

Firm level productivity under imperfect competition in output and labor markets and variable returns to scale

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Product and Labor Markets Imperfections

- Dobbelaere and Mairesse (2009) embed efficient **bargaining model** (MacDonald and Solow, 1981) into the R. Hall (1988) approach for estimating **price-cost margins**
- Boone (2008) proposes an alternative (to price-cost margins) measure of competition based on **profits elasticity**
- **Our contribution:** global understanding of the impact of market behavior on productivity growth (TFPG)
 - product and labor imperfect competition simultaneously included to determine changes in TFP
 - focus on appropriate measure of product competition
- Application on a panel of Dutch firms spanning over 16 years (1989-2005) and over 22 manufacturing industries

Productivity, Competition and Innovation

- Production function for three inputs (capital, labor and intermediate goods):

$$Y_{it} = A_{it} F_i(K_{it}, L_{it}, M_{it}) \quad i = 1, 2, \dots, N ; t = 1, \dots, T,$$

A_{it} is defined as TFP and $F_i(\cdot)$ is assumed to be homogeneous of degree θ_{it}

- Introducing unions' market power through Nash bargaining model

$$\max_{W_{it}, L_{it}} [L_{it}(W_{it} - \bar{W}_{it})]^{\phi_{it}} [P_{it}(Y_t)Y_{it} - W_{it}L_{it} - R_{it}K_{it} - Z_{it}M_{it}]^{1-\phi_{it}}$$

$\phi_{it} \in [0, 1]$ is the degree of workers' bargaining power

Productivity, Competition and Innovation

- By combining the production function with the bargaining problem and by logarithmic differentiation, the production function can be rewritten as:

$$\Delta y_{it} = \mu_{it} \Delta x_{it} + \gamma_{it} (s_{it} - 1) \Delta l_{it} + \Delta a_{it}$$

where μ_{it} is the price-cost markup and $\gamma_{it} \equiv \mu_{it} \frac{\phi_{it}}{(1-\phi_{it})}$

- $TFPG \equiv \Delta a_{it} = a_i + \delta_t + u_{it}$ takes into account:
 - firm-specific growth rate, a_i ,
 - period specific growth rate, δ_t , common across firms in the same period,
 - plus a white noise, u_{it} (productivity shocks, such as *technology shocks*)

- Input choices might be correlated with u_{it}
 - Composite error Δa_{it} includes unobservable component u_{it} taken into account in the firm's information set
- Ordinary Least Squares (OLS) might be inconsistent and biased
- Instrumental variables – Generalized Method of Moments (GMM) estimators applied to the first differences transformation of the equation of interest
 - remove time-invariant unobserved individual heterogeneity.

Estimation Results

Results for 22 industries

	FD GMM		
	I	II	III
$\hat{\phi}$	0.614 (0.054)	0.621 (0.056)	0 -
$\hat{\mu}$	1.063 (0.026)	1 -	1.044 (0.027)
$\hat{\theta}$	0.993 (0.025)	0.910 (0.040)	0.976 (0.025)
Hansen's J χ^2_{df}	1.719 $df = 4$ pval(0.423)		
Time Dummies	Yes	Yes	Yes
# firms	7161	Std. err. in parentheses	

- (1) Sample period 1989-2005
- (2) Dependent variable: output growth Δy_{it}
- (3) Hansen J test of the overidentifying restrictions

- Magnitude of the estimated markup $\hat{\mu}$, elasticity of scale $\hat{\theta}$ and bargaining power $\hat{\phi}$ vary among industries:
 - $\hat{\mu}$ is lower than 1.01 for Q_1 of industries and higher than 1.16 for Q_3
 - $\hat{\phi}$ is lower than 0.58 for Q_1 of industries and higher than 0.82 for Q_3
 - almost all industries reveal non-increasing returns to scale $\hat{\theta}$
- At both level of aggregation, data suggests that taking into account **labor market imperfections increases the price-cost markup $\hat{\mu}$**
- **However**, sectors for which $\hat{\mu} > 1$ behave differently:
 - including ϕ reduces the level of imperfect output market competition from 1.20 to 1.14
- **Conclusion**: workers' unions power, and in general rigidities of the labor market, affect firms' marginal cost, and, consequently the markups

Impact on TFPG

TFPG	$\phi \in (0, 1]$	$\phi = 0$	$\phi = 0$ $\mu = 1$	$\phi = 0$ $\theta = \mu = 1$
Mean	0.95	1.00	-0.20	-0.73
Median	0.93	1.00	-0.10	-0.61
SECTORS where $\hat{\mu} > 1$				
Mean	2.30	2.60	0.02	-0.47
Median	1.50	2.40	0.23	-0.27
SECTORS where $\hat{\mu} \leq 1$				
Mean	0.94	1.03	-0.26	-0.78
Median	0.91	1.04	-0.16	-0.66

- Not taking into account labour market imperfection leads to an **upward bias of TFPG**
- Innovations imply labor force reallocations
- As rigidity of labor market does not allow firms from adjusting their labor factor, **labor market imperfection** may **slow down innovation rate**

Markup and Profits Elasticity (1)

- The theoretical framework to derive the markup measure of competition does not account for differences in efficiency
- Boone *et al.* (2007) find that both profits elasticity (PE) and price-cost markup (PCM) give an accurate view of competition
- However, when reallocation effect is strong (i.e. few firms and high Herfindahl index), PE and PCM may point to different directions
- We complete our analysis on TFPG, by comparing the PCM to the PE and other measures of competition

Markup and Profits Elasticity (2)

- Log nominal profits can be written as a function of log unit nominal costs:

$$\ln \pi_{ijt} = \alpha_{ij} + \delta_{jt} - \beta_{jt} \ln c_{ijt} + \varepsilon_{ijt}$$

where β_{jt} indicates the % fall in profits due to a 1% increase in marginal costs

- Empirical relationship between PCM and PE and other market structural variables

$$\hat{\mu}_{jt} = \hat{\beta}'_{jt} \omega_{j1} + H'_{jt} \omega_{j2} + N'_{jt} \omega_{j3} + \left(\hat{\beta}_{jt} \odot H_{jt} \right)' \omega_{j4} + \left(\hat{\beta}_{jt} \odot N_{jt} \right)' \omega_{j5} + \varepsilon_{jt}$$

$\hat{\mu}_{jt}$ are the estimated markups, $\hat{\beta}_{jt}$ are the estimated relative profits' elasticities, H_{jt} are the Herfindhal indexes, and N_{jt} are changes in the number of firms

Markup and Profits Elasticity (3)

- **No effect** of an encompassing measure of competition **on the TFPG**
- Including rigidities of the labor market in the production function corrects for that part of profits that would result in a higher gain for the firm
- Bargaining power takes into account reallocation effect (when $\hat{\phi}$ small is $\hat{\mu}$ large)

- Introducing labor market imperfections:
 - main role in determining the price-setting behavior
 - corrects upward bias of productivity growth rate
- Adding more structure to competition measure (PE) does not add any information to TFPG and on efficiency in general, as this is already included in the model