The New Keynesian Approach to Monetary Policy Analysis and Consumption: case study (OPEC countries)

Sadr, Seyed Mohammad Hossein a, Gudarzi Farahani, Yazdan b *

aPh.D student in Management Information Technology, Department of Management and accounting, University of Allame Tabataba’i (ATU)
b M.A. student in Economics, University of Tehran, Faculty of economics, North Kargar, Tehran, Iran, yazdan.farahani@gmail.com

Abstract

While consumption habits have been utilized as a means of generating a hump shaped output response to monetary policy shocks in sticky-price New Keynesian economies, there is relatively little analysis of the impact of habits (particularly, external habits) on optimal policy. In this paper we consider the implications of external habits for optimal monetary policy, when those habits either exist at the level of the aggregate basket of consumption goods or at the level of individual goods. External habits generate an additional distortion in the economy, which implies that the flex-price equilibrium will no longer be efficient and that policy faces interesting new trade-offs and potential stabilization biases. Furthermore, the endogenous mark-up behavior, which emerges when habits are deep, can also significantly affect the optimal policy response to shocks, as well as dramatically affecting the stabilizing properties of standard simple rules. I discuss several lessons regarding the design and conduct of monetary policy that have emerged out of the New Keynesian research program. Those lessons include the benefits of price stability, the gains from commitment about future policies, the importance of natural variables as benchmarks for policy, and the benefits of a credible anti-inflationary stance.

Keywords: Consumption; Interest rate rule; Optimal monetary policy; OPEC Countries;

1. Introduction

The New Keynesian (NK) approach to monetary policy analysis has emerged in recent years as one of the most influential and prolific areas of research in macroeconomics. It has provided us with a framework that combines the theoretical rigor of Real Business Cycle (RBC) theory with

Keynesian ingredients like monopolistic competition and nominal rigidities. That framework has also become the basis for the new generation of models being developed at central banks, and increasingly used for simulation and forecasting purposes. In the present paper I will try to summarize what I view as some of the key lessons that have emerged from that research program and to point to some of the challenges it faces, as well as possible ways of overcoming those challenges.

In this paper we extend the benchmark sticky-price New Keynesian economy to include external habits in consumption, where these habits can be either superficial or deep. The focus on external habits implies that there is an externality associated with fluctuations in consumption which implies that the flexible price equilibrium will not usually be efficient, thereby creating an additional trade-off for policy makers, which may give rise to additional
stabilisation biases if policy is constrained to be time consistent. Such trade-offs will occur whether or not habits are superficial or deep. We also consider the implications for optimal policy of assuming habits are of the deep kind. Here the ability of policy to influence the time profile of endogenously determined mark-ups can significantly affect the monetary policy stance and how it differs across discretion and commitment. In addition to examining optimal policy, we also consider how the introduction of habits affects the conduct of policy through simple rules.

In this paper, we intend to examine the prediction consumption for OPEC countries according to Campbell Leith, Ioana Moldovan and Raffaele Rossi (2009) article.

2. The Model

The economy is comprised of households, two monopolistically competitive production sectors, and the government. There is a continuum of final goods that enter the households’ consumption basket, each final good being produced as an aggregate of a continuum of intermediate goods. Households can either form external consumption habits at the level of each final good in their basket, Ravn, Schmitt-Grohe, and Uribe (2006) call this type of habits ‘deep’, or they can form habits at the level of the consumption basket - ‘superficial’ habits. Throughout the paper, we use the same terminology. Furthermore, we assume price inertia at the level of intermediate goods producers. We shall derive a general model, and note when assuming superficial or deep habits alters the behavioural equations (Campbell Leith, Ioana Moldovan and Raffaele Rossi, 2009).

HOUSEHOLDS

The economy is populated by a continuum of households, indexed by k and of measure. Households derive utility from consumption of a composite good and disutility from hours spent working. When habits are of the deep kind, each household’s consumption basket, $X^k_t$, is an aggregate of a continuum of habit-adjusted final goods, indexed by i and of measure,$$
X^k_t = \left( \int_{i=0}^1 \left( C^k_{it} - \theta C_{it-1} \right)^{\frac{\eta}{\eta-1}} di \right)^{\frac{\eta-1}{\eta}}
$$where $C^k_{it}$ is household k’s consumption of good i and $C_{it} \equiv \int_{i=0}^1 C^k_{it} dk$, denotes the cross sectional average consumption of this good. $\eta$ is the elasticity of substitution between habit-adjusted final goods ($\eta > 1$), while the parameter $\theta$ measures the degree of external habit formation in the consumption of each individual good i. Setting $\theta$ to 0 returns us to the usual case of no habits (Campbell Leith, Ioana Moldovan and Raffaele Rossi, 2009). The composition of the consumption basket is chosen in order to minimize expenditures, and the demand for final goods is

$$C^k_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} X^k_t + \theta C_{it-1} ; \quad \forall_i$$

Where $P_t$ represent the overall price index, defined as an average of final goods prices, $P_t = \left( \int_{i=0}^1 P_{it}^{1-\eta} di \right)^{1/1-\eta}$. Aggregating across households yields the total demand for good , $i \in [0,1]$.

$$C_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} X^k_t + \theta C_{it-1} \quad (1)$$

Due to the presence of habits, this demand is dynamic in nature, as it depends not only on current period elements but also on the lagged value of consumption. This, in turn, will make the pricing/output decisions of the firms producing these final goods, intertemporal.

Habits are superficial when they are formed at the level of the aggregate consumption good. Households derive utility from the habit-adjusted composite good, $X^k_t$,$$
X^k_t = C^k_t - \theta C_{t-1}
$$
Where household $k$’s consumption, $C_k^t$, is an aggregate of a continuum of final goods indexed by $i \in [0,1]$, 
\[
C_k^t = \left( \int_{i=0}^{1} (C_k^t)^{\eta} \, di \right)^{\frac{1}{\eta}}
\]
With $\eta$ the elasticity of substitution between them and $C_{t-1} \equiv \int_{i=0}^{1} C_k^{t-1} \, dk$, the cross-sectional average of consumption.

Households decide the composition of the consumption basket to minimize expenditures and the demand for individual good $i$ is 
\[
C_k^t = \left( \frac{P_i^t}{P_c^t} \right)^{-\eta} C_k^t = \left( \frac{P_i^t}{P_c^t} \right)^{-\eta} (X_k^t + \theta C_{t-1}^t)
\]
Where $P_t = \left( \int_{i=0}^{1} P_i^{1-\eta} \, di \right)^{1/(1-\eta)}$, is the consumer price index. The overall demand for good $i$ is obtained by aggregating across all households:
\[
C_i^t = \int_{i=0}^{1} C_k^t \, dk = \left( \frac{P_i^t}{P_c^t} \right)^{-\eta} C_t
\]
Unlike the case of deep habits, this demand is not dynamic and the final goods producing firms will face a static pricing/output decision (Campbell Leith, Ioana Moldovan and Raffaele Rossi, 2009).

Specifically, households choose the habit-adjusted consumption aggregate, $X_k^t$, hours worked, $N_k^t$, and the portfolio allocation, $D_k^{t+1}$, to maximize expected lifetime utility
\[
E_0 \sum_{t=0}^{\infty} \beta^t \left[ \frac{(X_k^t)^{1-\sigma}}{1-\sigma} - \frac{R(N_k^t)^{1+\nu}}{1+\nu} \right]
\]
Subject to the budget constraint:
\[
\int_{i=0}^{1} P_i^t \, C_i^k \, di + E_t Q_{t,t+1} D_t^{k+1} = W_t N_k^t + D_t^k + \phi_t - T_t
\]
and the usual transversality condition. $E_t$ is the mathematical expectation conditional on information available at time $t$, $\beta$ is the discount factor ($0 < \beta < 1$), $R$ the relative weight on disutility from time spent working, and $\sigma$ and $\nu$ are the inverses of the intertemporal elasticities of habit-adjusted consumption and work ($\sigma, \nu > 0; \sigma \neq 1$). The household’s period-$t$ income includes: wage income from providing labour services to intermediate goods producing firms, $W_t N_k^t$, dividends from the monopolistically competitive firms, $\phi_t$, and payments on the portfolio of assets, $D_t^k$. Financial markets are complete and, $Q_{t,t+1}$, is the one-period stochastic discount factor for nominal payoffs. $T_t$ are lump-sum taxes collected by the government. In the maximization problem, households take as given the processes for, $C_{t-1}$, $W_t$, $\phi_t$, and $T_t$, as well as the initial asset position, $D_{t-1}$.

The first order conditions for labour and habit-adjusted consumption are:
\[
\frac{R(N_k^t)^{\nu}}{(X_k^t)^{-\sigma}} = \omega_t
\]
And
\[
Q_{t,t+1} = \beta \left( \frac{X_k^t}{X_k^t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \frac{w_t}{p_t}
\]
Where $\omega_t \equiv \frac{W_t}{P_t}$ is the real wage. The Euler equation for consumption can be written as
\[
1 = \beta E_t \left[ \left( \frac{X_k^{t+1}}{X_k^t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \right] R_t
\]
Where $R_t^{-1} = E_t[Q_{t,t+1}]$ denotes the inverse of the risk-free gross nominal interest rate between periods $t$ and $t + 1$.

**Firms**

In this subsection we consider the behaviour of firms. These are split into two kinds: final and intermediate goods producing firms, respectively. In the case of the former, their behaviour depends upon the form of demand curve they face, which is dynamic in the case of deep habits, and static under superficial habits. Intermediate goods firms produce a differentiated intermediate good and are subject to nominal inertia in the form of Calvo (1983) contracts.
This structure is adopted for reasons of tractability, allowing us to easily switch between superficial and deep habits. Additionally, combining optimal price setting under both Calvo contracts and dynamic demand curves would undermine the desirable aggregation properties of the Calvo model as each firm given the signal to re-set prices would set a different price dependent on the level of consumption habits their product enjoyed relative to other firms. By separating the two pricing decisions we avoid reintroducing the history-dependence in price setting the Calvo set-up is designed to avoid (Campbell Leith, Ioana Moldovan and Raffaele Rossi, 2009).

### Final Goods Producers

We assume that final goods are produced by monopolistically competitive firms as an aggregate of a set of intermediate goods (indexed by j), according to the function:

\[ Y_{it} = \left( \int_{j=0}^{j} (Y_{jlt})^{\frac{\epsilon}{\epsilon-1}} \right)^{1-\frac{1}{\epsilon}} \tag{5} \]

where \( \epsilon \) is the constant elasticity of substitution between inputs in production (\( \epsilon > 1 \)). Taking as given intermediate goods prices \( \{P_{jlt}\} \) and subject to the available technology (5), firms first choose the amount of intermediate inputs \( \{Y_{jlt}\} \), that minimize production costs, \( \int_{0}^{1} P_{jlt} Y_{jlt} \). The first order conditions yield the demand functions:

\[ Y_{jlt} = \left( \frac{P_{jlt}}{P_{it}} \right)^{1-\epsilon} Y_{it} \tag{6} \]

where \( P_{it} = (\int_{j}^{j} P_{jlt}^{1-\epsilon} djl)^{1/1-\epsilon} \) is the aggregate of intermediate goods prices in sector i and represents the nominal marginal cost of producing an additional unit of the final good i. Nominal profits are given by \( \phi_{it} = (P_{it} - P_{it}^{m})Y_{it} \). It is important to note that this cost-minimisation problem takes the same form whether firms are faced with consumers whose habits are deep or superficial. However, their pricing decisions will differ across this dimension. We now examine the pricing decision of final goods firms, dependent upon whether habits are deep or superficial.

Deep Habits When habits are deep, firms face the dynamic demand from households, given by expression (1), and their profit maximization problem becomes intertemporal: the choice of price affects market share and future profits. Therefore, firms choose processes for \( Y_{it} \) and \( P_{it} \) to maximize the present discounted value of expected profits, \( E_{t} \int_{t}^{t} Q_{t+t+s} \phi_{it+t+s} \), subject to this dynamic demand and the constraint that \( C_{it} = Y_{it} \cdot Q_{t+t+s} \) is the s-step ahead equivalent of the one-period stochastic discount factor in (4). The first order conditions for \( Y_{it} \) and \( P_{it} \) are

\[ v_{it} = (P_{it} - P_{it}^{m}) + \theta E_{t}[Q_{t+t+1}v_{it+1}] \]

where the Lagrange multiplier \( v_{it} \) represents the shadow price of producing an additional unit of the final good i. This shadow value equals the marginal benefit of additional profits, \( (P_{it} - P_{it}^{m}) \), plus the discounted expected payoff from higher future sales, \( \theta E_{t}[Q_{t+t+1}v_{it+1}] \). Due to the presence of habits in consumption, increasing output by one unit in the current period leads to an increase in sales of \( \theta \) in the next period. In the absence of habits, when \( \theta = 0 \), the intertemporal effects of higher output disappear and the shadow price simply equals time-t profits. The other first order condition in equation (8) says that an increase in price brings additional revenues, \( Y_{it} \), while simultaneously causing a decline in demand, given by the term in square brackets and valued at the shadow value \( v_{it} \).

Under superficial habits the profit maximization problem of the final goods firms is the typical static problem whereby firms choose the price to maximize current profits, \( \phi_{it} = (P_{it} - P_{it}^{m})Y_{it} \), subject to the demand for their good (2) and under the restriction that all demand be satisfied at the chosen price. The optimal, \( C_{it} = Y_{it} \) price is set at a constant markup, \( \mu = \frac{-\eta}{\eta-1} \), over the marginal cost,

\[ P_{it} = \mu P_{it}^{m} \]

### Intermediate Goods Producers

The intermediate goods sectors consist of a continuum of monopolistically competitive firms indexed by j and of measure 1. Each firm j produces a unique good using only labour as input in the production process:

\[ Y_{jlt} = A_{l} N_{jlt} \]
Total factor productivity, \( A_t \), affects all firms symmetrically and follows an exogenous stationary process, \( \ln A_t = \rho \ln A_{t-1} + e_t \), with persistence parameter \( \rho \in (0, 1) \) and random shocks \( e_t \sim i.i.d. N(0, \sigma_A^2) \).

Firms choose the amount of labour that minimizes production costs, \((1 - \kappa)W_t N_{jit}\). The subsidy \( \kappa \), financed by lump-sum taxes, is designed to ensure that the long-run equilibrium is efficient. The minimization problem gives a demand for labour, \( N_{jit} = \frac{Y_{jit}}{A_{jite}} \), and a nominal marginal cost, \( MC_t = (1 - \kappa) \frac{W_t}{A_t} \), which is the same across firms.

Nominal profits are expressed as, \( \phi_{jite} = (P_{jite} - MC_t)Y_{jite} \).

We further assume that intermediate goods producers are subject to the constraints of Calvo (1983)-contracts such that, with fixed probability \((1 - \alpha)\) in each period, a firm can reset its price and with probability \( \alpha \) the firm retains the price of the previous period. When a firm can set the price, it does so in order to maximize the present discounted value of profits, \( E_t \sum_{s=0}^{\infty} \alpha^s Q_{t+s} \phi_{jite+s} \), and subject to the demand for its own good (6) and the constraint that all demand be satisfied at the chosen price. Profits are discounted by the s-step ahead stochastic discount factor \( Q_{t+s} \) and by the probability of not being able to set prices in future periods.

Optimally, the relative price satisfies the following relationship:

\[
\frac{P_{jite}}{P_t} = \left( \frac{\varepsilon}{\varepsilon - 1} \right) \left( \frac{E_t \sum_{i=0}^{\infty} \alpha^i (X_{t+i})^{-\alpha} (X_{t+i})^{-\alpha} \cdot \frac{P_{jite+s}}{P_t} Y_{jite+s}}{E_t \sum_{i=0}^{\infty} \alpha^i (X_{t+i})^{-\alpha} \left( \frac{P_{jite+s}}{P_t} \right)^{-1} \left( \frac{P_{jite+s}}{P_t} \right)^{-1} Y_{jite+s}} \right)
\]

Where, \( mc_t = \frac{MC_t}{P_t} \) is the real marginal cost. \( P_{jite}^{m} \) represents the price at the level of sector \( i \) and is an average of intermediate goods prices within that sector. With \( \alpha \) of firms keeping last period’s price and \((1 - \alpha)\) of firms setting a new price, the law of motion of this price index is:

\[
(P_{jite}^{m})^{1-\varepsilon} = \alpha (P_{jite}^{m})^{1-\varepsilon} + (1 - \alpha) (P_{jite}^{\alpha})^{1-\varepsilon}
\]

This description of intermediate goods firms is the same irrespective of the nature of habits formation.

The Government

The government collects lump-sum taxes which it rebates to intermediate goods producing firms as subsidies, which ensure an efficient long-run level of output. There is no government spending per se. The government budget constraint is given by

\[
\kappa W_t N_t = T_t
\]

In this cashless economy, monetary policy is conducted in optimal fashion, with the nominal interest rate being the central bank’s policy instrument. However, we also consider the consequences of the central bank adopting more simple forms of policy, such as Taylor-type interest rate rules, and explore how closely these simple policy rules come to the optimal (Campbell Leith, Ioana Moldovan and Raffaele Rossi, 2009).

Equilibrium

In the absence of sector-specific shocks or other forms of heterogeneity, final goods producers are symmetric and so are households. However, symmetry does not apply to intermediate goods producers who face randomness in price setting. There is a distribution of intermediate goods prices and aggregate output is therefore determined as:

\[
Y_t = A_t \frac{N_t}{\Delta_t}
\]

\[\Delta_t = \int \left( \frac{P_{jite}}{P_{jite}^{m}} \right)^{-\varepsilon} dj \] is the measure of price dispersion, which can be shown to follow an AR(1) process given by

\[
\Delta_t = (1 - \alpha) \left( \frac{P_{jite}}{P_{jite}^{m}} \right)^{-\varepsilon} + \alpha (\pi_t)^{\varepsilon} \Delta_{t-1}
\]
Note that we have two measures of aggregate prices, a producer price index $P_t^m$ and the usual consumer price index $P_t$, and consequently, there will be two measures of inflation. We define: $\pi_t^m = \frac{P_t^m}{P_t^{m-1}}$ and $\pi_t = \frac{P_t}{P_{t-1}}$. Furthermore, the two inflation variables are related according to the following relationship

$$\pi_t = \pi_t^m \frac{\mu_t}{\mu_{t-1}}$$

(13)

where $\mu_t = \frac{P_t}{P_{t-1}}$ is the markup of final goods producers. In the presence of deep habits, this markup is time-varying. The overall markup in the economy is given by the product of markups in the intermediate goods and final goods sectors and equals the inverse of the real marginal cost, $mc_t^{-1} = \frac{P_t}{MC_t}$. It should be noted that when habits are superficial, the mark-up in the final goods sectors is constant, $\mu_t = \mu$, and there is no longer any wedge between consumer price and producer price inflation. Finally, the aggregate version of the household’s budget constraint (3) combines with the government budget constraint (10) and the definition of aggregate profits $\Phi_t = P_tY_t - (1-N)W_tN_t$ to obtain the usual aggregate resource constraint,

$$Y_t = C_t$$

(14)

The equilibrium is then characterized by equations (11) - (14), to which we add the monetary policy specification (to be detailed in Sections 3 and 4 below) and the following set of equations:

**Consumers:**

$$X_t = C_t - \theta C_{t-1}$$

(15)

$$\frac{X_t^\sigma}{X_t^{-\sigma}} = \omega_t$$

(16)

$$X_t^{-\sigma} = \beta E_t \left[ X_{t+1}^{\sigma} \frac{P_t}{P_{t+1}} \right] R_t$$

(17)

**Government:**

$$NW_tN_t = T_t$$

(18)

**Intermediate goods producers:**

$$(P_t^m)^{1-\varepsilon} = \alpha (P_t^{m-1})^{1-\varepsilon} + (1-\alpha) (P_t^{m-1})^{1-\varepsilon}$$

(19)

$$\frac{P^*_t}{P_t} = \left( \frac{\varepsilon}{\varepsilon-1} \right) \frac{k_{1t}}{k_{2t}}$$

(20)

**Final goods producers:**

The differences in the two economies when habits are deep rather than superficial emerges in the behaviour of the final goods firms. As noted above, when habits are superficial they simply adopt a constant mark-up over the price of the bundle of intermediate goods,

$$\mu_t = \mu$$

(21)

In contrast, when habits are deep and final goods firms face a dynamic demand curve for their product, the endogenous time varying mark-up is described by the following two equations (note that we have written the shadow price of producing final goods in real terms, i.e. $w_t = \frac{w_t}{P_t}$)

$$w_t = \left( 1 - \frac{1}{\mu_t} \right) + \theta \beta E_t \left[ \left( \frac{X_{t+1}}{X_t} \right)^{-\sigma} w_{t+1} \right]$$

(22)

$$Y_t = \eta w_t X_t$$

(23)

4. Conclusion

In this paper we considered the optimal policy response to technology shocks in a New Keynesian economy subject to habits effects in consumption. These effects were assumed to be external, such that one household fails to take account of the impact their consumption behaviour has on other households as each household seeks to ‘catch up with the Joneses’. This consumption externality needs to be traded-off against the monetary policy maker’s usual
desire to stabilise inflation (a trade-off which would not exist if habits were internal) and generates a new form of stabilisation bias as time consistent policy is unable to mimic the initial policy response under commitment. This framework is further enriched by allowing the habits effects to be either superficial (at the level of the household’s total consumption) or deep (at the level of individual consumption goods). Under deep habits, firms face dynamic demand curves which imply an intertemporal dimension to price setting and endogenous mark-up behaviour. This, in turn, further modifies the optimal policy response to technology shocks when habits are deep.

In addition to considering optimal policy, we also consider the stabilising properties of simple rules.

References

Figures:

Figure 1: Impulse responses to a 1% positive technology shock under optimal commitment policy, in the case of superficial habits: $\theta = 0.4$ (dash lines), $\theta = 0.65$ (benchmark value, pluses), $\theta = 0.75$ (solid lines).