Endogenous Market Structures and the Business Cycle

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Aim of the Paper

- Introduce Endogenous Market Structures (EMSs) in general equilibrium. EMSs: number of firms and mark ups (M-ups) depend on structural parameters of the economy.
- Analyze how different market structures affect the propagation of aggregate shocks, with particular reference on the effect on M-ups and aggregate firms’ profits.
Neoclassical theory (Kydland and Prescott, 1982): Perfect Competition

- zero price mark up (M-up)
- zero profits
- number of firms and individual production are indeterminate


- price stickiness delivers countercyclical M-up
- profits are countercyclical
- the number of firms is taken as exogenous
Theoretical Shortcomings

The frameworks above neglect:

1. the role of strategic interactions between firms;
2. the endogeneity of the number of firms;
3. the impact of firms’ entry on strategic interactions.
Empirical Shortcomings

1. Procyclicality of firms’ entry is not addressed (Chatterjee and Cooper, 1993, Portier 1995);
2. Cannot obtain M-up countercyclicality together with procyclicality of aggregate profits (Rotemberg and Woodford 1999 and Galì et al. 2007, Bilbiie, Ghironi and Melitz 2007 (BGM, henceforth))
Figure: US quarterly data: 1948:1-2007:3. Series detrended with a cubic filter
We model the economy with a dynamic **flexible prices model**;

**EMSs:**

1. we introduce sunk entry costs as in Ghironi and Melitz (2005) and BGM (2007) to endogenize the number of competitors in each sector;
2. we consider strategic interactions between producers: **Competition in Prices** (Bertrand) and **Competition in Quantities** (Cournot, Conjectural Variations and Stackelberg). This allows to endogenize M-ups
Main Results

The model delivers:

1. M-ups endogeneity: M-ups depend on the degree of substitutability between goods belonging to the same sector and on the number of competitors in a sector;
2. Countercyclical M-ups;
3. Procyclical aggregate profits;
4. Procyclical Entry of Firms;

**Standard flexible prices model is silent with regard to 1-4.**

5. The model outperforms a standard flexible prices model at matching Business Cycle properties of the main macroeconomic variables (based on US data)
We emphasize a novel propagation mechanism based on competition among firms:

- temporary technology shock
  - increases profits opportunities and attracts entry of new firms
  - strengthens competition and reduces mark ups
  - temporary price reduction induces a stronger intertemporal substitution effect in favor of current consumption
  - increase in demand has a positive effect on profits which feeds the mechanism.
Comparison to Existing Literature

1. Jaimovich and Floetotto (2008): consider price competition in flexible prices model. Beside having a different focus (TFP measurement) they endogenize the number of firms by means of a zero profits condition; thus they cannot address profits procyclicality;

2. BGM (2007): in a special case of their analysis they can address the facts above. However to do so they need a specific preference specification (Translog Preferences) for which goods get more substitutable as new varieties becomes available on the market;

Our results hold under general CES preferences as used in most of business cycle literature, and are due to a propagation mechanism based on competition and strategic interaction among firms in a sector.
Flexible prices economy with endogenous number of producers;
There is a continuum of sectors in the economy indexed with k;
sector k is characterized by the presence of $N_{kt}$ firms at time t;
need to hire $\eta$ efficient units of labor to build a new firm;
entry condition is sector k reads as

$$V_{kt} = \eta \frac{W_t}{A_t}$$

Market Value Sunk Cost
**Dynamic of the number of firms**

- **Time to Build**: A firm which decides to enter into sector $k$ at time $t$ will be able to produce just at time $t + 1$;

- **Exogenous death probability**: with probability $\delta$ a firm will not be able to get to produce next period
  
  \[
  \begin{cases} 
  N_{kt}^e : \text{new entrants in sector } k \text{ at } t \\
  N_{kt} : \text{firms already producing at } t 
  \end{cases}
  \]

  \[ \Rightarrow N_{kt+1} = (1 - \delta) \left( N_{kt} + N_{kt}^e \right) \]

- so the number of firms is an endogenous state variable
- Households can, at time $t$, invest in risk-free bonds: $B_{t+1}$;
- Households can, at time $t$, invest in a portfolio of shares of firms belonging to each sector: $s_{kt+1}$;
- Output of firm $i$ in sector $k$ is $y_{kt}(i) = A_t L_{kt}(i)$
Firms maximize profits, $\pi_t(i)$, in each period. Under different forms of competition we obtain symmetric equilibrium prices satisfying:

$$p_t = \frac{\mu(\theta, N_t)}{\frac{W_t}{A_t}}$$

Under all forms of competition considered below it will be the case that

$$\frac{\partial \mu(\theta, N_t)}{\partial N_t} < 0 \quad \text{and} \quad \frac{\partial \mu(\theta, N_t)}{\partial \theta} < 0$$

$$\lim_{N \to \infty} \mu(\theta, N_t) = \frac{\theta}{\theta - 1} \rightarrow \text{standard, constant, mark up}$$
Each firm chooses its production $y_t(i)$ taking as given the production of the other firms. Profit maximization leads to the following price mark up and profits (Imposing goods’ market equilibrium):

$$\mu^Q(\theta, N_t) = \frac{\theta N_t}{(\theta - 1)(N_t - 1)}; \quad \pi^Q_t(\theta, N_t) = \frac{(N_t + \theta - 1)}{\theta N_t^2} C_t$$

Notice that

$$\lim_{\theta \to \infty} \mu^Q(\theta, N_t) = \frac{N_t}{(N_t - 1)} > 1$$
Each firm $i$ chooses the price $p_t(i)$ to maximize profits taking as given the price of the other firms. Profit maximization leads to

$$
\mu^P(\theta, N_t) = \frac{1 + \theta(N_t - 1)}{(\theta - 1)(N_t - 1)} < \mu^Q(\theta, N_t)
$$

$$
\pi^P_t(\theta, N_t) = \frac{C_t}{1 + \theta(N_t - 1)}
$$

Notice that

$$
\lim_{\theta \to \infty} \mu^P(\theta, N_t) = 1;
$$
Baseline Calibration

TFP is a first order autoregressive processes.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.99</td>
<td>Subjective discount factor</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>4</td>
<td>Frech elasticity of labor supply</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.025</td>
<td>Exogeneous death probability</td>
</tr>
<tr>
<td>$\eta$</td>
<td>1</td>
<td>Steady state entry cost</td>
</tr>
<tr>
<td>$A$</td>
<td>1</td>
<td>Steady state value of technology</td>
</tr>
<tr>
<td>$\rho^A$</td>
<td>0.9</td>
<td>Autoregressive coefficients for tech process</td>
</tr>
<tr>
<td>$\theta$</td>
<td>6</td>
<td>Elasticity of substitution between sectoral goods</td>
</tr>
</tbody>
</table>
Figure: Cournot competition. IRF to a temporary technology shock.
Figure: Bertrand competition. Impulse response function to a temporary technology shock.
<table>
<thead>
<tr>
<th>Variable</th>
<th>$\sigma(X)$</th>
<th>$\sigma(X)/\sigma(Y)$</th>
<th>$E(X_t, X_{t-1})$</th>
<th>$\text{Corr}(X, Y)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y$</td>
<td>1.66, 1.39</td>
<td>1</td>
<td>0.84, 0.72</td>
<td>1</td>
</tr>
<tr>
<td>$C$</td>
<td>1.19, 0.60</td>
<td>0.75, 0.43</td>
<td>0.78, 0.78</td>
<td>0.76, 0.94</td>
</tr>
<tr>
<td>$I$</td>
<td>4.97, 4.09</td>
<td>2.99, 2.59</td>
<td>0.87, 0.70</td>
<td>0.79, 0.98</td>
</tr>
<tr>
<td>$L$</td>
<td>1.82, 0.67</td>
<td>1.10, 0.48</td>
<td>0.90, 0.70</td>
<td>0.88, 0.97</td>
</tr>
<tr>
<td>$\Pi$</td>
<td>8.08, n.a.</td>
<td>4.87, n.a.</td>
<td>0.76, n.a.</td>
<td>0.67, n.a.</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.99, n.a.</td>
<td>0.60, n.a.</td>
<td>0.79, n.a.</td>
<td>$-0.28$, n.a.</td>
</tr>
</tbody>
</table>

**Table**: Second moments. Left: US data. Right: RBC model.
## Second Moments: Cournot and Bertrand

### Table: Second moments under the baseline parameterization. Left: Cournot Competition; Right: Bertrand Competition

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\sigma (X)$</th>
<th>$\sigma (X) / \sigma (Y)$</th>
<th>$E (X_t, X_{t-1})$</th>
<th>Corr (X, Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y$</td>
<td>1.52, 1.51</td>
<td>1</td>
<td>0.68, 0.68</td>
<td>1</td>
</tr>
<tr>
<td>$C$</td>
<td>0.78, 0.78</td>
<td>0.51, 0.52</td>
<td>0.77, 0.76</td>
<td>0.94, 0.95</td>
</tr>
<tr>
<td>$I$</td>
<td>5.89, 7.56</td>
<td>3.87, 5.00</td>
<td>0.65, 0.64</td>
<td>0.97, 0.97</td>
</tr>
<tr>
<td>$L$</td>
<td>0.85, 0.77</td>
<td>0.56, 0.50</td>
<td>0.65, 0.64</td>
<td>0.96, 0.96</td>
</tr>
<tr>
<td>$\Pi$</td>
<td>0.70, 0.74</td>
<td>0.46, 0.49</td>
<td>0.71, 0.72</td>
<td>0.99, 0.98</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.15, 0.13</td>
<td>0.10, 0.08</td>
<td>0.95, 0.94</td>
<td>$-0.17$, $-0.17$</td>
</tr>
</tbody>
</table>
Summary

- We have studied a DSGE model where the structure of the markets is endogenous and accounts for strategic interactions of different kinds.

- The model belongs to the emerging literature on endogenous entry in the macroeconomy started by Ghironi and Melitz (2005), BGM (2007, 2008,a) and Jaimovich and Floetotto (2008) and it provides further improvements in the explanation of the business cycle compared to the standard RBC framework.

- The interplay between sunk entry costs and strategic interactions between producers allows to explain the procyclical variability of the profits together with the countercyclical variability of the mark ups.
On going research

- Extend the model with Bertrand competition to nominal frictions
- The presence of strategic interactions between a limited number of firms would amplify the role of price rigidities
- As well known, strategic complementarity leads firms to adjust less their prices when other firms do not adjust theirs
- Difficulty: under calvo firms should take into account the effect of their current price choices on future aggregate price level, maybe strat with menù costs or rootemberg pricing.