}{\sigma}\left(\frac{\sigma+\varphi}{1+\varphi}\right) \tag{18}$$

Figure 3. Necessary thresholds of Ω for $\frac{\partial c^W_t}{\partial p_{t+1}} > 0$ if $\sigma > 1$