Measuring Competition

Jan Boone, Jan van Ours and Henry van der Wiel

CentER, Tilburg University

Introduction

- Conventional ways of measuring competition (concentration (H) and price cost margin (PCM)) are not robust from a theoretical point of view
  - see, for instance, Amir and Lambson (2000), Bulow and Klemperer (2002) and Stiglitz (1987) for cases where competition goes up and PCM goes up as well
- We introduce a new measure based on the intuition that *in a more competitive market, firms are punished more harshly for being inefficient*
- In particular, we estimate for an industry the following *elasticity*: percentage increase in profits due to a 1 percent increase in efficiency
- We do this estimation for 113 Dutch industries in both manufacturing and services using firm level data (on average 87.000 firms per year)
- On average this elasticity equals 7 for the Dutch industries in the data

Findings using the new competition measure

- We find for Dutch industries that competition is more intense
  - if it has a higher labor income share (or if it has lower depreciation costs (compared to revenue))
  - if the average efficiency level in the industry is higher
  - if a manufacturing industry has a higher import quote
  - (if it is in manufacturing instead of services)
  - if number of firms is smaller (reversed causality)
  - in 1993-1997 than in 1998-2002
  - in the segment with big enterprizes (more than 50 employees) compared to small and medium sized enterprizes (0-50 employees)
- As these (preliminary) results seem to make sense, we view them as further motivation to explore the advantages of this measure compared to the other measures (future research)

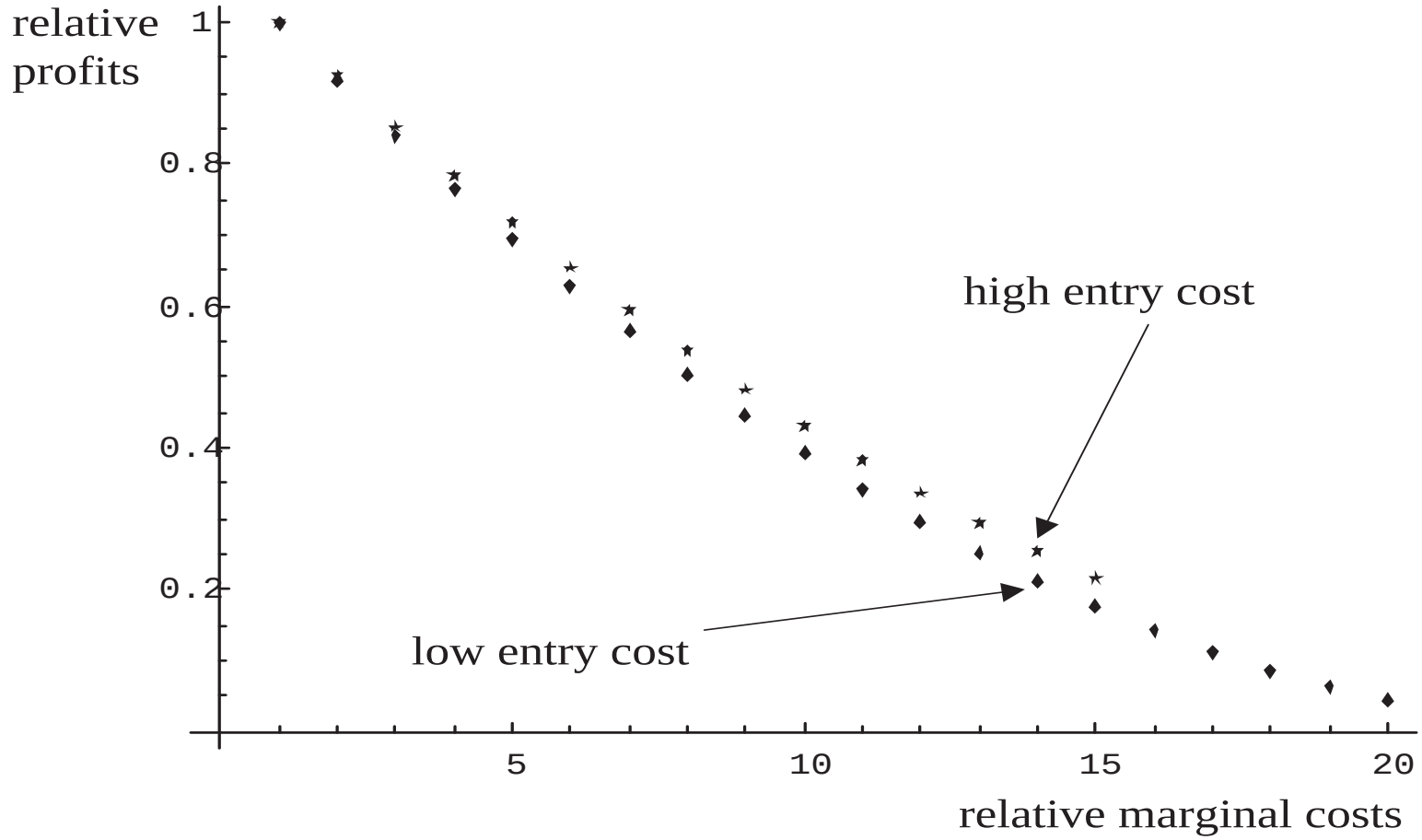
Simple Model

- A firm i faces a demand curve of the form $p(x_i, x_{-i}) = a - bx_i - d\sum_{j \neq i} x_j$
- i chooses output x_i which solves $\max_{x \geq 0}\{(a - bx - d\sum_{j \neq i} x_j)x - c_i x\}$
- Cournot output for firm i is given by

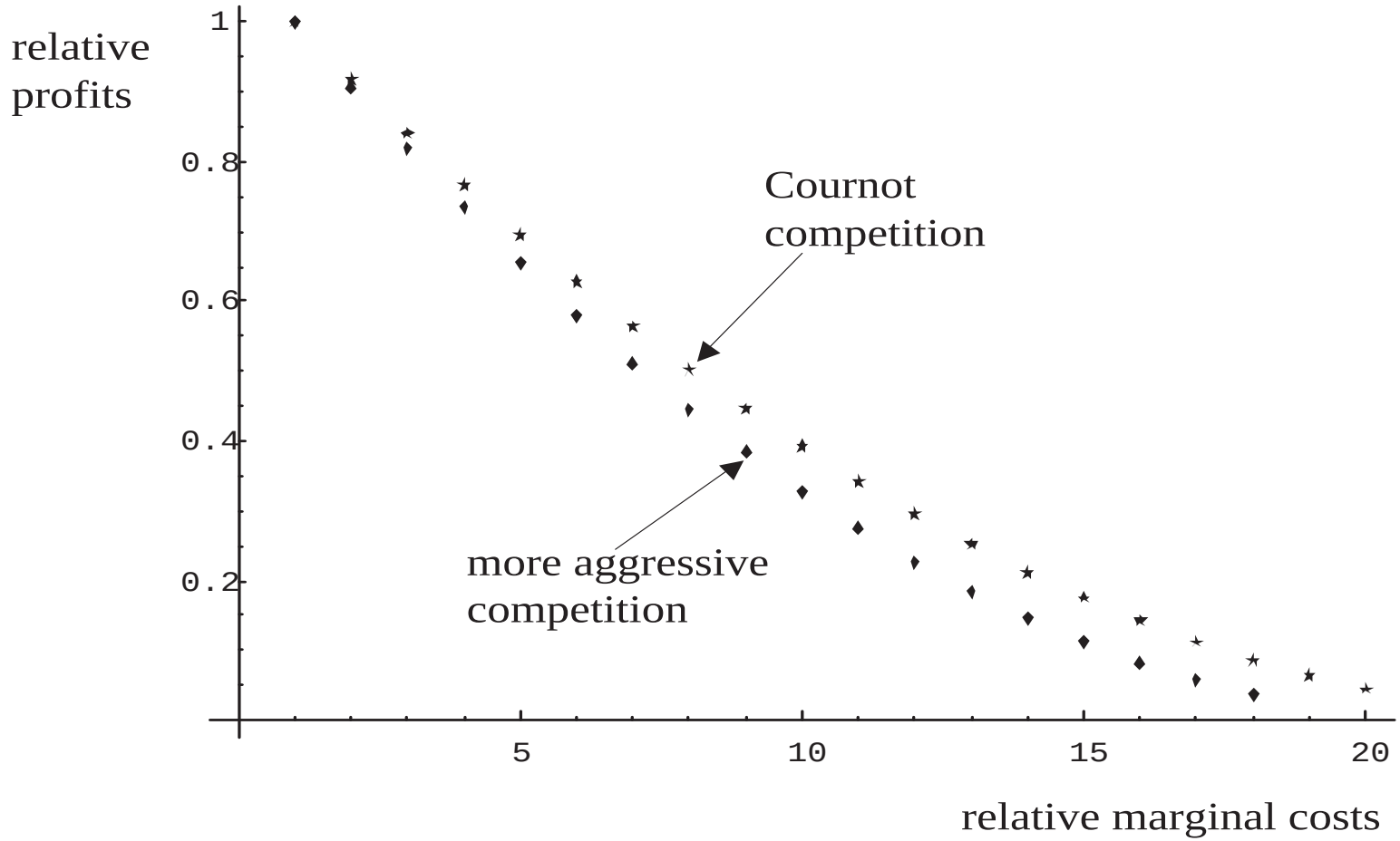
$$x(c_i, c_{-i}, n) = \frac{(\frac{2b}{d} - 1)a - (\frac{2b}{d} + n - 1)c_i + \sum_{j=1}^{n} c_j}{(2b + d(n-1))(\frac{2b}{d} - 1)}$$

- profits are given by $\pi_i = (b + \lambda d)x(c_i, c_{-i}, n)^2$
- Firm i enters if $\pi_i \geq f$
- We increase competition by reducing entry barriers (f) and by making conduct more aggressive (using conjectural variation)
- relative (variable) profits are defined as π_i/π_1 and relative marginal costs as c_i/c_1
- Simulations with $a = 20, b = 2, d = 1.5, f = 0.05, c_i = i/10$ for $i = 1, \ldots, 21$

Fall in entry barriers



More aggressive conduct



Robustness

- The slope between relative profits and relative marginal costs also becomes steeper in models with other parameterizations of competition (like an Hotelling beach with lower travel costs; demand based on a CES utility function where goods become closer substitutes; models with foreign competition where import tariffs are reduced etc.)
- to estimate the slope we only need to observe a sample of firms out of the industry, not all of them (as one needs with PCM and H)
- problem with H is that more aggressive conduct forces inefficient firms out of the market thereby increasing concentration (which then incorrectly suggests that competition is reduced)
- as conduct becomes more aggressive, market share is reallocated from inefficient firms (with low PCM) to efficient firms (with high PCM) which tends to raise industry wide PCM (which then incorrectly suggests that competition is reduced)

Firm fixed effects and time fixed effects

- We want to estimate the elasticity β given by

$$\ln\left(\frac{\pi_{it}}{\pi_{1t}}\right) = \alpha - \beta \ln\left(\frac{c_{it}}{c_{1t}}\right) + \varepsilon_{it}$$

- However, we only observe the relative profits and marginal costs with some error denoted by u_i and v_i resp.

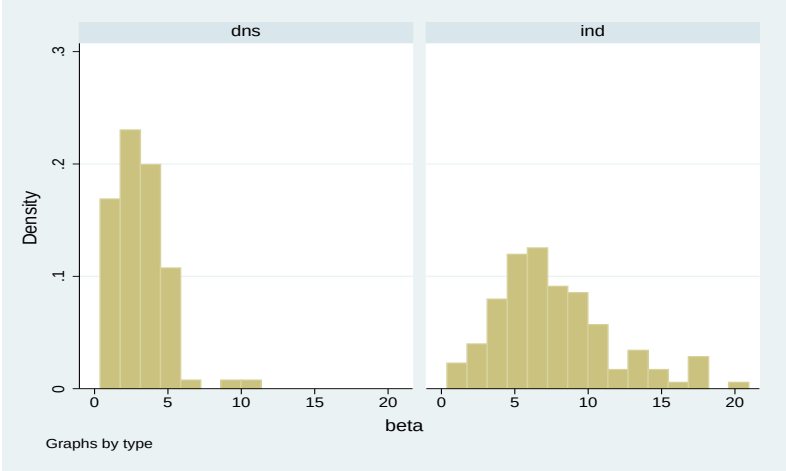
- The equation to be estimated becomes
  $\ln\left(\frac{\pi_{it}u_i}{\pi_{1t}}\right) = \alpha - \beta \ln\left(\frac{c_{it}v_i}{c_{1t}}\right) + \varepsilon_{it}$ or equivalently

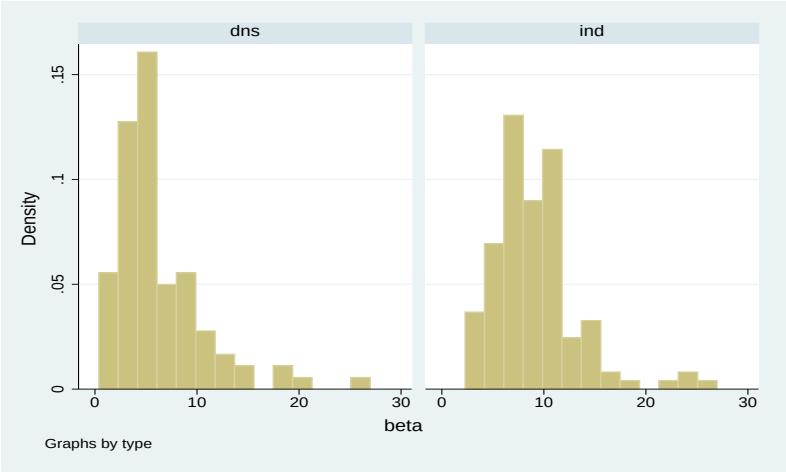
- $\ln(\pi_{it}) = \alpha_i + \alpha_t - \beta \ln(c_{it}) + \varepsilon_{it}$ where
  $\alpha_i = \alpha - \beta \ln(v_i) - \ln(u_i)$ and $\alpha_t = \ln(\pi_{1t}) + \beta \ln(c_{1t})$

Data

- We use firm level data from Statistics Netherlands (CBS)
- Data covers 1993-2002 which we split in two periods: 1993-1997 and 1998-2002
- number of industries is 113 and roughly speaking we have on average 87.000/115 = 750 firms per year per industry
- variable profits π_i are defined as: $revenues_i$ minus $variable\ costs_i$ where
- $variable\ costs_i$ =
  $labor\ costs_i + energy\ costs_i + intermediate\ inputs_i$
- average variable costs c_i are defined as: $variable\ costs_i / revenue_i$

Frequency distributions β





Left: services, right: manufacturing; top: SME, bottom: BE

Estimated coefficients to explain β_{jst}

explanatory variables	coefficient	t-value
labor income share	15.6^*	9.8
average efficiency	1.2^*	2.7
import quote manufacturing	2.1^*	2.1
import quote services	-4.0	-0.8
manufacturing dummy	0.7	1.1
number of firms	-0.7^*	-6.0
big enterprize dummy	1.3^*	3.8
period (=1 in 1998-2002)	-0.9^*	-2.7

- adjusted $R^2 = 0.44$
- $j =$ industry, $s =$ size class and $t =$ time period

Interpretation

- A high labor share in value added indicates low capital costs and hence it is easier to enter the industry; alternatively, intense competition between firms may raise the bargaining power of labor unions on the input side of firms and lead to a higher wage share
- Firms that are on average more efficient, compete more fiercely; alternatively more intense competition weeds out inefficient firms and hence average productivity goes up
- manufacturing industries that face more competition from abroad are more competitive
- (manufacturing industries are more competitive than service industries, this is in line with earlier results from CPB and OECD)
- as competition intensifies some firms are forced to exit the industry
- big firms operate on a more competitive (probably national) market segment than small and medium sized firms.
- competition appears to have become less intense over time

Conclusion

- In this paper we consider a new measure of competition
- we estimate for an industry the following elasticity: *percentage fall in variable profits due to a one percent increase in marginal costs*
- The higher this elasticity (in abs. value), the more competitive the industry: firms are punished more harshly for being inefficient
- On average this elasticity equals 9.1 (7.7) for big (small) firms in manufacturing and 6.2 (3.1) for big (small) firms in services
- This elasticity varies with industry characteristics in a way that we can interpret
- future research: can we actually show that this measure is also empirically more robust than PCM and H?