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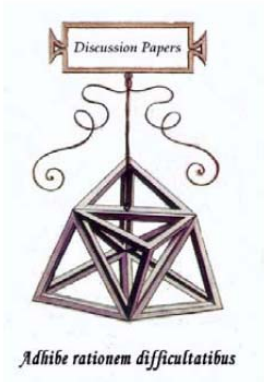

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Firms' Entry, Imperfect Competition and Regulation

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Abstract

In this paper we try to build a macro model of imperfect competition where the number of firms is endogenous. In particular, the product market works as as a Cournot oligopoly, while in the labour markets the determination of wages is influenced by the presence of unions. Moreover, the number of firms and its equilibrium level are determined through a costly entry process, so that firms enter the market as long as expected profits are enough to cover entry costs. This mechanism allows to determine the equilibrium number of firms and to study its properties.

Once we have determined this, we may examine the effects of imperfect competition in both the short and long run and we can evaluate the consequences of (de)regulation policies on both the time horizons.

1 Introduction

The aim of this paper is to build a dynamic model able to explain the process of firms' entry and to tie it to the presence of imperfect competition in the markets. The idea behind this is rather simple: imperfect competition contributes to the determination of profits and through them it certainly influences the entry of firms.

If we imagine that the entry costs depend on the number of entrant firms and on some fixed costs, then it is possible to build a dynamic process and to study its properties. Moreover, the relationship between imperfect competition and firms' entry does not run in one direction only but it also acts, indirectly, in the other way. In fact, the process of entry contributes to determine the number of firms and through it is likely to influence the degree of market power. Then, not only we can analyze the entry dynamics but we can also search for the sources of market power.

The entry of firms in an imperfectly competitive environment has been studied in some classical works by Modigliani (1958) and Sylos-Labini (1962) which established the well known limit pricing model. The focus of it was on the entry deterrence and on the (limit) pricing which guarantees such deterrence. This two stages, two competitors model was then extended over continuous, infinite time in Gaskin (1971) and to multiple entrants and incumbents in Gilbert and

Vives (1986). All the above works aim to prove the existence of a limit pricing, leaving the study of the dynamic process and of the very role of market imperfections as side questions. For these reasons those models cannot be the base of our analysis.

The study of the dynamic aspects have found slightly more space in recent literature: for example Das and Das (1995) try to evaluate the entry/exit process with non-homogenous firms, while Datta and Dixon (2003) try to evaluate the impact that improvements in productivity have in the entry dynamics. Only in Blanchard and Giavazzi (2003) the problem is introduced explicitly in connection to imperfect competition, but such work only introduces this aspect and does not formalize it.

What we try to do in this paper is first to develop a model where a fixed number of firms operate in an oligopolist market and where unions bargain on wages and then to explore what happens when new firms can enter the market. We consider the former case as the short run and the latter as the long run[1]. In effect, this allows us to endogenize the number of firms.

The introduction of a dynamic component obviously complicates the analysis and will force us to apply some simplification to make the problem tractable.

There is another point on which we focus our attention: the effects that (de)regulation policies have on some key variables (employment, real wages and profits mainly) in a context where the number of firms is endogenous. In particular, we can examine the (de)regulation of product markets through the change in the administrative (entry) costs and of the labour market through a change in unions bargaining power. Even more interestingly, we are able to compare how those policies affects the markets both in the short and the long run and we can check for the existence of complementarity in the deregulation of different markets through different time horizons.

The paper is organized as follows: in section 2 we build the basic model, in section 3 we study the short run, in section 4 we introduce firms' entry and study the dynamics of the process, in section 5 we study the long run, in section 6 we compare the effect of deregulation of the markets in the short and in the long run and in section 7 we conclude.

2 Basic Framework

Our model is based on a standard Cournot oligopoly, similar to the one described in Dixon (1988) and to which we add the presence of unions which bargains over wages.

The economy is populated by n firms: each of them hires labour to produce a y_i amount of a homogenous good. Their production function is

$$y_i = aL_i \tag{1}$$

[1]We borrow this distinction from Blanchard and Giavazzi (2003).

where L_i is the amount of labour hired by firm i and a is a parameter that measures the average and marginal productivity. Clearly, we imagine that the labour input has constant returns to scale.

The product market works as in a Cournot oligopoly: the prevailing market price P is given by the following inverse demand function

$$P = A - \sum_{i=1}^{n} y_i. \tag{2}$$

For simplicity we set the parameter $A = 1$ so that

$$P = 1 - \sum_{i=1}^{n} y_i. \tag{2a}$$

2.1 Firms Behaviour

Firms sell their product in an oligopolistic market: their profits π_i are given by

$$\pi_i = P y_i - W_i L_i \tag{3}$$

where W_i is the wage rate paid by firm i. As it will become clearer later, each firm pay the same wage so that W_i is the same for any i.

Given equation (1) and ($2a$) we can write the above as

$$\pi_i = \left(1 - \frac{W_i}{a} - \sum_{i=1}^{n} y_i\right) y_i. \tag{4}$$

In order to obtain positive profits it is necessary (but not sufficient) that $W_i < a$ which simply guarantees that the average cost does not exceed average productivity.

Each firm chooses the quantity of y_i that maximizes the profits, taking as given all the competitors' quantity (this is the standard hypothesis in the Cournot oligopoly):

$$\frac{\partial \pi_i}{\partial y_i} = 0. \tag{5}$$

Since all firms are the same, they all produce the same amount in equilibrium and the above equation yields

$$y_i = y^* = \frac{\left(1 - \frac{W_i}{a}\right)}{1 + n} \tag{6}$$

where y^* is the equilibrium amount of production. Equation (6) is the standard Nash-Cournot solution.

Given that amount of production, we can derive the resulting price: combining ($2a$) with (6) we have

$$P = \frac{1 + n\frac{W_i}{a}}{1+n} \tag{7}$$

which, for $W_i < a$, is a negative function of the number of firms n.

2.2 Union Bargaining

The workers of each firm are organized in unions that bargain over wages. There is a union for each firm and they are interested in both employment and wages. Their utility function is given by

$$U_i = (W_i - B)\, L_i \tag{8}$$

where B is the outside option. The utility depends on the nominal wages because each union thinks that his bargaining will not affect the general level of price and takes it for granted. If this is the case, then it does not really matter whether it is the nominal or the real wage[2] that enters the utility function[3]. This hypothesis is reasonable as long as the bargaining is decentralized and the number of firms is not too small. We also imagine that each union shares the same bargaining power.

During the bargaining, each union tries to obtain the wage that maximizes (8): we call such a value W_i^C and it is given by

$$W_i^C = \arg\max_{W_i} (W_i - B)\, L_i = \frac{a+B}{2} \tag{9}$$

where W_i^C represents then the claims of each union in terms of wages. Obviously, unions would never accept a wage lower than the outside option B and, if the unions had the right to set unilaterally the wages (the case of the monopoly union) then they would choose W_i^C. However, firms oppose to this and try to settle on a lower wage (in fact lower wages guarantee higher profits). In the end, the parts will settle on a value between B and $\frac{a+B}{2}$ where the exact outcome depends on the bargaining power of the parts.

Here we imagine that the outcome is the weighted average between the wage claim and the fall back value[4], with the bargaining power of unions β (which ranges 0 and 1) being the weight:

$$W_i^B = \frac{a-B}{2}\beta + B \tag{10}$$

[2] In fact, if the utility function depends on the real values we would have $U_i = (W_i/P - B/P)\, L_i$ where P, if exogenous, have only a scale effect.

[3] See Blanchard and Giavazzi (2003) for an example of a work where such an assumption is made.

[4] Obviously we are renouncing here to the axiomatic solution of bargaining we have adopted in the previous chapter in favour to a much simpler solution. While this gives a less realistic representation of the bargaining process it does not significally change the results in terms of outcome, nor it modify the sign of the relationships between the parameters of the modek and the solution of bargaining. For these reason we believe that this is an acceptable simplification.

where W_i^B is the bargained wage: when $\beta = 1$ the union claims are fully met and $W_i^B = W_i^C$, while $\beta = 0$ implies a wage equal to the outside option. Obviously, higher bargaining power leads to higher wages.

Since each union has the same bargaining power, the bargained wage will be the same in each firms and will determine the economy wide wage W^B:

$$W^B = W_i^B = \frac{a-B}{2}\beta + B. \tag{10a}$$

3 The Short Run Analysis

The short run is defined by the fact that the number of firms is fixed. That number is exogenous and can be considered merely a parameter. In this circumstances the only (de)regulation policies that can affect the markets are those affecting the bargaining power of unions. In what follows we derive some key variables and examines how they are affected by the number of firms and by bargaining power

3.1 Market power and Profits

The above scheme allows us to derive the relationship between the number of firms, the degree of market power and the resulting profits. If we measure the market power μ as the price-cost margin (as suggested in Lerner (1934)), we have

$$\mu_i = \frac{1 - \frac{\frac{a-B}{2}\beta + B}{a}}{1 + n\frac{\frac{a-B}{2}\beta + B}{a}} \tag{11}$$

which is inversely related to the number of firms and to the bargaining power of unions.

The profits are given by

$$\pi_i = \left(\frac{1 - \frac{W_i^B}{a}}{1+n}\right)^2 \tag{12}$$

which is again inversely related to the number of firms.

If we insert the bargained wage (10) in (12) we have

$$\pi_i = \left(\frac{1 - \frac{a-B}{2}\beta - B}{1+n}\right)^2 \tag{13}$$

which shows that profits are lower when β or B are higher.

We can also obtain the prevailing price inserting the bargained wage (10) in the equation for price (7):

$$P = \frac{1 + n\left(\frac{a-B}{2a}\beta + \frac{B}{a}\right)}{1+n} \tag{14}$$

which tells us that a higher number of firms reduces the price level (in fact it reduces the price-cost margin, as we saw above) and that higher bargaining power increases it (through the increase of firms costs).

The picture we get is quite clear, a product market with fewer firms shows high mark-up and prices allowing for higher profits. On the other end, a labour market highly regulated (where unions have a higher bargaining power) produces lower profits for firms.

3.2 Employment and Real Wages

Given the fixed number of firms n we can derive the level of employment and real wages.

The production of each firm is given by (6) and if we combine it with the bargained wage (10a) we have the employment per firm

$$L_i = \frac{1}{1+n}\frac{\left(1 - \frac{a-B}{2}\beta - B\right)}{a} \tag{15}$$

and, similarly, the aggregate employment L is

$$L = \frac{n}{n+1}\frac{\left(1 - \frac{a-B}{2}\beta - B\right)}{a} \tag{16}$$

which depends positively on n and negatively on β.

The number of firms impact negatively on the employment per firms but positively on the aggregate level. In fact, when more firms are in the market, each of them has a smaller share but the resulting price is lower so that aggregate demand (and employment) is higher.

On the other side, bargaining power increases wages and reduce the demand for labour, leading eventually to lower employment.

As for the real wage, we can obtain it dividing the bargained nominal wage (10a) for the prevailing price (14):

$$\frac{W^B}{P} = \frac{1+n}{\frac{2}{(a-B)\beta+2B} + n\frac{1}{a}} \tag{17}$$

so that both the bargaining power and the number of firms have a positive effects on it[5]. Both results are direct, with stronger unions getting better wages and with markets with more firms producing lower price-wages margins.

Summing up, in the short run, more concentrated product markets (with less firms) yields higher profits and lower aggregate production, employment and real wages; on the other side more regulated labour markets (where unions have more bargaining power) yields higher real wages but lower profits, aggregate production and employment. The picture we have got is the traditional one with market imperfections granting rents and benefits to incumbent workers and firms at the expense of overall production and employment.

[5] The positive effect of n on the real wages is easily understood if we consider that the bargained nominal wages do not depend on it and that the price depends negatively on it.

4 Firms' Entry

Firms entry is determined by profits and by entry costs. The idea is quite simple: high profits attract firms into the market while low profits discourage their entry. In fact, each potential entrant firm observes the profits and, given the entry costs, decides whether to enter or not. If the firm decides to enter it starts immediately to operate and to gather the possible profits. We also imagine that firms leave the market according to a stochastic rule, with each firm having a given probability to leave the market in each period. A possible explanation for this is that there is a fixed probability that the producing process of a firm becomes obsolete and it has to leave the market.

The exact sequence of actions that take place in each period is the following: potential firms choose whether to enter the market, the production and selling take place and, finally, some firms leave the market. As already said, new entrants are immediately able to operate.

The entry process depends on expected profits and we hypothesize that potential firms have static expectations. In other words, we imagine that they look at the amount of profits earned by incumbent firms in the previous period and they base their decision on the assumption that future profits will stay constant[6] at that level.

In each period t, each potential firm may choose to enter by paying an entry cost Q: if he does so, it is entitled to gather the profits of current period and, as long as he survives, of following periods. In particular, at the end of the period, each firms has a probability s to survive.

Entry costs depend on how many firms are entering and on some administrative fixed costs:

$$Q = C\frac{E_t}{n_{t-1}} + K \tag{18}$$

where E_t is the number of entrants, K are the fixed costs and C is a measure of how relevant the variable costs are.

More specifically, we can think to $C\frac{E_t}{n_{t-1}}$ as the costs due to congestion effects. When more firms try to enter at the same time, the resources needed to set-up the business become more demanded and more costly, so that costs rise. Even the bureaucratic procedures that a firms have to go through are likely to be more a burden when many firms are entering at the same time. The degree of congestion effect is normalized by the dimension of the market in the previous period, measured by n_{t-1}, because we believe that a market that is already large is less likely to suffer from congestion. In this scheme, the parameter C is a measure of how relevant is the congestion effect. On the contrary the parameter K is more likely to represent fixed administrative costs, either in the form of fixed fees they have to pay either as a loss of time in bureaucratic

[6] We can also imagine that this happens because potential entrants assume that future profits will stay at the same level on average.

procedures.[7]

This said, the expected present value of profits EPV_t for an entrant firm at time t, is given by

$$EPV_t = \sum_{m=0}^{\infty} (s\delta)^m \, \pi_{t+m}^e \tag{19}$$

where π^e are the expected profits and δ is the discount rate. Given the static expectation of firms we can set the π_{t+m}^e equal to π_{t-1} for every m and solve the above obtaining:

$$EPV_t = \frac{\pi_{t-1}}{1 - s\delta}. \tag{20}$$

If firms are risk-neutral, the no-arbitrage condition implies:

$$EPV_t = Q_t. \tag{21}$$

In fact when $EPV_t > Q_t$ firms would keep entering the market, rising the entry cost according to (18), so that the above equality is reached again; if $EPV_t < Q_t$ firms would not enter the market reducing the entrants, eventually, to zero. Obviously entry costs cannot be negative so that the number of entrants in never less than zero.

The above entry mechanism and the structures of costs allow us to build an equation which describes the entry process: inserting (15) and (16) in (14) we have

$$\begin{cases} E_t = \left[\dfrac{v}{(1 + n_{t-1})^2} - k \right] n_{t-1} \text{ for } n_{t-1} \leq \sqrt{\dfrac{v}{k}} - 1 \\ E_t = 0 \text{ for } n_{t-1} > \sqrt{\dfrac{v}{k}} - 1 \end{cases} \tag{21a}$$

where $v = \frac{\left(1 - W_i^B\right)^2}{(1 - s\delta)C}$ and $k = K/C$. The above equation simply tells us that entry depends on the difference between expected profits and entry costs. Since equation (21) determines only the number of entrant it cannot be negative: in the event that expected profits are lower than the costs, no firms will enter and $E_t = 0$. In other words, as long as future profits cover the entry costs the firms keep entering the market but, as soon as this is not true, they stop. This mechanism generate a sort of discontinuity in the entry process: we call n_E the point where such discontinuity begin:

$$n_E = \sqrt{\frac{v}{k}} - 1. \tag{21b}$$

In order to justify the presence of even only one firm in the markets we have to suppose that $v > k$: this condition is necessary (but not sufficient) for profits

[7] Obviously part of the fixed costs may be due to technical reason, like the setting up of plants. This makes no difference in what we are arguing.

to cover entry opportunity cost. In what follows we imagine that $v > k$, as in any other case no firm would ever enter and the market would not even exist. In addition we have also to imagine that at time zero there is already at least one firm operating, otherwise the static expectation hypothesis would generate an inconsistency in this model.

The number of firms U_t that leave the markets at the end of period t is easily obtained, in fact if s is the survival rate then:

$$U_t = (1-s)n_t. \tag{22}$$

The number of firms operating in the market at any time t is then given by

$$n_t = n_{t-1} - U_{t-1} + E_t. \tag{23}$$

which combined with (22) and (23) gives

$$\begin{cases} n_t = \left[s + \dfrac{v}{(1+n_{t-1})^2} - k\right] n_{t-1} \text{ for } n_{t-1} \leq n_E \\ n_t = s + n_{t-1} \text{ for } n_{t-1} > n_E \end{cases}. \tag{24}$$

The above equation describes the dynamic process of the number of firms and is a non linear difference equation of first order: to make it more compact we may define such process as a function $f()$ of the number of firms in the previous period, so that

$$n_t = f(n_{t-1}) \tag{24a}$$

Obviously $f()$ takes the form described in equation (24). The dynamics of the process is represented in figure 4.1

4.1 Equilibrium, dynamics and stability

The equilibrium number of firms n^* is obtained for $E_t = U_{t-1}$ (this in fact implies $n_t = n_{t-1}$) so that

$$n^* = \sqrt{\frac{v}{1-s+k}} - 1. \tag{25}$$

Note that condition the condition $v > k$ guarantees that n^* is positive.

Since equation (24) is a non linear difference equation of first order, we cannot solve it analytically and all we can do is to study the local properties of equilibrium. Since n^* is always smaller than n_E we can study the local properties of equilibrium simply studying $f(n_{t-1})$ for values lower than n_E. This said the equilibrium is locally stable if $|f'(n^*)| \leq 1$: in our case we have

$$f'(n^*) = 1 - 2(1-s+k)\left(1 - \sqrt{\frac{1-s+k}{v}}\right). \tag{26}$$

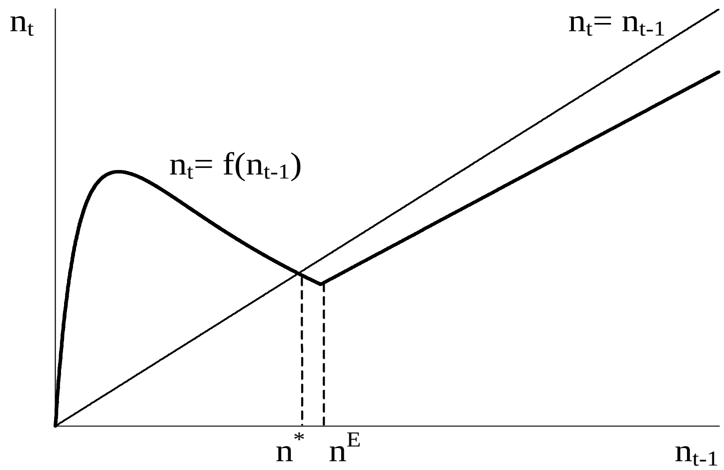

Figure 1: The dynamics of the number of firms

The above equation tells us that $f'(n^*) \leq 1$ for any value of the parameters and that the condition $|f'(n^*)| \leq 1$ is met when

$$(1-s+k)\left(1-\sqrt{\frac{1-s+k}{v}}\right) < 1. \tag{27}$$

The solution of the above has not a straightforward interpretation, but we can show that the condition hold when one of the following is met

$$\begin{cases} k < s \\ \text{or} \\ T < \left(1+\frac{1}{k-s}\right)\left[(1-s)\,C + K\right] \end{cases}. \tag{28}$$

Stability is not always met and when none of the above conditions hold, the process does not converge.

4.2 Global Stability

We want now to study the global stability of the process. Obviously local stability is a necessary (but not sufficient) condition for the global stability. Even when this condition is met, it could be impossible to prove analytically the global stability. Basically we can give some sufficient conditions without being able to determine all the cases when we have global stability.

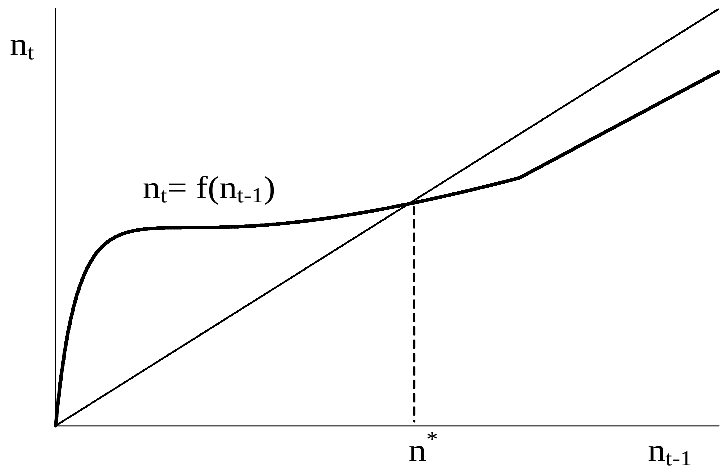

Figure 2: The dynamics of the number of firms when $0 \leq f'(n^*) < 1$

However this process shows a peculiar characteristic: in the cases where it is not possible to obtain the analytical derivation, we can show that the number of firms reaches and rests in an interval which we call $[n_A, n_B]$. In other words when we cannot derive global stability we can show that the number firms in the long run is confined in that interval.

What we are going to do is first to derive analytically the conditions that are sufficient for global stability and to determine the above interval when those conditions are not met.

4.2.1 Analytical derivation of global stability

We start discussing the conditions for global stability. Obviously the first one is the local stability, so that one of the condition expressed in (28) must hold . This means necessarily that $|f'(n^*)| < 1$ and then n^* is, at least locally, an attractor. Two possibility may happen in this case, the first one (which is represented in figure 4.2) is defined by the fact that $0 \leq f'(n^*) < 1$, the second is defined by the fact that $-1 \leq f'(n^*) < 0$.

We start discussing the first one. First of all it is easy to show that we have $0 \leq f'(n^*) < 1$ for

$$\begin{cases} k < s - \frac{1}{2} \\ \text{or} \\ v < \frac{(1-s+k)^3}{\left(\frac{1}{2}-s+k\right)^2} \end{cases} \tag{29}$$

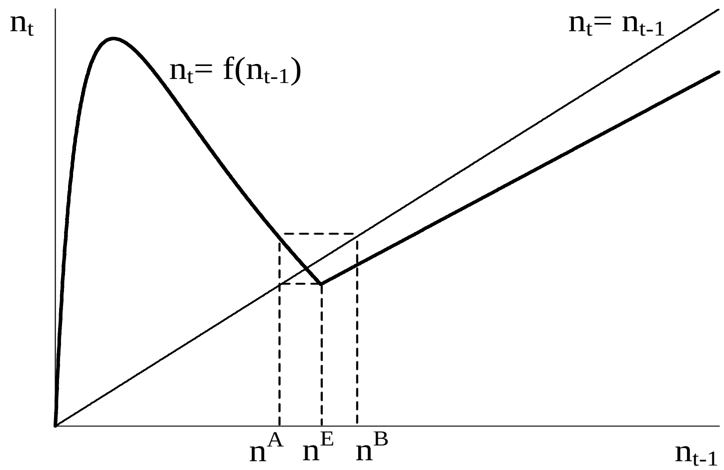

Figure 3: The interval $[n_A, n_B]$

and when this is the case we have that

$$n_t \leq n^* \Longrightarrow f(n_t) \geq n^* \tag{29a}$$

and that

$$n_t > n^* \Longrightarrow f(n_t) < n^*. \tag{29b}$$

This means that when $n_t \leq n^*$ the number of firms keeps rising but it never overshoot n^* and when $n_t > n^*$ the number of firms keeps decreasing but never below n^*. This necessarily implies that the number of firms converge to n^*. The process is then globally stable.

Regretfully, this is the only case where an analytical derivation is possible. In fact when $-1 \leq f'(n^*) < 0$ we cannot demonstrate the global stability. The only way we could do that is through simulation. However we had already said that outside the above case (so when $f'(n^*) < 0$) we can obtain an interval inside which the number of firms are, in the long run, confined. More importantly, such interval arise even in the case of local non stability. We call such interval the "range of oscillation" and we determine it in the following parts.

4.2.2 Range of oscillation

We have just said that, for $f'(n^*) < 0$, the number of firms is, in the long run, confined in the interval $[n_A, n_B]$ (we show this interval in figure 4.3).

Basically the idea is the following: consider a starting number of firms below n^*, it is easy to see that n_t keeps increasing. However, whenever n^* is overshot the number of firms it goes back to the interval $[n_A, n^*]$ and from there, it necessarily assume a value in the interval $[n^*, n_B]$; this once again implies the reaching of the previous interval and so on. The number of firms is then trapped between $[n_A, n_B]$.

Formally, we can demonstrate this in three steps (the analytical derivation of it is given appendix C):

1) for $n_t \leq n^*$ we have $f(n_t) \geq n_t$, then when $n_t \leq n^*$, the number of firms keep increasing and it will either reach n^* or overshoot it;

2) for $n_t > n^*$ we have $f(n_t) < n_t$ and $\min f(n_t) = f(n_E)$ so if n^* has been overshot, the number of firms will keep dropping, reaching a value between $f(n_E)$ and n^*; we define $n_A \equiv f(n_E)$;

3) for $n_A < n_t < n^*$ we have $n^* < f(n_t) < f(n_A)$ so that the number of firms can be at the most $f(n_A)$. We define $n_B \equiv f(n_A)$.

The three statements prove that the number of firms reaches a value inside the interval $[n_A, n_B]$ and it keeps staying inside such interval.

It could be interesting to give an idea of how broad this interval is. To measure this, we choice the relative increment from the smaller value (n_A) and the large (n_B): if we call this relative increase R then

$$R = \frac{n_B - n_A}{n_A} = \frac{n_B}{n_A} - 1. \tag{30}$$

The value R basically tells us the largest relative variation that we can observe in the long run number of firms. Alternative (but similar) measures are possible but we opted for this because is algebraically quite simple, because it is a measure of a range in which n^* is comprised and because taking as starting point n_A it delivers a larger value. The last reason is extremely important and allows us to assert that when R is small we can really be certain that the number of firms remains close to n^*.

If we insert the value of n_A and n_B in the equation[8] for R we have:

$$R = \frac{n_B}{n_A} - 1 = \frac{1}{\left(\frac{1-s}{\sqrt{t}} + \frac{s}{\sqrt{k}}\right)^2} - k - (1-s). \tag{31}$$

From the above equation it is clear that the range is an increasing function of v and k and a decreasing function of s.[9]

It follows that the dimension of R cannot be higher than the values that R assumes when v tends to infinitum. If we compute the limit of R for v that tends to infinitum we obtain

$$\lim_{v \to \infty} R = \frac{k}{s^2} - k - (1-s) = k\left(\frac{1-s^2}{s^2}\right) - (1-s) \tag{31a}$$

[8]By definition we know that $n_A \equiv f(n_E)$ and $n_B \equiv f(n_A)$.

[9]The relationship between the parameters t and s and the dimension of the interval R is obvious from the above equation. The effect of k on R is instead less immediate, but can be obtained if we compute the first derivative of R with respect of k.

TABLE 1: *R* Highest Values							
	Values of *s*						
Values of *k*	0.5	0.75	0.9	0.95	0.975	0.99	0.995
0.5	1	0.1388	0.01728	0.004	0.001	0.0002	0.0000
0.6		0.2167	0.0407	0.0148	0.0062	0.0022	0.001
0.7		0.2944	0.0642	0.0256	0.0113	0.0042	0.002
0.8			0.0876	0.0364	0.0165	0.0062	0.003
0.9			0.1111	0.0472	0.0217	0.0083	0.004

Equation ($31a$) tells us the highest relative change in the number of firms that we can observe in the long run, independently on the stability properties of the process. Since the interval $[n_A, n_B]$ comprises n^*, then in the long run, even if the process is not stable, the relative difference between the number of firms at any instant and the equilibrium value n^* cannot be higher[10] than R.

If the dimension R of the interval is small enough, we may approximate the long run number of firms to n^* even without deriving global stability. For this reason, in the next parts, we compute the highest possible value of R for different values of s and k when v goes to infinitum. We do this both for the case of local stability (but only in the case $-1 \leq f'(n^*) < 0$) and for the case of local instability ($f'(n^*) < -1$). The values we obtain represent a threshold for the relative difference between n^* and any other value that n_t can assume in the long run.

4.2.3 The local stable case

We compute the value of R when $-1 \leq f'(n^*) < 0$. This means that condition (28) must hold whereas condition (29) is not met. We report the results in table 1.

The above table shows that for reasonable values of s (when $s > 0.95$) the relative between the boundaries of the interval $[n_A, n_B]$ is, at the very most, 4,72% (and usually much smaller). For this reason we believe that in this case and for reasonable values of s, the long run number of firms can be approximate to n^*.

4.2.4 The local instable case

In this case we already know that n^* is a repeller point and that $f'(n^*) < -1$. However we also know that the number of firms necessarily reach and stays

[10]Remember that the difference cannot be greater than R but it is instead smaller (and possibly much smaller).

TABLE 2: *R* Highest Values							
	Values of *s*						
Values of *k*	**0.5**	**0.75**	**0.9**	**0.95**	**0.975**	**0.99**	**0.995**
0.75	1.75	0.3333	0.0759	0.0310	0.0139	0.0052	0.0026
1	2.5	0.5278	0.1346	0.0583	0.0212	0.0103	0.0051
1.5		0.9167	0.2518	0.1120	0.0418	0.0204	0.0101
2	5.5	1.3056	0.3691	0.1661	0.0625	0.0306	0.0151
3	8.5	2.0833	0.6037	0.2651	0.1037	0.0591	0.0252
5	14.5	3.639	1.0728	0.4902	0.1862	0.0915	0.0454
25	74.5	19.194	5.7642	2.6508	1.0108	0.4976	0.2469

in the interval $[n_A, n_B]$: in practice, in the long run, we observe oscillation in this interval with the number of firms never reaching a stable value. If the interval is small enough we can approximately state that the number of firms stays reasonably close to the stable value n^*; on the contrary, if the interval is big, the number of firms shows large oscillations. To assess this, we compute the highest possible value of R for different values of s and k when v goes to infinitum. We report the results in table 2.

Whether the above shows that the number of firms keeps staying near n^* depends on what we mean with the word "near". However, we can state that for $s > 0.975$ and for $k < 3$ the difference between the two boundaries of the interval is, at the very most, 10% something we can consider reasonably small. Then for $s > 0.975$ and for $k < 3$ we believe we could approximate the instable case to the stable one. For other values of the parameter that would be unwise.

4.2.5 Concluding remarks on the equilibrium and its stability

In the previous part we have shown that, depending on some key parameters, the process either converge to n^* or it is trapped in the interval $[n_A, n_B]$. The dimension of such interval is therefore extremely important: if it is small enough, the number of firms is always very close to n^* and can be approximated to it. This dimension depends on the values of the parameters v, k, s and we have founds values of them for which the interval is sufficiently small. Obviously those threshold values are subjective to what can really be called sufficiently small.

5 Long Run Analysis

As we have just seen, we can expect the number of firms to converge in the long run towards n^* or for many other reasonable values of the parameters, to stay close to that value. We have then all the elements to evaluate the long run outcomes in terms of our key variables. We can also assess the effects that the degree of regulation of markets has, comparing the short run effects with the long run. Obviously this analysis is correct only if the parameters have such values that the long run number of firms is n^* or a value close to it. When this is not the case the number of firms keeps moving from values greater than n^* to value lower than it: in this sense n^* can still be considered a sort of average of the long run number of firms, but not at all a precise measure of it.

This said, if we consider n^* as the long run number of firms, we can compute the equilibrium values of the index of Lerner, profits, employment and real wages. To make notation simpler, we derive those variables as functions of the bargained wage W^B which depends only on exogenous parameters and is positively correlated to the unions bargaining power β.

We start from the index of Lerner, which measures the market power of firms. If we insert in the price-cost margin (11) the equilibrium value of firms n^* we have

$$\mu = \frac{1 - \frac{W^B}{a}}{1 + \sqrt{\frac{\left(1-W_i^B\right)^2}{(1-s\delta)C} \frac{1}{1-s+k}} \frac{W^B}{a}} \tag{32}$$

so that the market power is tied in a positive way to the fixed costs K and the variable costs C. The above equation allows us to identify in the entry costs the ultimate source of firms market power and to tie it to something concrete and measurable: something on which a policy maker could, in effect, intervene.

The next step is to determine the long run profits of firms. If we insert n^* in the equation (13) we have

$$\pi_i = (1 - s\delta) \left[(1 - s) C + K\right] \tag{33}$$

which tells us that profits depend positively on the entry cost (both K and C) and, surprisingly, are independent on the bargaining power.

The first fact is quite obvious, higher entry cost discourage entry and reduce the number of firms in the market: this increases the market power and rises the profits. Note that also the variable component of entry costs influences the level of profits, however, given the fact that is multiplied by $(1 - s)$ its effects is, in most of the cases, small.

The absence of the bargaining power in the equation of profits may at first seems surprising. The truth however is that the effects of the bargaining power is two fold: on one side, it reduces the share of revenues that go to the firms but in doing this, it also discourages entry, reducing the number of firms and rising the profits. In the end the two effects cancel each other out.

In other words the bargaining power effectively reduces the degree of competition in the product markets so that its effects on profits is not necessarily negative and, actually, is neutral.

Finally, we derive the long run aggregate employment L^{LR} (combining short run employment (16) with n^*)

$$L^{LR} = \frac{1}{a}\left\{\left(1 - \frac{W^B}{a}\right) - \sqrt{(1-sd)\left[(1-s)\,C + K\right]}\right\} \tag{34}$$

and the long run real wage $\frac{W^{LR}}{P}$ (combining short run real wage (17) with n^*)

$$\frac{W^{LR}}{P} = \left\{\frac{\sqrt{(1-sd)\left[(1-s)\,C + K\right]}}{W^B} + \frac{1}{a}\right\}^{-1} \tag{35}$$

The above results allow us to make two assertions: first, in the long run, bargaining power maintains its short run effects, it reduces employment and increase real wages; second, entry costs decreases both employment and real wages (with variable entry costs having a small role).

The mechanism that makes this happen is still the same: entry costs and bargaining power discourage entry and reduce competition. In this, the effect of the bargaining power of union is two fold: it reduce the equilibrium number of firms (rising the aggregate price) but it increase the nominal bargaining wage. The latter effect however is stronger than the former so that real wages are in the end positively related to the bargaining power.

6 A Comparison of Deregulation Policies in the Short and Long Run

Now that we have examined both the short and the long run we can compare how a deregulation of markets affects employment and real wages in the two different time horizons. When we refer to the long run we use the results we obtained for the stable case. We have seen that these results are reasonably similar to the other cases for many values of the parameters: however they may differ when the parameters assumes some extreme values. We summarize now the effects that (de)regulation of labour and product markets have in the short and long run and we search for the existence of a (de)regulation policy mix that, affecting both markets, could improve the working of the economy without causing a loss to any economic agents.

For simplicity we report the effects of deregulation policies: in the labour market this would happens through a legislation that reduces the bargaining power (a stricter law on strikes, for example) while in the product market it would mean a reduction of the entry costs (in theirs fixed and variable component). While we do not focus directly on regulation policies, their effects would simply be the opposite than those of deregulation. Table 3 presents the effects that a deregulation of labour market (a decrease in the union bargaining power β) has on the key variables.

Table 4 does the same, showing the effects of a deregulation of the product market, which could be brought forth with a reduction of the fixed costs K or the variable costs $\dot{C}$.

Table 3: The Effect of a Deregulation of Labour Market		
	Short Run	**Long Run**
Employment	Increase	Increase
Real Wages	Decrease	Decrease
Profits	Increase	None

Table 4: The Effect of a Deregulation of Product Market		
	Short Run	**Long Run**
Employment	None	Increase
Real Wages	None	Increase
Profits	None	Decrease

The above tables suggest that the same deregulation policy may produce different effects in different time horizons. The following assertions seems to be particular relevant:

- In the short run, a combination of deregulation in both the markets, produces an increase in profits and employment and a decrease in the real wages. Such a combination is therefore favorable to firms but it is adverse to unions[11].

- In the long run, a mix of deregulation in both the markets, while increasing employment, necessarily reduce profits. Moreover, its effect on real wages can be, even if not always, positive. In the long run then, the deregulation of both markets brings a loss for the firms and, if adequately done, a benefit to the unions.

- The above findings allow us to state that, if we consider both the two horizons, the loss of a party in the short run may be compensated by its gain in the long run. Only if the parties find this intertemporal trade-off beneficial the deregulation of both markets seems to bring benefit to all the economic agents. Interestingly, in this case the incumbent firms would have a gain in the short run and a loss in the long run, while the positive and negative effects for workers would have the opposite timing.

- Since economic agents usually give a higher value to the short than to the long run[12], the above suggests that the intensity of deregulation in the labour market should be lower than the one in the product market.

[11] In fact, the union utilty is reduced as a consequence of the decrease of β.

[12] This simply mean that they have a positive intertemporal substitution rate.

- While in principle the same trade-off could be possible through a regulation of both markets, this would actually happens at the cost of the reduction of employment in both the short and long run.

-As a general fact, (de)regulation policies that affects the product markets do not have any effect in the short run. However if a policy reduces the variable parts of the entry costs, then it would be possible to accelerate the achievement of the long run equilibrium.

To summarize, it seems that deregulation policies generate intertemporal trade-off, offering better or worse economic conditions depending on which is the time horizons we consider: exploiting this trade-off could improve the working of the economy, but only if the workers accept to pay some short run costs to obtain long run benefits. This fact induces to suggest that deregulation policies should be stronger in the product market than in the labour market.

7 Conclusions

In this paper we have built a macro model and we have used it to explore three main aspects: the role of imperfect competition in the short run, the process of firms' entry and its dynamic properties and the effects of (de)regulation policies in the long run. The model we built features elements of imperfect competition in the form of a Cournot oligopoly in the product market and wage bargaining in the labour market. At first, we examined the case where the number of firms is fixed at a given level: through this we have obtained the short run results. Those findings confirm the standard view where less competitive markets reduce output and employment but increase rents, allowing for higher profits (when the product market is more concentrated) and higher real wages (when unions detain higher bargaining power). We then introduce firms' entry. To do that we imagined that firms' entry costs increase with the number of entrants and that firms keep entering the market as long as prospective profits can cover these costs. The study of this process allowed us to determine the equilibrium number of firms and to study its properties. The stability of this process proved to be troublesome and we shown that for several values of the parameter it may not converge to a stable value. However, we were also able to show that even when the process does not converge, the number of firms stay confined in an interval which. for many of the possible values of the parameters, is rather small (and contains the equilibrium value), so that in the long run we can approximate the number of firms with its equilibrium value.

The entry mechanism and the equilibrium value we found, allowed us to endogenize the number of firms and to explore the effects of imperfect competition in the long run. While these effects are often the same as the short run, some important differences arose and in particular, we have showed that in the long run the bargaining power does not have any effect on the level of profits.

Finally, we explored the existence of complementarities in the deregulation of these markets: while there are no complementarities if we consider a time horizon only, some intertemporal complementarities do arise. In effect, the deregulation of both markets could improve the overall working of the economy but it would induces a gain for firms and a loss for workers in the short run and exactly the opposite in the long run. The loss in a time horizon could be compensate by the gain in other so that we observe an intertemporal trade-off. Since usually short run is more valued than the long run, deregulation policies should probably be stronger in the product market than in the labour market.

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A Appendix: Long run interval for the number of firms

We want to show that if $f'(n^*) < 0$ (and if $n_0 > 0$) the number of firms in the long run stays in the interval $[n_A, n_B]$ where $n_A \equiv f(n_E)$ and $n_B \equiv f(n_A)$. We can show this proving the following three statements.

1) For $n \leq n^*$ it holds $f(n) \geq n$.

Proof. We show that $n \leq n^*$ implies $f(n) \geq n$. The disequality $f(n) \geq n$ is true when $\left[s + \frac{v}{(1+n)^2} - k\right] n \geq n$ which yields $n \leq \sqrt{\frac{v}{1+k-s}} - 1$ and since $n^* = \sqrt{\frac{v}{1+k-s}} - 1$ we have proved the statement. ■

2) For $n > n^*$ we have $f(n) < n$ and $\min f(n) = n_A$.

Proof. First we show that $n > n^*$ implies $f(n) < n$. For $n^* < n \leq n_E$ the disequality $f(n) < n$ holds if $\left[s + \frac{v}{(1+n)^2} - k\right] n < n$ which is true when $n > \sqrt{\frac{v}{1+k-s}} - 1$. Then $f(n_t) < n_t$ is true in always true for $n^* < n \leq n_E$. When $n > n_E$ we have $f(n) = sn$ so that for $s < 1$ the disequality $f(n) < n$ is clearly true. This proves that $n > n^*$ implies $f(n) < n$. Now we have to prove that for $n > n^*$ we have $\min f(n) = n_A$.To prove this we have to compute the minimum of the function $f(n)$ for $n > n^*$. The function is not derivable in all of its points, however for $n^* < n \leq n_E$, we know that $f'(n) < 0$ so that $f'(n)$ is a negative monotone function and its minimum is met where n is the highest as possible: n_E in this case. For $n > n_E$ we have $f(n_E) = sn$ which is clearly a monotone positive function that has its minimum where n is the smallest: once again this happens as n goes to n_E. Since by definition $n_A \equiv f(n_E)$ this is enough to say that for $n > n^*$ it holds $\min f(n) = n_A$. ■

3) For $n_A < n < n^*$ we have $n^* < f(n) < f(n_A)$.

Proof. In the interval $n_A < n < n^*$ we have $f'(n) < 0$, then $f(n)$ has a maximum where n is the smallest: this obviuosly happens in n_A and then the number of firms can be at the most $f(n_A)$ which, by definition, is equal to n_B. ■

The three statements prove that the number of firms necesseraly reaches a value inside the interval $[n_A, n_B]$ and it keeps staying inside such interval. In fact, the first statement implies that for $n \leq n^*$, the number of firms keep increasing and it will either reach n^* or overshoot it. The second statement implies that if n^* has been overshot, the number of firms will keep dropping, reaching a value between n_A and n^*. Finally, the third statement tells us that when n is a value between n_A and n^* the following number of firms can be at the most n_B. Summing up this three statements the number of firms necessarily reache, and stays in, the interval $[n_A, n_B]$.

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