

# Monopolistic Competition and Menu Costs

Christian Groth    Emiliano Santoro

November 2008



## General Focus

- An introduction to new Keynesian economics
- The Blanchard-Kiyotaki model of monopolistic competition
- The role of "menu costs"

- New Keynesian (NEK) economics as a reaction to New Classical Macroeconomics (NCM)
- Main scope:
  - Demonstrate the existence of involuntary unemployment
  - Money non-neutrality (or monetary policy effectiveness)
- From a methodological point of view the new doctrine accepts:
  - *Microfoundations* (derivation of macroeconomic relationships from "first principles")
  - *Rational Expectations*

- NKE departs from the paradigm of perfect competition through the introduction of explicit market "imperfections"
- Two main strands of analysis can be identified:
  - NEK-*im*: market power imperfections (distortions of the competitive allocation mechanism)
  - NEK-*ia*: imperfections stemming from information frictions (limited and/or asymmetric information)

## Keynes' General Theory (Keynes, 1936) and the Great Depression

- Attempt to come to grips with the economic catastrophe...
- ...find policies for its cure and prevention in the future
- Revolution in the way economists thought about the economy as a whole
- In many respects the analytical content of the book was incomplete

## Neoclassical synthesis (or “neoclassical-Keynesian” synthesis)

- Keynes' American followers: Samuelson, Klein, Modigliani, Solow and Tobin
- Pragmatic and policy-oriented
- Apart from incorporation a Phillips curve, substantial satisfaction with the basic logic of Keynes' theory
- Keynes' theory as relevant point of departure for the study of the short run (involuntary unemployment)
- Classical (pre-Keynesian) theory: flexible prices relying on market clearing through flexible prices,
  - This is only applicable for the study of the long run (or a state with sustained full employment)
- Reconciliation of Keynes and the classics: “neoclassical synthesis” or the “neoclassical-Keynesian” synthesis

## Milton Friedman and the Monetarism

- Critique the policy activism of the Keynesians
- Agreement on the relevance of nominal rigidities in the short run
- Although there is usually a short-run trade-off between inflation and unemployment, there is no long-run trade-off
  - Endogeneity of inflation expectations – in the long run it is impossible to fool rational people (Edmund Phelps, 1967, 1968)



## The new classical counter-revolution

- Initiated by Lucas and Sargent in the early 1970s and later joined by Barro and Prescott
- Substantial rejection of Keynesian thinking (disequilibrium)
- Embrace of the classical or Walrasian line of thinking (equilibrium)
- Emphasis on the equilibrating role of flexible prices under perfect competition not only as long-run theory, but also as short-run theory
- Lucas' epoch-making contribution:
  - Systematic incorporation of uncertainty and rational expectations into macroeconomics
- Rational expectations + market clearing by price adjustment → “policy-ineffectiveness proposition” (systematic monetary policy designed to stabilize the economy is doomed to failure)

## The new classical counter-revolution (contd.)

- Explanation of business cycle fluctuations:
  - Lucas' *monetary misperception theory* (Lucas 1972 and 1975): shocks to the money supply as the primary driving force
  - *Real business cycle theory* of Kydland and Prescott (1982) and Prescott (1986): economic fluctuations as primarily caused by shocks to real factors, "productivity shocks"

## New Keynesian reconstruction

- In the 1970s and the 1980s economists took a different line of attack
- Extension of the Keynesian approach through expectations-augmented Phillips curve: good empirical performance
- Money neutrality seemed a good approximation to the long-run issues, but not to short-run issues
- Some refinements were possible: new analytical tools from microeconomic general equilibrium theory and the rational expectations

## Limitations of the “old” Keynesian theory addressed by the new Keynesians

- 1 It is not encompassed that nominal prices and wages do in fact change somewhat over time in response to events in the economy
- 2 It is not made clear why nominal prices and wages change only sluggishly
- 3 The underlying microeconomics is not elucidated
  - What are the budget constraints faced by the economic agents? How are demand and supply determined when some agents have market power and are price setters?
  - If markets do not clear by instantaneous adjustment of perfectly flexible prices, how do they then “clear”?
  - What kind of general equilibrium arises under these circumstances, taking into account the spillovers across the different markets?
- 4 The integration of forward-looking rational (unbiased) expectations into the theory is only halfway

## Third Point

- Macroeconomics with quantity rationing
- With wages and prices predetermined in the short run, the short side of the market determines the actual amount of transactions. This is called the *minimum transaction rule*
- In the first wave of “macroeconomics with quantity rationing” wages and prices were treated as exogenous
- But a path-breaking paper on general equilibrium with monopolistic competition by Blanchard and Kiyotaki (1987) made it possible to integrate the quantity rationing framework with price setting behavior
- At about the same time Akerlof and Yellen (1985) and Mankiw (1985) developed the “menu cost theory”.

- In the Keynesian tradition employment and output fluctuations are viewed as primarily demand-driven in the short run.
- Nominal rigidities at the basis of this view are simply assumed
- To understand what determines prices and their movement over time, we need a theory with agents that set prices and decide when to change them and by how much
- This brings agents with market power into the picture
- That is why imperfect competition is a key ingredient in new Keynesian economics
- BK model as a cornerstone of new Keynesian thinking
- In contrast to the ad hoc IS-LM model the BK model pays attention to the supply side no less than the demand side.
- The behavior of the price setting suppliers is explained on the basis of their objectives and constraints

*Monopolistic competition* is a market structure with the following properties:

- 1 There is a given, large number of firms and equally many (horizontally) differentiated goods
- 2 Each firm supplies its own good on which it has a monopoly and which is an imperfect substitute for the other goods
- 3 A price change by one firm has only a negligible effect on the demand faced by any other firm

A (short-run) *equilibrium under monopolistic competition* is defined as a set of prices and quantities such that:

- supply equals demand, and
- each firm's profit is maximized, given the firm's downward-sloping demand curve, i.e., given the other firms' prices (or equivalently, given the general price level).

## What should we expect from the model

- No wage and price adjustment costs
- In the “flexible price case”, in spite of monopolistic competition, money is neutral
- But in contrast to perfect competition, monopolistic competition leads to a Pareto-inferior general equilibrium with underutilization of resources.

...when adjustment costs are introduced

- Price setters may abstain from adjusting their price when demand changes
- Money is not neutral
- Even small adjustment costs can have large real consequences at the aggregate level



## Model Economy

- $m$  firms,  $i = 1, \dots, m$ , and  $m$  goods
- Goods are imperfect substitutes (think of different kinds or brands of cars, bears and toothpaste)
- A representative household (*in the original BK setting:  $n$  households (or craft unions),  $j = 1, \dots, n$ , each supplying its specific type of labor*)
- The model is static
- Money is the numeraire and is demanded because it yields liquidity services
- There are “many” firms ( $m$  large).

## Representative Household

$$\max_{C,N,M} U_j = C^\gamma \left( \frac{M'}{P} \right)^{1-\gamma} - \frac{1}{\beta} N^\beta \text{ s.t.} \quad (1)$$

$$C = m^{\frac{1}{1-\theta}} \left( \sum_{i=1}^m C_i^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}} \quad (2)$$

$$P = \left( \frac{1}{m} \sum_{i=1}^m P_i^{1-\theta} \right)^{\frac{1}{1-\theta}} \quad (3)$$

$$\sum_{i=1}^m P_i C_i + M' = M + WN + \sum_{i=1}^m V_i \equiv I, \quad (4)$$

## First Order Conditions

$$\begin{aligned} \gamma \left( \frac{M}{PC} \right)^{1-\gamma} \left( \frac{C}{mC_i} \right)^{\frac{1}{\theta}} &= \lambda P_i \\ (1-\gamma) \left( \frac{M}{PC} \right)^{-\gamma} &= \lambda P \\ N^{\beta-1} &= \lambda W \end{aligned}$$

Demand function faced by the  $i^{th}$  firm:

$$P_i = \frac{\gamma}{1-\gamma} \frac{M}{C} \left( \frac{C}{mC_i} \right)^{\frac{1}{\theta}}$$

Thus

$$P = \frac{\gamma}{1 - \gamma} \frac{M}{C}$$

$$C_i = \left( \frac{P_i}{P} \right)^{-\theta} \frac{C}{m}$$

Let's express the demand for consumption and money as a function of the endowment ( $I$ ).

$$\sum_{i=1}^m P_i C_i + M' \equiv I$$

Real consumption expenditure

$$\begin{aligned} \sum_{i=1}^m \frac{P_i}{P} C_i &= \sum_{i=1}^m \left( \frac{C_i}{mC} \right)^{\theta} C_i = C^{\frac{1}{\theta}} m^{\frac{1}{1-\theta}} \sum_{i=1}^m C_i^{\frac{\theta-1}{\theta}} \\ &= C^{\frac{1}{\theta}} C^{\frac{\theta-1}{\theta}} = C \end{aligned}$$

Thus

$$\sum_{i=1}^m P_i C_i = PC$$

$$C = \gamma \frac{I}{P}$$

$$M = (1 - \gamma) I$$

As  $C = Y$ :

$$Y = \frac{\gamma}{1 - \gamma} \frac{M}{P}$$

As to labour supply:

$$N^{\beta-1} = \frac{W}{P} (1 - \gamma) \left( \frac{M}{PC} \right)^{-\gamma} = \frac{W}{P} (1 - \gamma) \left( \frac{\gamma}{1 - \gamma} \right)^{-\gamma}$$

Thus

$$N = \left[ (1 - \gamma)^{1-\gamma} \gamma^\gamma \right]^{\frac{1}{\beta-1}} \left( \frac{W}{P} \right)^{\frac{1}{\beta-1}}$$

## Firms

The decision problem of firm  $i$  is to choose a vector  $(P_i, Y_i, N_i)$ , where  $P_i$  is price,  $Y_i$  is output and  $N_i$  is the

$$\max_{P_i, N_i, Y_i} V_i = P_i Y_i - W N_i \quad \text{s.t.} \quad (5)$$

$$Y_i = C_i = \left( \frac{P_i}{P} \right)^{-\theta} \frac{C}{m}, \quad (6)$$

$$Y_i = N_i^\alpha, \quad \alpha < 1 \quad (7)$$

$$\max_{P_i} V_i = P_i \left( \frac{P_i}{P} \right)^{-\theta} \frac{C}{m} - W \left( \left( \frac{P_i}{P} \right)^{-\theta} \frac{C}{m} \right)^{\frac{1}{\alpha}}$$

First order condition:

$$\frac{P_i}{P} = \left( \frac{\theta}{\theta - 1} \frac{1}{\alpha} \frac{W}{P} \left( \frac{C}{m} \right)^{\frac{1-\alpha}{\alpha}} \right)^{\frac{\alpha}{\alpha + \theta(1-\alpha)}}$$



## Equilibrium

$$P_i = P \quad \forall i$$

Firm specific equilibrium production

$$C_i = Y_i = \frac{C}{m} \quad \forall i$$

Labour market equilibrium

$$N^D = \sum_{i=1}^m N_i^D = m Y_i^{\frac{1}{\alpha}} = m \left( \frac{C}{m} \right)^{\frac{1}{\alpha}} = m^{\frac{\alpha-1}{\alpha}} \left( \frac{\gamma}{1-\gamma} \frac{M}{P} \right)^{\frac{1}{\alpha}}$$

$$N^S = N^D$$

$$\Rightarrow \frac{W}{P} = \left[ m^{\frac{(a-1)(\beta-1)}{\alpha}} \left( \frac{\gamma}{1-\gamma} \right)^{\frac{\beta-1}{\alpha}-\gamma} \frac{1}{1-\gamma} \right] \left( \frac{M}{P} \right)^{\frac{\beta-1}{\alpha}}$$

After denoting with  $K_L$  the constant term in the square bracket and taking logs:

$$\ln \left( \frac{W}{P} \right) = \ln K_L + \frac{\beta-1}{\alpha} \ln \left( \frac{M}{P} \right)$$

## Goods market equilibrium

We impose relative price equal to 1 in the price rule:

$$\frac{W}{P} = \frac{\theta - 1}{\theta} \alpha \left( \frac{\gamma}{1 - \gamma} \frac{M}{mP} \right)^{\frac{\alpha - 1}{\alpha}}$$

Taking logs:

$$\ln \left( \frac{W}{P} \right) = \ln K_P - \frac{1 - \alpha}{\alpha} \ln \left( \frac{M}{P} \right)$$

## General Equilibrium

We see that in the absence of price adjustment costs the model has the classical features:

- Real variables (output and the real wage) are determined by technology and preferences independently of the supply of money
- The price level is proportional to the supply of money

## Underutilization of resources

- Primarily an effect of market power
- Pareto-inferior underemployment that arises under monopolistic competition as an example of coordination failure
- Any agent does the best, given what the others do, but the outcome is socially inefficient
- A coordinated action could improve the outcome for everybody (see Cooper 1999, Benassy 2002)

In the analysis so far neutrality of money derives from assuming the price setters face no costs when they change prices

### **Two types of price adjustment costs:**

- *Menu costs*: fixed costs of changing price
- *Convex adjustment costs*: adjustment cost is increasing in the size of the price change.

*Menu costs* should not be understood in its narrow literal sense. Rather, menu costs should be viewed as a parable including:

- ① costs
  - ① faced by restaurants when they have to reprint the menu list,
  - ② faced by stores when they have to remark the commodities with new price labels and reprint price lists and catalogues,

## ① costs associated with

- ① information-gathering,
- ② recomputing optimal prices,
- ③ conveying the new directives to the sales force,
- ④ offending customers by frequent price changes,
- ⑤ search for new customers willing to pay a higher price,
- ⑥ renegotiations.

A number of simplifying assumptions

From  $Y = \frac{\gamma}{1-\gamma} \frac{M}{P}$  into  $\frac{P_i}{P} = \left( \frac{\theta}{\theta-1} \frac{1}{\alpha} \frac{W}{P} \left( \frac{C}{m} \right)^{\frac{1-\alpha}{\alpha}} \right)^{\frac{\alpha}{\alpha+\theta(1-\alpha)}}$ , for  $\beta = 1$

$$\frac{W}{P} = \frac{1}{(1-\gamma)^{1-\gamma} \gamma^\gamma}$$

Thus marginal disutility from labour is constant.

Substitute this into the price rule:

$$\frac{P_i^*}{P} = [\text{const}] \cdot \left( \frac{M}{P} \right)^{\frac{1-\alpha}{\alpha+\theta(1-\alpha)}}$$

$$P_i^* = [\text{const}] \cdot P^\phi M^{1-\phi}$$

where  $\phi = \frac{\alpha+(\theta-1)(1-\alpha)}{\alpha+\theta(1-\alpha)}$ , ( $0 < \phi < 1$ ).



We can express profits as a function of real money balances and of the ratio between actual price set by the  $i^{\text{th}}$  producer and the optimal reset price

$$\Pi \left( \frac{M}{P}, \frac{P_i}{P_i^*} \right)$$

If  $\frac{P_i}{P_i^*} = 1$ :

$$\Pi_2 \left( \frac{M}{P}, 1 \right) = 0 \quad \Pi_{22} \left( \frac{M}{P}, 1 \right) < 0 \quad \forall \frac{M}{P}$$

Moreover

$$\Pi_1 \left( \frac{M}{P}, \frac{P_i}{P_i^*} \right) > 0 \quad \Pi_{11} \left( \frac{M}{P}, \frac{P_i}{P_i^*} \right) < 0$$

## Monetary Innovations

Suppose the constant term is one

$$M = 1$$

$$P_i = P_i^* = P = 1$$

A disturbance occurs to the nominal stock of money ( $dM$ )

Firms can choose between:

- Adequate their price to the optimal level  $P_i^*$  ( $dM + M$ ), after bearing and adjustment cost equal to  $c$
- Keep  $P_i = 1$

## Sticky price equilibrium

This is an equilibrium if a single producer has not incentive to adequate his price when the all the other producers do so.

If producers stick with the initial price:

$$P = 1 \text{ and } \frac{M}{P} = M$$

Two alternatives open to the  $i^{\text{th}}$  producer:

- Do not adjust to the optimal price  $P_i^* = M^{1-\phi}$  (for  $P = 1$ ), thus keeping  $P_i = 1$ . In this case:

$$\frac{P_i}{P_i^*} = \frac{1}{M^{1-\phi}} \quad \text{and} \quad \Pi \left( M, \frac{1}{M^{1-\phi}} \right) \equiv \Pi^R$$

- Adjust to the optimal price  $P_i = P_i^* = M^{1-\phi}$ . In this case:

$$\Pi(M, 1) \equiv \Pi^F$$

need to subtract  $c$  from this profit

Price rigidity is an equilibrium only if the producer gains from adequating his price

$$G = \Pi^F - \Pi^R < c$$

Second order Taylor expansion of  $G$  in the neighborhood of  $M = 1$   
 $(\Pi_2(1, 1) = \Pi_{21}(1, 1) = \Pi_{12}(1, 1) = 0)$

$$\begin{aligned} G &= \Pi(M, 1) - \Pi\left(M, \frac{1}{M^{1-\phi}}\right) \\ &\simeq -\frac{(1-\phi)^2}{2} \Pi_{22}(1, 1) (dM)^2 > 0 \end{aligned}$$

The potential gain from adjusting the price increases in  $dM$   
 Price rigidity is an equilibrium as long as:

$$-\frac{(1-\phi)^2}{2} \Pi_{22}(1,1) (dM)^2 < c$$

$$\Rightarrow |dM| < \sqrt{\frac{-2c}{(1-\phi)^2 \Pi_{22}(1,1)}} \equiv (dM)_R$$

## Flexible price equilibrium

This is an equilibrium if a single producer has the incentive to adequate his price when the all the other producers do so.

If producers adequate their price:

$$P = M \text{ and } \frac{M}{P} = 1$$

Two alternatives open to the  $i^{\text{th}}$  producer:

- Do not adjust his price  $P_i = 1$ . In this case:

$$\frac{P_i}{P_i^*} = \frac{1}{M} \quad \text{and} \quad \Pi \left( 1, \frac{1}{M} \right) \equiv \Pi^R$$

- Adjust to the optimal price  $P_i = P_i^* = M$ . In this case:

$$\Pi(1, 1) \equiv \Pi^F$$

need to subtract  $c$  from this profit

Price flexibility is an equilibrium only if the producer gains from adequating his price when everybody else does the same

$$G = \Pi^F - \Pi^R > c$$

Second order Taylor expansion of  $G$ :

$$\begin{aligned} G &= \Pi(1, 1) - \Pi\left(1, \frac{1}{M}\right) \\ &\simeq -\frac{1}{2}\Pi_{22}(1, 1)(dM)^2 > 0 \end{aligned}$$

The potential gain from adjusting the price increases in  $dM$   
 Price flexibility is an equilibrium as long as:

$$-\frac{1}{2}\Pi_{22}(1,1)(dM)^2 > c$$

$$\Rightarrow |dM| > \sqrt{\frac{-2c}{\Pi_{22}(1,1)}} \equiv (dM)_F$$



It is straightforward to derive the following relationship:

$$(dM)_R = \frac{1}{1-\phi} (dM)_F > (dM)_F$$

Three scenarios

- Price rigidity:  $|dM| < (dM)_F$
- Flexible prices:  $|dM| > (dM)_R$
- Multiple equilibria:  $(dM)_F < |dM| < (dM)_R$

## Strategic complementarities

$$\frac{P_i^*}{P} = [\text{const}] \cdot \left( \frac{M}{P} \right)^{\frac{1-\alpha}{\alpha+\theta(1-\alpha)}}$$

An increase in  $P$  has two effects:

- given  $\frac{M}{P}$ ,  $P_i^* \uparrow$  to maintain the same relative price
- as an increase in  $P$  corresponds to a decrease in aggregate demand ( $\frac{M}{P} \downarrow$ ), there is an incentive to decrease  $P_i^*$

It is clear that the first effect dominates the second, as  $\phi > 0 \Rightarrow$  Strategic Complementarities (Cooper and John, QJE, 1988)

Strategic complementarities are crucial to the rise of multiple equilibria  
Movements in  $P$  increase the incentive to move  $P_i$  in the same direction  
If, when  $M \uparrow$ , also  $P \uparrow$ , there is an additional incentive to change prices  
Strategic complementarities enforce the incentive to vary prices when other producers do so.

## Real rigidities

In our case ( $\beta = 1$ ) we can obtain a high degree of real rigidity by assuming constant marginal costs ( $\alpha = 1$ )

It can be shown that as

$$\alpha \rightarrow 1 \Rightarrow \phi \rightarrow 1$$

resulting in increasing strategic complementarity and the interval in which  $(dM)_F < |dM| < (dM)_R$  becomes large.