

# NEW KEYNESIAN THEORY: MONOPOLY PRICING

MARCH 29, 2010

*Introduction*

## RELEVANT MARKET STRUCTURE(S)?

- ❑ **Real business cycle (RBC)/neoclassical theory**
  - ❑ All (goods) prices are determined in perfect competition
  - ❑ In both consumption-leisure and consumption-savings dimensions
  - ❑ **Critical assumption: no firm is a price *setter* → no firm has any market power**
- ❑ **New Keynesian theory**
  - ❑ **Starting point: firms do wield (at least some) market power**
  - ❑ **Critical assumption: firms do set their (nominal) prices**
  - ❑ **Purposeful setting/re-setting of (nominal) prices may entail costs of some sort**
    - ❑ "Menu costs," but soon interpret more broadly
    - ❑ Central issue in macro: how do "costs of adjusting prices" ("sticky prices") affect monetary policy insights and recommendations?
- ❑ **Upcoming analysis**
  - ❑ **Step 1: Develop theory in which firms are purposeful price *setters*, not price *takers***
  - ❑ **Step 2: Superimpose on the theory some "costs" of setting/re-setting nominal prices**
  - ❑ **Step 3: Study optimal monetary policy**

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## NK MODEL OVERVIEW

- ❑ Monopolistic competition in goods markets the underlying market structure
- ❑ Operationalize by dividing goods markets into two "sectors"
  - ❑ **Retail firms**
    - ❑ Each sells a perfectly-substitutable "retail good" in a perfectly-competitive market
    - ❑ Purchase differentiated "wholesale goods" in monopolistically-competitive markets
  - ❑ **Wholesale firms**
    - ❑ An "infinite" number of them
    - ❑ Each produces a "wholesale good" **imperfectly substitutable** with any other "wholesale good"
    - ❑ → each wholesale firm is a price **setter**
    - ❑ "Wholesale goods" sold to retail firms
- ❑ Conceptual separation allows for separate consideration of
  - ❑ Price setting at the microeconomic level
  - ❑ Determination of market outcomes at the macroeconomic level

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## RETAIL FIRMS

- ❑ A representative retail firm
  - ❑ Operates a "production function" that "bundles together" wholesale goods into retail goods
    - ❑ Inputs: wholesale goods ONLY, no labor or other inputs required
    - ❑ Example: a retail store that produces no goods of its own
  - ❑ Dixit-Stiglitz aggregator function/"production function"
    - ❑ Workhorse building block of NK theory
 

$$y_t = \left[ \int_0^1 y_{it}^{1/\varepsilon} di \right]^\varepsilon$$

↑ Output of the retail good    ↑ An infinity (continuum) or differentiated wholesale goods

(Also a basic building block of theory of international trade)
    - ❑ Parameter  $\varepsilon$  measures curvature
    - ❑ Elasticity of substitution between any pair of differentiated wholesale goods is  $\varepsilon/(\varepsilon-1)$
- See all this soon {
- ❑  $\varepsilon$  also the critical determinant of profit-maximizing markup
  - ❑ Restriction for NK model to make any sense:  $\varepsilon > 1$
  - ❑ Setting  $\varepsilon = \_\_\_\_\_\_$  recovers perfect competition (i.e., RBC, not NK)

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## RETAIL FIRMS

- **A continuous infinity of wholesale goods**
  - A metaphor for “many varieties of goods”
  - Easier to deal with mathematically than discrete infinity (tools of calculus can be applied!)
  - And normalize to continuum [0,1] (could also say, i.e., [0,2], etc...)
- **Schematic structure of goods markets**
- **Representative retail firm’s profit function**

$$\begin{array}{c}
 \text{Nominal price of the retail good} \quad \xrightarrow{\quad} \quad \downarrow \quad \quad \quad \downarrow \quad \quad \quad \text{Nominal price of wholesale good } i \\
 P_t y_t - \int_0^1 P_u y_u di \\
 \downarrow \quad \quad \quad \text{Substitute Dixit-Stiglitz production function} \\
 P_t \left[ \int_0^1 y_u^{1/\epsilon} di \right]^\epsilon - \int_0^1 P_u y_u di
 \end{array}$$

## RETAIL FIRMS

- **Representative retail firm’s profit-maximization problem**

$$\max_{\{y_u\}_{u=0,\dots,\infty}} P_t \left[ \int_0^1 y_u^{1/\epsilon} di \right]^\epsilon - \int_0^1 P_u y_u di$$

Chooses profit-maximizing quantity of input of each wholesale good. Focus analysis on any arbitrary wholesale good – call it  $y_j$ .

- **FOC with respect to  $y_{jt}$  (for any  $j$ )**

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•  
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•

- **...after several rearrangements**

$$y_{jt} = \left( \frac{P_{jt}}{P_t} \right)^{\frac{\varepsilon}{1-\varepsilon}} y_t$$

**DEMAND  
FUNCTION FOR  
GOOD  $j$**

## WHOLESALE FIRMS

- **Focus on the activities of an arbitrary wholesale firm  $j$**
- **Symmetry:** assume that every wholesale firm makes decisions analogously
  - Consistent with the representative-agent approach
- **So can speak of a "representative" wholesale firm**
- **Assume zero fixed costs of production**
- **Operates a constant-returns-to-scale (CRS) production technology in order to produce its unique, differentiated output**
  - **CRS:** if all inputs are scaled up by the factor  $x$ , total output is scaled up by the factor  $x$
  - **Implementation of theory requires specifying neither the factors of production (i.e., labor, capital, etc) nor a production function ( $f(\cdot)$ )**

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- **Marginal cost of production**
  - = average cost of production
  - is invariant to the quantity produced
    - i.e., mc is NOT a function  $mc(\text{quantity})$

Together, these imply a simple description of production

## WHOLESALE FIRMS

- **Representative wholesale firm's profit-maximization problem**

Total revenue depends on firm's production and its own product price.

$$\max_{P_{jt}} P_{jt} y_{jt} - P_t mc_{jt} y_{jt}$$

$mc$  is NOT a function of quantity produced - CRS assumption.  
 $FC = 0 \rightarrow mc = ac$

Substitute in demand function for wholesale good  $j$ .

The critical point of analysis of monopoly: the firm *understands* and *internalizes* the effect of its price on the quantity that it sells.

Conversion of production costs into nominal terms requires factor  $P_t$ , NOT  $P_{jt}$ . Because costs are not denominated in the firm's own prices.

$$\max_{P_{jt}} P_{jt} \left( \frac{P_{jt}}{P_t} \right)^{\frac{\epsilon}{1-\epsilon}} y_t - P_t mc_{jt} \left( \frac{P_{jt}}{P_t} \right)^{\frac{\epsilon}{1-\epsilon}} y_t$$

- The sole choice object is  $P_{jt}$ 
  - Compute FOC!

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- FOC with respect to  $P_{jt}$  (see p. 268)

$$\frac{1}{1-\varepsilon} P_{jt}^{\frac{\varepsilon}{1-\varepsilon}} P_t^{\frac{\varepsilon}{1-\varepsilon}} y_t - \frac{\varepsilon}{1-\varepsilon} P_{jt}^{\frac{2\varepsilon-1}{1-\varepsilon}} P_t^{\frac{2\varepsilon-1}{1-\varepsilon}} mc_{jt} y_t = 0$$

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- ...after several rearrangements

$$\frac{P_{jt}}{P_t} = \varepsilon mc_{jt}$$

- Define relative price as  $p_{jt} = \frac{P_{jt}}{P_t}$ 
  - In which case can express pricing rule as  $p_{jt} = \varepsilon mc_{jt}$
  - Or as optimal markup rule  $\mu_{jt} = p_{jt} / mc_{jt} = \varepsilon$

Optimal relative price of wholesale firm  $j$  is a markup  $\varepsilon$  over marginal cost of production.

KEY PRICING RESULT OF DIXIT-STIGLITZ THEORY.

## THE DIXIT-STIGLITZ FRAMEWORK

- **Key prediction of basic Dixit-Stiglitz theory**

$$\mu_{jt} = \frac{p_{jt}}{mc_{jt}} = \varepsilon$$

- **Firms aim to keep their prices at a constant markup over marginal cost**
- **Empirical relevance of DS constant markup prediction?**
  - **Not very in the short run...**
  - **...but maybe in the long run (Eichenbaum, Jaimovich, Rebelo 2008 paper)**
- **Markups generally observed to be countercyclical (with respect to GDP)**
  - **During expansions, markups decline; during recessions, markups rise**
  - **(detrended, business cycle frequencies)**
- **DS framework has long been the main starting point for pricing theories; recent incorporation into studying**
  - **Customer switching effects**
  - **Brand loyalty**
  - **Search costs**