INTRODUCING COMPETITION TO A MONOPOLY WITH MOTIVATION SPILLOVER

by

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to my family

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1. Introduction

Monopoly can be defined as the case when a specific individual or an enterprise has sufficient control over a product or a service to determine the terms on which the demanders have access on it. Thus monopolies have lack of competition which is inefficient for the economy. The only one that is happy from the monopoly is the monopolist himself. Monopolist has all the control over the product and competition will make him lose some of the control by losing some of the market share of the product. After now this initial monopolist firm will be called as *Monopolist* even if there is competition. First thing we want to follow is the changes obtained for the initial firm, so we will call the firm *Monopolist* to remind that this firm was the monopolist at the beginning.

Introducing an other firm to a monopoly, will force the *Monopolist* to be more careful. It is known that in the case of monopoly the prices fall and some of the profit of *Monopolist* will fly to the other firm, which are not desired changes for the *Monopolist*. But the increase in competition forces the *Monopolist* to run more efficiently. Then there might be a case where the marginal costs decrease and the initial case *Monopolist* start to make more profit than before. Addition to that because of the competition the demand may increase and the *Monopolist* may make higher profits. Monopolist being the only firm in the market has no incentive to decrease the costs and also it is hard to define whether you are, as a monopolist, doing good or bad. There is no other firm to benchmark. So, at the end of the day, as the new firm is introduced to the market, the *Monopolist* has the opportunity to compare

its employees with the other firms' employees depending on the performance of the firm. Now the *Monopolist* has to be more motivated and has to spend more effort not to loose its share in the market. Near that as there is an increase in the motivation of the other firm, the *Monopolist* has to be even more motivated.

This motivation based intuition is valid for all kinds of economies, since motivation is needed always. But there are some markets that motivation is directly related with the performance or the efficiency of the companies. To make our point clearer now lets consider the football market. Since the teams are directly effected from the performance of the other teams, other's motivation is almost as important as our own motivation. In a normal goods market you could call yourself an efficient company even if you are not running efficiently and in this case you may not care about the motivation of other firms'. Because, lets say, the market is too big and you get enough profit without being efficient. But for football sector you need to take the other motivations into account.

Although we are not aiming to construct a model for the football sector only, let us give an example in this sector to make the idea clear. Bayern Munich is one of the biggest football teams in the world. The February 2009 Deloitte research shows that when the quality and the price of the players,

number of audiences, the budget of the teams and revenues are considered Bayern is at top 5 (Football Money League,2009) teams of the world. In this research it is also given that German League is one of the biggest leagues in the world with English, Spanish and Italian Leagues. Bayern as being the strongest team of Germany on the basis of revenue, budget and player quality,

has been successful in Bundesliga (German League) about 15 times in the last 20 years. So Bayern Munich is behaving like a monopolist in German League market. It is dominating the market. But when it is compared to the big teams of English, Spanish and Italian leagues it is not successful at all. We can compare these teams using the results they have from the international Champions League, where the biggest teams of Europe compete. In Italian, English or Spanish leagues there exists at least two teams that are highly qualified and rich and that are competing. Even for some leagues there are four or five teams that are closely strong and that compete every year in their own league and Champions League. So those teams that are competing in

English, Italian and Spanish leagues have the opportunity to learn from other teams and they always have to be motivated and efficient to be successful. Where as for Bayern Munich, they do not have to be very motivated to be champion in their league, because they already have much more qualified players than other German teams. This lack of motivation prevents Bayern Munich to be successful when they compete in a better league, here given as the Champions League. So teams are not using only their own motivation, but others's motivation is also very important.

There are many studies in regulations literature about how motivation can decrease the costs to make the company run more efficiently. Laffont and Tirole's 1986 paper construct their study on a model as follows: $C = (\beta - e) + \varpi.\mathrm{C}$ is total cost, β is marginal cost and e is the given effort level where we call it motivation in this study. What we are assuming here is more than that. Of course if a company becomes more motivated to eliminate some processes in order to be more efficient, then their cost will

decrease. But we also assume that there is a spillover between the motivation of competing firms. That is if there was an other big team competing with Bayern, then Bayern would firstly increase its own motivation meaning e_1, and addition to that Bayern would learn from also from other teams' training tactics. So other firm's effort (e_2) will directly decrease Bayern's cost too. So adding this to Laffont and Triole's paper, our cost function could be given as $C_1 = (\beta_1 - (e_1 + \alpha e_2) + \varpi$. Here α is the parameter showing the level of spillover.

This intuition has some common sense with the yardstick competition. Since there is not many studies assuming spillover of motivations between the firms, we can try to explain it using yardstick competition literature. But still in yardstick competition firms are not in the same market and they are not directly competing, where in our case they are in the same market and competing for the same good. Yardstick competition is mainly about the franchised monopolies and the regulation process of this monopolies. The main concern of this kind of regulation is the "cost-of-service". The regulator adjusts the prices of the monopolist depending on the cost it incurs. If the prices follow the costs then the monopolist has no incentive to minimize the costs. And as the regulator is not likely to know the efficient cost level, can not decide whether the monopolist is running efficiently. Schmalensee offers a kind of yardstick benchmarking to solve this problem (1979). He offers a state-owned firm engaged to the same business line as the regulated firm. But Schleifer oppose that by stating that state-owned firms are too different than the private firms and plus they are not running efficiently most of the time, so they can not be useful benchmarks. Shleifer suggests comparing similar

regulated firms with each other that are operating in independent markets (1985). This approach gets closer to our case by comparing two private firms, but still the only common thing between this paper and the regulation literature is the intuition of cost decreasing between the firms. Because we don't have a mechanism like regulation at all. Using the Shleifer's logic Armstrong et al. defines the prices in a regulated market as follows in his book (1994):

$$P(c_i, c_j) = p + \rho_1 c_i + \rho_2 c_j$$

where $\rho' s$ are the dependence rate of the prices to the costs of the firms. This model suggests that if cost of one firm decreases, then the regulator decrease the price and the other firm has to decrease its cost too. So if the benchmark firm spend more effort to decrease its costs, the regulator could even decrease the prices in a way that our firm can start to make loss. Hence it has to spend some effort too. That is: one's effort (motivation) will increase other's effort at the same time.

An other formal literature that was useful during the study was Petit and Randaccio's study about the technological innovations (2000). They search how investment on R&D influences the form of the foreign expansion or vice versa. The main, generally known, assumption they made was the spillover of the R&D investments. They assume the process innovation investments are cost reducing and in a two firm country, firms' marginal costs are effected from computing firms's investments in R&D. They try to find the way of foreign expansion (exporter or MNE-multinational firm) under this assumption. Similar studies has been made by d'Aspremont and Jacquemin (1998) for a

closed economy where they analyze the R&D investment process in a country with the assumption of innovation spillover. We use the intuition of the yardstick competition and the spillover effect of the innovations to answer the given question, except we now assume that motivation is the element that decrease the marginal costs and there is a spillover of the motivation among companies.

What distinguishes our study from previous literature is that we take the idea of yardstick competition with the decreasing marginal costs and ask a completely different question: what happens to the profit of the monopolist when competition is introduced to the market under the assumption of decreasing marginal costs with motivation. Kenneth J. Arrow also compares monopoly with competition, concluding that incentive to invest is higher under competition than monopoly (1969). But he leans his study on royalties that are used by the inventor company for the inventions, which is totally different than our case.

We present a two country, two firm model for mainly two different cases and then we analyze two extension cases. In the first case we analyze a monopolist running in a closed economy. Then we add an other firm to this market to see the changes in motivations of the monopolist, quantity sold and finally the profits. In the second case we consider an open economy where the firms can sell their products abroad. Again, for this case we first assume an individual monopolist firm and then we add an other firm to realize competition. Later we try to see what happens when we increase competition by increasing the number of firms. We first analyze comparison of two, three and four firms cases, then we make an other assumption, that

is what if increasing number of firms in the market decrease the power of the firms and they start to lose their ability to be more motivated. The equations for the models are kept as simple as possible in order to be able to obtain analytical results and analyze them.

There are mainly three different forces fighting when we introduce competition to a market. A new entrant decreases the market share of the firms that are already in the market. But on the other side the new entrant will increase the motivation of older firms and now they have the opportunity to utilize competition. After a point because of the free riding effect, the spillover of motivations may become bad for the companies and they may want to decrease their motivations. So for the competition to be better for older firms, the positive effect of competition (increased motivation and motivational spillover) should be higher than the negative effect of free riding and market share loss. We prove that under certain amount of spillover competition profits for the firms are higher than the monopolist's profit both for the open and the closed economy. The same result is valid for motivations and quantities that is when competition is introduced the motivation levels increase for the firms and interestingly this increase in motivation decrease the prices more than anticipated (more than a normal decrease caused by competition without any motivational structure). An other result we obtained is, for the open market the increase of profit when we move from monopoly to competition is higher than the closed economy case. Since the number of markets increase, the potential profit for the monopolist also increases in an open economy, and hence the *Monopolist* has more opportunity to utilize in the case of competition. We have also found that under this motivational

structure more competition can make the market worse off, and if we try to decrease the free riding effect then more firms in the market starts to mean more welfare for the economy.

The paper is organized as follows: in section 2 the model will be described with the analysis of the results. We will compare the cases of monopoly and duopoly for both closed and open economies. Then we will analyze the changes for the firms and customers with the case of new entrants to the market which means more competition and finally section 3 will conclude the paper.

2. The Model

The constructed model considers two markets (home and abroad) and two firms (firm 1, firm 2) which manufacture the same homogenous good in home and abroad. We consider that motivation (m) is effective on the optimal quantity levels of the firms chosen. Petit and Randaccio's model about export and FDI assume investments as a cost decreasing element. same wise, introduced motivation reduces the marginal and average costs. A profit function very similar to Shleifer (1985) will be used with some changes. The prices will be assigned using Cournot's equilibrium as used by Petit and Randaccio or d'Aspremont and Jacquemin. The profit function can be defined as follows:

$$\pi_i = (p - C_i)q_i(p) - R(m_i) \qquad (1)$$

The cost function with yard stick competition intuition is given as follows :

$$C_i(m_i, m_j) = c_i - \theta(m_i + \alpha m_j) \qquad i, j = 1, 2 \tag{2}$$

Where c_1 and c_2 are marginal costs for firm 1 and firm 2. m_1, m_2 are the motivation levels for the companies. The value of c can differ depending on firms, so c can be seen as past accumulated knowledge (Petit, Randaccio, 1997) where if the firm is more experienced c will be smaller, but for simplicity we will assume $c_1 = c_2$. The effectivity of the motivations on the costs changes depending on the *motivation effectivity parameter*, θ. The spill over parameter for the costs or the motivations between the firms is α. Hence as the spillover parameter increase, a decrease in the cost of firm 2 decrease the cost of the firm 1 more. Each firm has a constant marginal cost c and can reduce the cost to $c - \theta m$, by spending $R(m)$ that is the cost of motivation. $R(m)$ will be as $\gamma \cdot \frac{m^2}{2}$ in our model. We assume $\frac{\partial R}{\partial m} > 0$ and $\frac{\partial^2 R}{\partial m^2} > 0$. That is the cost function is an increasing, convex function; reducing costs by increasing motivation becomes more and more costly.

If we substitute eq. (2) into eq. (1) and rewrite it, we will obtain:

$$\pi_i = pq_i(p) - c_i q_i(p) + \theta(m_i + \alpha m_j)q_i(p) - R(m_i)$$

As you see this time the motivations are included with a positive coefficient. With this construction the cost decreasing motivation approach is very similar to profit increasing advertisement approach. Now m's can be seen as the investments for advertisement. Even if we are competing, if the other firm makes advertisement the market increases and my profit increases too. Also if the other firm makes investments for advertisement, it also forces me to make investment too, because of the competition. That increases my own m.

We are going to use Cournot Equilibrium to find the optimal levels of motivation and quantities. The linear inverse demand functions are considered as:

$$p_h = a_h - b_h \cdot q_h \qquad and \qquad p_f = a_f - b_f \cdot q_f \qquad (3)$$

q_h, q_f are the total amount of goods sold at home and foreign country, respectively. For the sake of simplicity, $a_h = a_f$ and $b_h = b_f$ is assumed where a and b's are positive constants, as we know from Cournot's model $\frac{1}{b}$ represents the size of the market. The main assumptions for the model can be represented as follows:

1. $\frac{c}{\theta} \geqslant m_i + \alpha m_j, \;\; i, j = 1, 2$
2. $\frac{a}{b} \geqslant q_i \geqslant 0, \;\; i = h, \, f$
3. $a > c_i + c_j > 0, \;\; i; j = 1, 2$

First two conditions satisfy the prices and the costs to be greater than zero. Third condition is the initiality condition: for $q = 0, m = 0$, $p > C(c1, c2)$. This condition makes sure that the firms will be active.

Firstly we will analyze a monopoly and then a competitive market in a closed economy. Then same analysis will be made for an open economy.

2.1 Closed Economy

2.1.1 *Closed economy-Monopoly*

The firm is a monopolist in the market, has no exporting activity. The profit of the company is given by:

$$\pi = (p - (c - \theta m))q(p) - R(m) \quad \text{or}$$
$$\pi = ((a - b \cdot q) - (c - \theta m)) \cdot q - \gamma \cdot \frac{m^2}{2} \tag{4}$$

where $\gamma \cdot \frac{m^2}{2}$ is the cost of motivation. γ is a positive constant, showing the cost efficiency of the firm. The quadratic form says that there exist a possibility of diminishing returns to motivation (Cheng, 1984). Here, since the market is a monopoly; there is no other firm and no spillover of motivation.

2.1.2 *Closed economy-Duopoly*

Now an other company is introduced to the market with similar properties. We allow for motivational spillover. We assume that increase in one's motivation increase the other's motivation too, hence directly and indirectly decrease the other's marginal cost. Now the marginal cost function becomes:

$$C_i(c_1, c_2) = c - \theta(m_i + \alpha m_j) \tag{5}$$

α is the spillover parameter. The new inverse demand function becomes:

$$p = a - b \cdot (q_1 + q_2) \tag{6}$$

so the profits for the two firms are as follows:

$$\pi^1 = ((a - b \cdot (q_1 + q_2)) - (c - \theta(m_1 + \alpha m_2))) \cdot q_1 - \gamma \cdot \frac{m_1^2}{2} \tag{7}$$

$$\pi^2 = ((a - b \cdot (q_1 + q_2)) - (c - \theta(m_2 + \alpha m_1))) \cdot q_2 - \gamma \cdot \frac{m_2^2}{2} \tag{8}$$

2.1.3 Impact of competition on Monopolist

Closed economy-Monopoly

It is known that introducing competition to the market will take many advantages from the monopolist, but on the other side; because of the spillover effect, the efficiency of the initial firm (*Monopolist*) will increase with the decrease in marginal costs. So it is a trade off between market share and marginal costs. For the monopoly market case, from the first order conditions we get:

$$q = \frac{1}{2} \cdot \frac{(a-c+\theta \cdot m))}{b} \qquad (9)$$

The positive relationship between optimal level of quantity sold and motivation can be easily seen. Decreasing marginal costs induce an increase in quantity sold. Substituting (9) into (4) and maximizing over m gives the following level of quantity and motivation:

$$m = \frac{\theta \cdot (a-c)}{-\theta^2 + 2\gamma b} \qquad (10)$$

$$q = \frac{\gamma \cdot (a-c)}{-\theta^2 + 2\gamma b} \qquad (11)$$

Assuming that second order condition ($2\gamma b - \theta^2 > 0$) is satisfied[1], as expected the motivation and the quantity increase with higher demand and decrease with marginal cost. Given $\partial m/\partial \theta > 0$ and $\partial q/\partial \theta > 0$; as productivity of motivation (θ) increase , again, firms become more motivated and sell more. Using equations (10) and (11), the equations for price and profit are given as follows:

[1] See assumption 3 for $a - c > 0$

$$\pi = \frac{1}{2} \cdot \frac{\gamma(a-c)^2}{-\theta^2+2\gamma b} \qquad \text{and} \qquad p = a - b\frac{2\gamma\cdot(a-c)}{-\theta^2+2\gamma b} \qquad (12)$$

Closed economy-Duopoly

Now we assume that an other company enters to the market. Because of competition, this company will take some of the market share of the previous one, but the marginal costs will decrease, hence we need to search for the final effect of the competition. Each firm tries to maximize its profit by choosing their optimal level of output under Cournot assumptions. We assume that the game is played in sequential manner; first the quantities are found and then the motivations. We obtain:

$$q_1 = \frac{1}{3} \cdot \frac{a-c+\theta(m_1(2-\alpha)+m_2(2\alpha-1))}{b} \qquad (13)$$

$$q_2 = \frac{1}{3} \cdot \frac{a-c+\theta(m_2(2-\alpha)+m_1(2\alpha-1))}{b} \qquad (14)$$

It is clear that firm's own motivation increase the quantity sold, but the effect of other firm's motivation depends on the spillover parameter. The effect is positive if $\alpha > 0.5$. If the spill over between the firms is not high enough ($\alpha < 0.5$) the effect is negative. An increase in the motivation of firm 2 has two opposing effects on the output of firm 1. On one hand an increase in m_2 will reduce the marginal cost of firm 2 and this will have a negative effect on q_1. On the other hand, an increase in m_2 will also reduce

the marginal cost of firm 1 and this will have a positive effect on q_1. The last one is the spillover effect. So the net affect depends on value of α.

Substituting (13), (14) into the profit functions and maximizing for m_1, m_2 we get:

$$m_1 = m_2 = \frac{2\theta(2-\alpha)(a-c)}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2} \tag{15}$$

yielding:

$$q_1 = q_2 = \frac{3\gamma(a-c)}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2} \tag{16}$$

Price and profit of *Monopolist*:

$$p = a - \frac{6b\gamma(a-c)}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2} \tag{17}$$

$$\pi = \frac{\gamma(a-c)^2(9\gamma b-2\theta^2\alpha^2+8\theta^2\alpha-8\theta^2)}{(9\gamma b-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2)^2} \tag{18}$$

Again, the motivation and sales amounts are positively related with the knowledge accumulation of the companies (decrease in c), the demand (increase in a), motivation cost effectivity $(\frac{1}{\gamma})^2$, productivity of motivations $(\theta)^3$ and the market size $(\frac{1}{b})$. Given that $2\gamma b - \theta^2 > 0$, then $9b\gamma - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2 > 0$[4] Hence solution for m, q and p are positive in this case as well. Now the important question is, how does the competition effect the optimal level of motivation and quantity? When equations (10) and (15) are compared;

[2] $\partial m/\partial\gamma < 0$ and $\partial q/\partial\gamma < 0$

[3] $\partial m/\partial\theta > 0$ and $\partial q/\partial\theta > 0$

[4] See Appendix A.1 for the proof

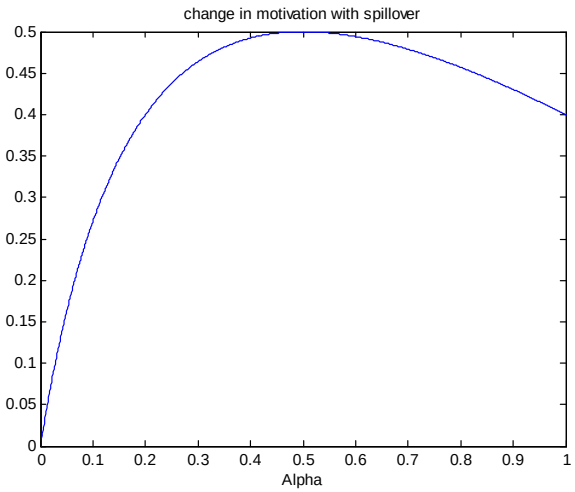

Figure 1: Change in Motivation

for the competition case motivation to be higher, $\frac{equation\ 10}{equation\ 15} < 1$ should hold. Depending on this inequality we found that, given $1 > \alpha > 0$; the α values satisfying $\frac{2\theta^2(2\alpha-\alpha^2)}{1+4\alpha} > b\gamma$ will certainly say that motivation under competition is higher than motivation under monopoly [5]. The motivation efficiency is constant and α takes values between 1 and 0. The behavior of the function $\frac{2(2\alpha-\alpha^2)}{1+4\alpha}$ is depicted in Figure 1.

The given inequality is pretty intuitive actually, it says if the efficiency of motivation increases (θ) the possibility of motivation under competition to be higher than motivation under monopoly increases, or if the market gets smaller (b gets higher) or the motivation cost efficiency is smaller (γ higher-motivation is costly) then the possibility of motivation under monopoly being higher than motivation under competition increases. Looking at the graph,

[5] See Appendix A.2 for the proof

the left hand-side of the inequality gets higher for the values of α that are close to 0.5, hence when α is around 0.5 the possibility of *competition becoming more attractive than the monopoly,* gets higher; that is if the spillover effect is too small the advantages of competition is not utilized well or the cost decreasing effect of competition is not utilized enough to compensate the market share loss. Similarly when spillover is too much, other firm utilize the monopolist motivation a lot and hence, because of the free riding effect competition becomes worse than monopoly for the *Monopolist.* As we can see from the graph as $\alpha > 0.5$, the value of the function decreases slowly where when $\alpha < 0.5$ the function decreases faster, that is because after 0.5 there are two opposing effects: because of the free riding effect the motivation tends to decrease, but on the other side increasing motivation makes the market larger by decreasing the costs and hence this effect makes the decrease of the function to be slower. Similar analysis can be made for the optimal quantities (see eq. (11) and (16)). we obtain that quantity for competition is higher than the quantity for monopoly if $\frac{\theta^2}{3}(1 + 2\alpha - 2\alpha^2) > b\gamma$. Same intuition, achieved for motivation, is also valid for optimal quantities.To see how graph of the function $\frac{1+2\alpha-2\alpha^2}{3}$ behaves see Figure 2.

Analysis about the profits will give us the final decision whether competition is better for the monopolist or not and for what level of spillover it is better. The profit level for the duopoly is given by

eq. 18. As we can see, $\partial\pi/\partial\alpha > 0$, as α increase profit of the *Monopolist* in the competition increases too. So higher the level of spillover better it is for the monopolist. Comparison of eq. 18 with eq. 12 will yield the following

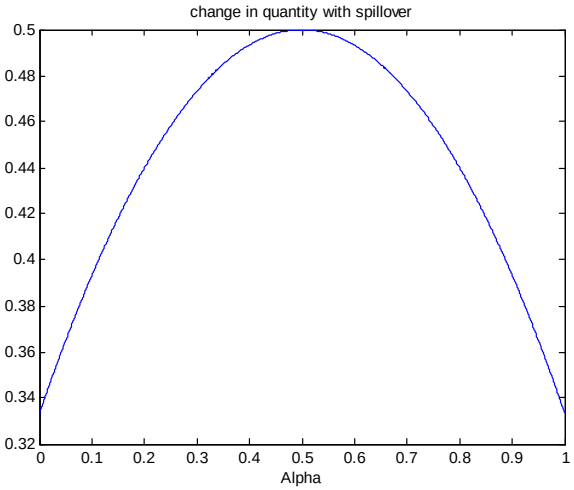

Figure 2: Change in Quantities

results:

for $\alpha = 0$;

$\pi_2 - \pi_1 = \frac{\gamma(a-c)^2(9\gamma b - 2\theta^2\alpha^2 + 8\theta^2\alpha - 8\theta^2)}{(9\gamma b - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{\gamma(a-c)^2(9\gamma b - 8\theta^2)}{(9\gamma b - 4\theta^2)^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2} < 0$

$\alpha = 0.5$;

$\pi_2 - \pi_1 = \frac{\gamma(a-c)^2(9\gamma b - 2\theta^2\alpha^2 + 8\theta^2\alpha - 8\theta^2)}{(9\gamma b - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{\gamma(a-c)^2}{9\gamma b - 4.5\theta^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2} < 0$

$\alpha = 1$;

$\pi_2 - \pi_1 = \frac{\gamma(a-c)^2(9\gamma b - 2\theta^2\alpha^2 + 8\theta^2\alpha - 8\theta^2)}{(9\gamma b - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{\gamma(a-c)^2(9\gamma b - 2\theta^2)}{(9\gamma b - 4\theta^2)^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2}$

It is seen that for $\alpha = 0.5$, the profit of a firm under monopoly structure is higher than a duopoly market structure. But for $\alpha = 0.1$, profit of a firm

under duopoly structure is higher than the that under monopoly structure higher if $45\gamma^2 b^2 < 46\gamma b\theta^2 - 12\theta^4$.

If the motivation cost efficiency or the motivation efficiency is high for the monopolist, or if the market is large enough then for high level of spillover, competition becomes better for the *Monopolist*.

2.2 Open economy

Now the firms both compete at home and abroad. At part 2.1, we have seen that the motivation and quantity level is positively related for each firm. That is, if the firm can produce more the opportunity to make profit gets higher, hence the firm becomes more motivated. Near that if the firm can increase the motivation, then the costs become smaller and producing more becomes more profitable. So more motivation means more production or sales, and more production means more motivated company. At this part another market is added to the model. Now the firm has the opportunity to make more profit by producing more. This opportunity makes the firm to be more motivated and firm starts to produce even more. Given that the motivation increase obtained because of the foreign market will also be effective for the home market, an interesting analysis can be made, at that part, by analyzing the effect of foreign market in the home market. For simplicity we assume that there is no foreign competitor.

2.2.1 *Open economy-Monopoly*

First, we will consider the case where there is only one firm selling goods at home and abroad. Inverse demand function at home and abroad will be

as follows:

$$p_h = (a - bq_h) \qquad and \qquad p_f = (a - bq_f) \tag{19}$$

where q_h and q_f are the quantities sold. The profit function of the monopolist will be as follows:

$$\pi = ((a - b \cdot q_h) - (c - \theta \cdot m)) \cdot q_h + ((a - b \cdot q_f) - (c - \theta \cdot m)) \cdot q_f - \gamma \cdot \frac{m^2}{2} \tag{20}$$

We assume that the exported goods are produced in the same company and exporting goods is not costly. The monopolist has to choose the optimal values for home and abroad market to maximize the profit. We assume that the demand functions are same for both of the markets.

2.2.2 *Open economy-Duopoly*

At that point another company enters the market which will be also active at foreign market. Because of the competition the prices will fall, but the competition will also induce efficiency and the marginal costs will be lower too. Inverse demand function are given as:

$$p_h = (a - b(q_{1,h} + q_{2,h})) \qquad \text{and} \qquad p_f = (a - b(q_{1,f} + q_{2,f})) \tag{21}$$

Given the prices the profit function for the firms are:

$$\pi^1 = ((a - b \cdot (q_{1,h} + q_{2,h})) - (c - \theta \cdot (m_1 + \alpha m_2))) \cdot q_{1,h} + ((a - b \cdot (q_{1,f} + q_{2,f})) - (c - \theta \cdot (m_1 + \alpha m_2))) \cdot q_{1,f} - \gamma \cdot \frac{m_1^2}{2} \tag{22}$$

$$\pi^2 = ((a - b \cdot (q_{1,h} + q_{2,h})) - (c - \theta \cdot (m_1 + \alpha \cdot m_2))) \cdot q_{2,h} + ((a - b \cdot (q_{1,f} + q_{2,f})) - (c - \theta \cdot (m_1 + \alpha \cdot m_2))) \cdot q_{2,f} - \gamma \cdot \frac{m_2^2}{2} \qquad (23)$$

First firm has to choose $q_{1,h}$ and $q_{1,f}$ by considering the move that firm 2 will make, same thing is also true for firm 2. So the obtained quantities will be the profit maximizing Nash equilibrium values.

2.1.3 Impact of competition on profits

Analysis of this part is more important, because now we will be able to analyze two different relations:

1) Does the profitability of moving from monopoly to duopoly change when the *Monopolist* is exporting?

2) For an exporting monopoly market, how does introduced competition effect optimal quantity, motivation and profit levels (at home and abroad)?

Open economy-Monopoly

We start by maximizing the profit with choosing sales at home and abroad under Cournot assumptions. The maximizing quantities are obtained as:

$$q_f = q_h = \frac{1}{2}\frac{(a-c+\theta m)}{b} \qquad (23)$$

using the given sales the optimal level of motivation is given by:

$$m = \frac{\theta(a-c)}{-\theta^2+\gamma b} \qquad (24)$$

when compared to the non-exporting monopolist case (equation (10)) it can be seen that motivation is higher for the exporting monopolist. We now

that motivation is directly related with the quantity sold, hence if the firm opportunity to sell at new markets then it become more motivated.

Using the optimal motivation level, the quantities are given as:

$$q_f = q_h = \frac{1}{2}\frac{\gamma(a-c)}{-\theta^2+\gamma b} \qquad (25)$$

We now assume that $-\theta^2+\gamma b > 0$. q_h values are higher than the q values where q values for denoting the amount sold by the non-exporting monopolist. Introducing a new market increases the quantity produced, that was expected, but a new market increase the opportunity to make profit which increases the motivation and motivation makes the process more efficient by decreasing the marginal costs. Hence producing more becomes more profitable. Finally, excluding the sales made outside, firm starts to sell inside more than the non-exporting case, which is an interesting result.

Exporting firms are more motivated than the non-exporting ones, hence competition is more profitable for the exporting firms than non-exporting ones (See eq. (33)).

Respectively the price and the profit (total profit of the firm) can be obtained:

$$p_h = a - \frac{1}{2}\frac{b\gamma(a-c)}{-\theta^2+\gamma b} \qquad (26)$$

$$\pi = \frac{1}{2}\cdot\frac{(a-c)^2}{-\theta^2+\gamma b} \qquad (27)$$

Since the quantity sold at home increases when the monopolist start to export, then the prices expected to decrease more than non-exporting case which can also be seen by comparing price equations for exporting and non-exporting monopolies (equations (11) and (26)).

Open economy-Duopoly

Again, firms start with choosing their quantities of sales at home and abroad to maximize the profits under Cournot assumptions. We obtain:

$$q_{1,h} = q_{1,f} = \frac{1}{3}\frac{a-c+\theta(m_1(2-\alpha)+m_2(2\alpha-1))}{b} \tag{28}$$

and

$$q_{2,h} = q_{2,f} = \frac{1}{3}\frac{a-c+\theta(m_2(2-\alpha)+m_1(2\alpha-1))}{b} \tag{29}$$

The relationship between the sales and motivation can be seen from equations (28) and (29). The motivation of each firm effects its own sales positively. But the effect of other firm's motivations is uncertain depending on value of α. if $\alpha > 0.5$ the effect is positive on the other firm and if $\alpha < 0.5$ it is negative. If firm 1 start to increase its motivation, the competitiveness of this firm increases because of the decrease in its marginal cost which negatively affect the sales decision of firm 2. But after a point if the spillover is too much, the free rider effect becomes stronger and this also cause a marginal cost decrease for firm 2, hence it leaves a positive effect on firm 2, so same results as the non-exporting case hold here too.

Substituting equations (28) and (29) into the profit functions, we can now obtain Nash equilibrium strategies for m_1 and m_2:

$$m_1 = m_2 = \frac{4\theta(2-\alpha)(a-c)}{9b\gamma-4\theta^2\alpha+4\theta^2\alpha^2-8\theta^2} \tag{30}$$

A positive equilibrium solution exists if $9b\gamma - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2 > 0$. Given $\gamma b - \theta^2 > 0$, it can be easily proven that a positive solution exists[6]. All

[6]See Appendix B.1 for proof

the results we have found in the closed economy-duopoly case are relevant at that point too, about the effect of cost efficiency, market largeness and etc. Comparison of eq. (15) and (30) also confirms that exporting firms are more motivated than the non-exporting ones, hence we can conclude; an exporting opportunity increase motivation and hence increase efficiency.

The final equilibrium output quantities are obtained as follows:

$$q_{1,h} = q_{1,f} = q_{2,h} = q_{2,f} = \frac{3\gamma(a-c)}{9b\gamma - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2} \qquad (31)$$

Applying the same analysis we did for the closed economy; competition motivation is higher than the optimal monopoly motivation for the α values satisfying

$4\theta^2 \frac{(2\alpha - \alpha^2)}{1+4\gamma} > \gamma b$ (see eq. (25) and (31)) (32)

At that part we will make two different comparisons. First what is the difference between introducing competition to a closed and open economy. Second how the level of motivation, quantities and profits change by moving from open economy monopoly to open economy duopoly. When we compare eq. (32) with the similar inequality for the closed economy ($4\theta^2 \frac{(2\alpha - \alpha^2)}{1+4\gamma} > 2\theta^2 \frac{(2\alpha - \alpha^2)}{1+4\gamma}$), we see that the motivation increase obtained when we move from monopoly to duopoly under open economy is higher than the motivation increase obtained when we move from monopoly to duopoly under closed economy. Comparing eq. (25) and (31), similarly if $\frac{\theta^2}{6}(4\alpha - 4\alpha^2 + 1) > \gamma b$ then optimal quantities for duopoly case is higher than the monopoly case.

The equilibrium prices and profits (total profit of the *Monopolist*) become:

$$p_h = p_f = a - \frac{6b\gamma(a-c)}{9b\gamma - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2} \tag{33}$$

$$\pi = \frac{2\gamma(a-c)^2(9\gamma b - 4\theta^2\alpha^2 + 16\theta^2\alpha - 16\theta^2)}{(9\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2)^2} \tag{34}$$

Similar to the closed economy case we see that as α gets higher, the profit for the competition increases. But when we compare this open economy duopoly case profit of the *Monopolist* with the closed economy duopoly case profit of the *Monopolist*, it is seen that when the market size doubles (where firms also enter to the foreign market), the profits increase more then two times. The opportunity of selling more also increases the motivations of the each firm. That also increases the other firms motivation and the decrease in the marginal costs take place more then expected which makes increasing the production even more profitable. Comparing the profits for open economy will yield the following difference between the profits of *Monopolist* for monopoly and duopoly:

$\alpha = 0$;

$\pi_2 - \pi_1 = \frac{2\gamma(a-c)^2(9\gamma b - 4\theta^2\alpha^2 + 16\theta^2\alpha - 16\theta^2)}{(9\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 2\gamma b} = \frac{2\gamma(a-c)^2(9\gamma b - 16\theta^2)}{(9\gamma b - 8\theta^2)^2} - \frac{\gamma(a-c)^2}{2\gamma b - 2\theta^2} < 0$

$\alpha = 0.5$;

$\pi_2 - \pi_1 = \frac{2\gamma(a-c)^2(9\gamma b - 4\theta^2\alpha^2 + 16\theta^2\alpha - 16\theta^2)}{(9\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 2\gamma b} = \frac{2\gamma(a-c)^2}{9\gamma b - 9\theta^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 2\gamma b} < 0$

$\alpha = 1$;

$\pi_2 - \pi_1 = \frac{2\gamma(a-c)^2(9\gamma b - 4\theta^2\alpha^2 + 16\theta^2\alpha - 16\theta^2)}{(9\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 2\gamma b} = \frac{2\gamma(a-c)^2(9\gamma b - 4\theta^2)}{(9\gamma b - 8\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 2\gamma b}$

We can see that for $\alpha = 0.5$, the *Monopolist*'s profit under monopoly is higher than the *Monopolist*'s profit under duopoly. But for $\alpha = 1$, *Monopolist*'s profit under duopoly is higher than the *Monopolist*'s profit under monopoly if $45\gamma^2 b^2 < 92\gamma b\theta^2 - 48\theta^4$.If the motivation cost efficiency $(\frac{1}{\gamma})$ or the motivation efficiency (θ) is high enough (which is true for highly motivation dependent markets) then for high level of spillover $(\alpha > 0.5)$, competition becomes better for the *Monopolist*. Both for the closed and open economy we see that as the spillover is not high enough $(\alpha < 0.5)$, the profit of the *Monopolist* under monopoly is higher than the profit of the *Monopolist* under Duopoly. High spillover is not good for the customers because of the excess free riding effect (firms decide to be less motivated and produce less which increases the prices). But duopoly becomes better for the firms if the spillover is high, because high spillover decrease their own motivation and hence their motivational cost, but still they utilize other's motivation and they become better off with high level of spillover. So what firms want is high spillover and highly motivated competitors where their own motivation can be low. Comparing the closed and open economies again, we see that under open economy the profit difference of the Monopolist for the monopoly and duopoly cases is higher than closed economy profit difference of the Monopolist for the monopoly and duopoly cases. So even if under closed economy it is not profitable for the *Monopolist* to move from monopoly to duopoly for, lets say, $\alpha = 0.7$, for the same α it can be profitable for the *Monopolist* to move from monopoly to duopoly under open economy. This can be easily seen from given conditions for the profits to be higher for duopoly. The condition for the closed economy *Monopolist*'s profit to be higher for the duopoly

case was $45\gamma^2 b^2 < 46\gamma b\theta^2 - 12\theta^4$. The competition is more profitable for the *Monopolist* when the firms are exporters since $92\gamma b\theta^2 - 48\theta^4 > 46\gamma b\theta^2 - 12\theta^4$.

2.3 Oligopoly (2,3,4 firms)

The next thing to consider is the depth of the competition. Depending on the spillover parameter there exists a level of competition already, now we ask the question, what happens if the level of the competition is increased in the market with increased number of firms. This may lead to various results, for example the optimal value of alpha for the firms, which is 1, may decrease because of two much competition. To see how number of firms in the market effect the motivation level and hence the welfare of the economy, we will analyze the cases where the market has three and four competitive firms. For simplicity we will make the analysis for a closed economy. The calculation for three firm case is made below. Since the analysis for four firm case is the same only the results has been given for this case.

Similar to the previous cases, the profit functions will be given as follows for three different firms.

$$\pi^1 = ((a - b \cdot (q_1 + q_2 + q_3)) - (c - \theta(m_1 + \alpha m_2 + \alpha m_3))) \cdot q_1 - \gamma \cdot \frac{m_1^2}{2} \quad (35)$$

$$\pi^2 = ((a - b \cdot (q_1 + q_2 + q_3)) - (c - \theta(m_2 + \alpha m_1 + \alpha m_3))) \cdot q_2 - \gamma \cdot \frac{m_2^2}{2} \quad (36)$$

$$\pi^3 = ((a - b \cdot (q_1 + q_2 + q_3)) - (c - \theta(m_3 + \alpha m_1 + \alpha m_2))) \cdot q_3 - \gamma \cdot \frac{m_3^2}{2} \quad (37)$$

Solving the equation for quantities will give us the following equations.:

$$q_1 = \frac{1}{4} \cdot \frac{a-c+\theta(m_1(3-2\alpha)+m_2(2\alpha-1)+m_3(2\alpha-1))}{b} \tag{38}$$

$$q_2 = \frac{1}{4} \cdot \frac{a-c+\theta(m_2(3-2\alpha)+m_1(2\alpha-1)+m_3(2\alpha-1))}{b} \tag{39}$$

$$q_3 = \frac{1}{4} \cdot \frac{a-c+\theta(m_3(3-2\alpha)+m_2(2\alpha-1)+m_1(2\alpha-1))}{b} \tag{40}$$

First interesting result is the following; when $\alpha < 0.5$, where the motivation of the other firms effect the *Monopolist*'s motivation positively, as the number of firms increase in the market, the quantity level of the *Monopolist* becomes more and more dependent to its own motivation. The dependence of quantities to the motivations is given with the coefficient of motivations. For example from eq. (38), it is seen that the dependence of firm 1's quantity to its own motivation is $\frac{\theta(3-2\alpha)}{4}$. This dependence for two firm case was $\frac{\theta(2-\alpha)}{3}$ (see eq. (13)) and the dependence of *Monopolist*'s quantity to its own motivation for four firm case is $\frac{\theta(4-3\alpha)}{5}$. When the spillover is not high enough and the number of firms is high in the market, the risk of losing the market increases and the *Monopolist* feels to be more motivated to deal with it. When spillover is large enough ($\alpha > 0.5$), the *Monopolist*'s motivation is utilized by the other firms even more then the duopoly case which decrease the incentive of the *Monopolist* to be motivated, plus now the *Monopolist* can also utilize the third firm's motivation addition to the second one so its motivation can be less than the two firm case. This is summarize at Figure 3. We have seen that to have the best solution for the customers, there need to be many firms with low level of spillover. This structure decrease the free riding, makes all the firms to be motivated and this gives the maximum

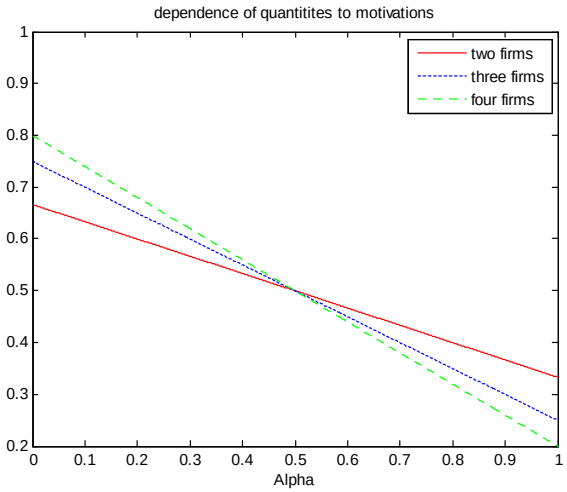

Figure 3: Dependence of Quantities on Motivations

amount of production and minimum amount of price level. What firms want is high level of spillover, so that they can utilize others' motivation and don't have to be dependent to their own motivation which decreases the cost of motivation.

The motivation and the quantity values can be found as follows:

$$m_1 = m_2 = m_3 = \frac{\theta(3-2\alpha)(a-c)}{8b\gamma-4\theta^2\alpha+4\theta^2\alpha^2-3\theta^2} \tag{41}$$

$$q_1 = q_2 = q_3 = \frac{2\gamma(a-c)}{8b\gamma-4\theta^2\alpha+4\theta^2\alpha^2-3\theta^2} \tag{42}$$

When the quantities for the three firm case and the four firm case compared with the two firm case, it seems that the firms become less motivated. Now each new entering firm gets a big share of the market and causes big

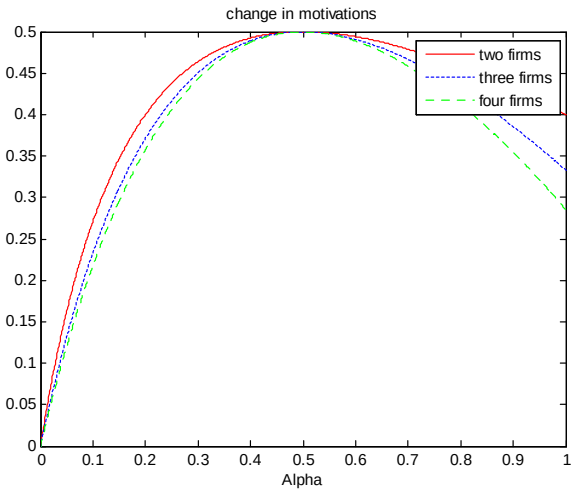

Figure 4: change in Motivations

loses to the *Monopolist* and adds some positive spillover effect. Now the motivation of the *Monopolist* will be utilized with more firms which increases the free riding effect. Market share loss with new entrant and increasing free riding effect repress the positive spillover effect and hence new entrants decrease the motivation. But as more and more firms are introduced we will see the motivation loss becomes less, that is after duopoly introducing an other firm decreases the motivation a lot, but then introducing an other one decreases the motivation less. This is because each new entrant cause less market share loss. This is summarized at Figure 4.

Figure 5 also shows that the changes in the quantities are similar to the changes in motivations. Less motivation means less willingness to produce, so as new firm enter to the market *Monopolist's* motivation decrease because negative effect of market share loss and free riding effect is more than the

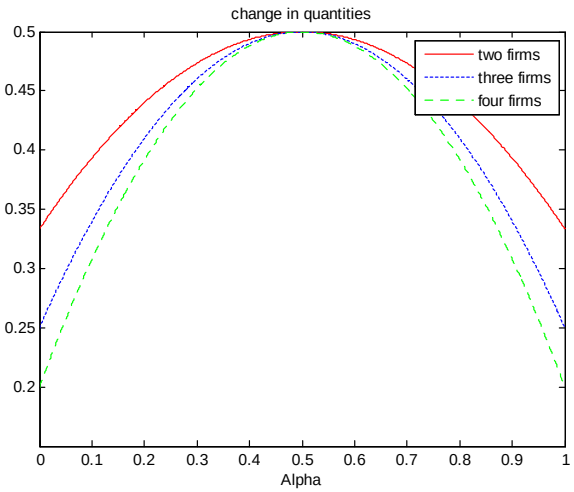

Figure 5: Change in Quantities

positive effect of marginal cost decrease obtained by using the new entrants motivation (spillover).

Price and profit for three firm case can be obtained as follows:

$$p = a - \frac{6b\gamma(a-c)}{8b\gamma - 4\theta^2\alpha + 4\theta^2\alpha^2 - 3\theta^2} \tag{43}$$

$$\pi = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - 4\theta^2\alpha^2 + 12\theta^2\alpha - 9\theta^2)}{(8\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 3\theta^2)^2} \tag{44}$$

The profit difference for the *Monopolist* between three firm case and monopoly case is given below:

for $\alpha = 0$;

$\pi_2 - \pi_1 = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - 4\theta^2\alpha^2 + 12\theta^2\alpha - 9\theta^2)}{(8\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 3\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - 9\theta^2)}{(8\gamma b - 3\theta^2)^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2} < 0$

$\alpha = 0.5;$

$$\pi_2 - \pi_1 = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - 4\theta^2\alpha^2 + 12\theta^2\alpha - 9\theta^2)}{(8\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 3\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{1}{2}\frac{\gamma(a-c)^2}{8\gamma b - 4\theta^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2} < 0$$

$\alpha = 1;$

$$\pi_2 - \pi_1 = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - 4\theta^2\alpha^2 + 12\theta^2\alpha - 9\theta^2)}{(8\gamma b - 4\theta^2\alpha + 4\theta^2\alpha^2 - 3\theta^2)^2} - \frac{\gamma(a-c)^2}{-2\theta^2 + 4\gamma b} = \frac{1}{2}\frac{\gamma(a-c)^2(8\gamma b - \theta^2)}{(8\gamma b - 3\theta^2)^2} - \frac{\gamma(a-c)^2}{4\gamma b - 2\theta^2}$$

We can easily realize that the profit difference for $\alpha = 0.5$ is smaller than the difference for two firm case. Four firm case profit difference is similarly smaller than the three and two firm cases. Three firm case profit of the monopolist is higher than the monopoly case if $38\gamma b\theta^2 - 8\theta^4 > 48\gamma^2 b^2$. We see that as the number of firms increases possibility of competition being better than monopoly for the *Monopolist* decreases. This results are similar to the results we obtained for motivations and quantities. With new firms *Monopolist*'s profit is shared and the positive spillover effect is not high enough to compensate this. New firms decreases the profitability of the *Monopolist*, but what happens to the welfare of the customers? We will answers this question at next section. Change in the profit level for the *Monopolist* is given in Figure 6 for different market structures.

2.4 Decreasing Motivational Efficiency

Up to this part, we have tried to see the effects of competition on firms and customers by examining two things: the spillover level and the number of firms involved in competition. We have assumed that when the number of firms increase, the configuration of the market stays still; meaning the

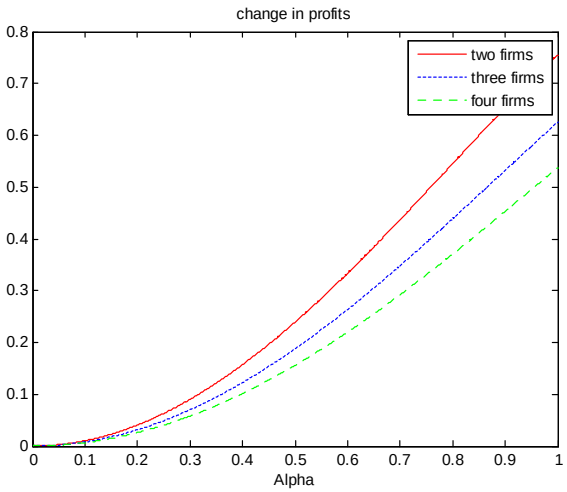

Figure 6: Change in Profits

cost and motivation structure do not change. Now what we want to answer at that part is, what if introduced competition changes the market in some other ways near changing motivation level and market shares directly. For example by changing motivational efficiency. So in this part of the study, we consider a decrease in the motivational efficiency of the firms as the number of firms increase. Let's try to explain this connecting with the financial crisis. It is known that after the crisis the weak firms will leave the market and the firms that have managed to stay in the market will raise their market share and they will become stronger. Hence these firms will have more power to invest on education level of the employees to make them learn how to utilize their motivations in a better way or, lets say as the firm was not very strong (there were too many firms in the market), they could not hire well educated employees or they could not spent too much money to increase the work

based education level of the employees. So even if the company increases the motivation of the employees', say from m to m', the utility they get from this is smaller then the case of this firm being stronger with the same motivation increase (from m to m'). In our case when the competition in the market increases by the increasing number of firms then each firm has less market share and hence they have less control on their motivations. We have defined the motivational efficiency parameter as θ.So in this part we assume a change in θ as number of firms increase. Assuming the real structure of the economy is as given in this part, we will be also trying to answer the question of *what will happen to the prices after the crisis.*

Similar to the previous cases, the profit functions will be given as follows except this time the motivation efficiency is given as $\frac{\theta}{n}$, and it is dependent to the number of firms in the market.

$$\pi^i = ((a - b \cdot (q_1 + q_2 + q_3 + ... + q_n)) - (c - \tfrac{\theta}{n}(m_1 + \alpha m_2 + \alpha m_3 + ... + \alpha m_n))) \cdot q_i - \gamma \cdot \tfrac{m_i^2}{2}$$

Under this new assumption, the results for one, two, three and four firm cases have been obtained (See Table 1). Since for this part we are mostly interested in the changes at the market as a whole, now instead of the firm level profits or firm based quantities, we analyze the changes in motivations and total quantity sold. So that we can tell what will happen to the prices with new entrants to the market. That might be interesting because now the efficiency of motivation, hence the importance of motivation decreases. One may expect the firms to run less motivated and they may produce less and the prices will increase, but it is also possible to say that the free riding

problem will be solved and the firms will become more motivated to produce more. Now let see how this assumption really changes the motivation and total quantity levels.

In Table 2, the conditions for two, three and four firm case motivations to be higher or lower than the monopoly case has been given. Figure 7 also summarizes these results. First interesting result that could also be seen from Figure 7 is the negative changes obtained in motivations. The figure means, first of all when we move from monopolist market structure to the two, three or four firm case market structure the motivations certainly becomes smaller, but after we have two firm in the market, introducing an other firm increases the motivations. In other words, when we move from one firm case to two firm case, the market share of the Monopolist will decrease, hence this will decrease the motivation. Addition to that now we have the decrease in motivational efficiency which also decreases the motivation. This time with the motivational efficiency decrease, the free riding effect also diminishes, hence addition to losing some of the market to the second firm, the Monopolist can not also utilize the competition enough. Therefore we have the result that the motivation will be certainly smaller when new firms introduced to a monopoly under this structure. Of course this does not mean being less motivated will induce less sales of the goods, motivation is also costly and less motivation may also force the firms to produce more under competition. That will be analyzed later. Now, although moving from one firm to two firm case, decreases the motivation of the Monopolist; moving from two firms case to three and then four firms cases starts to increase the motivation of the Monopolist. The direct negative effect of introducing a new

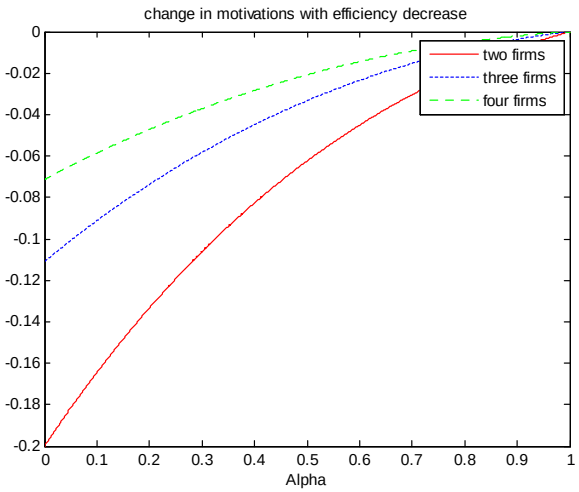

Figure 7: Change in Motivations

firm to the monopoly because of the market share loss will be, lets say, $\frac{1}{2}M$. M denoting the market, before the Monopolist had whole M. Now with two firm case it has the half, which means the loss is half of the market. When we move from two firm case to three firm case the loss becomes $(\frac{1}{2}M - \frac{1}{3}M)$ $\frac{1}{6}M$. So introducing new firms becomes less costly for the Monopolist, plus having new firms increases the opportunity to utilize competition more for the Monopolist because of the spillover. So after two firm case, adding an other one increases the motivation for the Monopolist.

An other important result, at that point, is obtained about the optimal value of spillover. At section 2.3, we have shown that with no motivational efficiency decrease, the motivations started to go down for $\alpha > 0.5$, because of the excess free riding effect (see Figure 4). Inversely, now even after $\alpha = 0.5$, the motivations increase. The decreasing motivational efficiency,

solves the free riding problem and firms want to have higher spillover to utilize the competition. Now smaller free riding encourages firms to utilize others' motivation more and the peak point for the optimal motivations become $\alpha = 1$. If the decrease in efficiency of motivations were to be slower when the number of firms increase then some effect of free riding would come back and we would probably have a peak point at α about 0.8.

Now lets look at the changes in total quantities sold. Depending on the analysis we made at part 2.3, we can draw the graph of the total quantities sold at the market. Without the assumption of decreasing motivational efficiency it is seen that two firm case is the best one for the customers (The smaller the level of curve the better it is for this part because of the direction of the inequality-See Table 3). As we see at Figure 5, if we move from two firm case to the three firm case, the quantity produced decreases for each firm. With no decreasing motivational efficiency, one additional firm means more free riding danger. This free riding problem plus the market share loss with a new entrant, surpress the positive effect of increased competition and hence the motivations start to go down when we move from two firm case to three or four firm cases. This has been shown at Figure 4. Similarly we also showed at section 2.3 that because of this motivational decrease two firm case Monopolist's production is higher then the three firm case's (See Figure 5). Hence the total quantities for two firm case is higher than three firm case and this is higher than the four firm case. Figure 8 summarizes this relation for total number of productions. So without the motivational efficiency assumption, in a case of crisis we would conclude that after the crisis the prices would fall down, because now we have less firms in the economy.

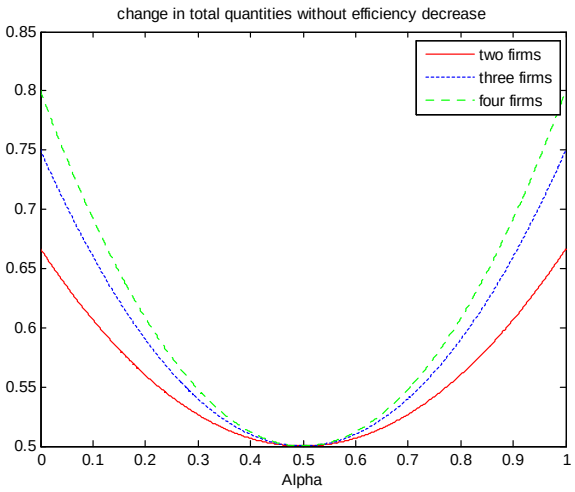

Figure 8: Change in Total Quantities Without Efficiency Decrease

But, when we assume decreasing motivational efficiency when number of firms increase, the picture becomes inverse. In Figure 9, the curve representing four firm case is the lowest one, meaning in four firm case total quantity produced is higher then other cases. We have seen that with the motivational efficiency assumption, the motivations were highest for four firm case. The second highest was the three firm case, Hence the total quantities produced is parallel to the level of motivations as usual. An other interesting result is the following; we have said that with decreasing motivational efficiency, the motivations become lower when we move from monopoly to two, three or four firm cases (see Figure 7). For the total quantity of duopoly to be higher than the monopoly the condition $(\frac{\theta^2(2+2\alpha^2-2\alpha)}{3} < \gamma b)$ should hold if there is no decreasing motivational efficiency (see Table 3). This condition becomes $(\frac{\theta^2(10+\alpha^2-\alpha)}{6} < \gamma b)$ when there is decreasing motivational efficiency. From

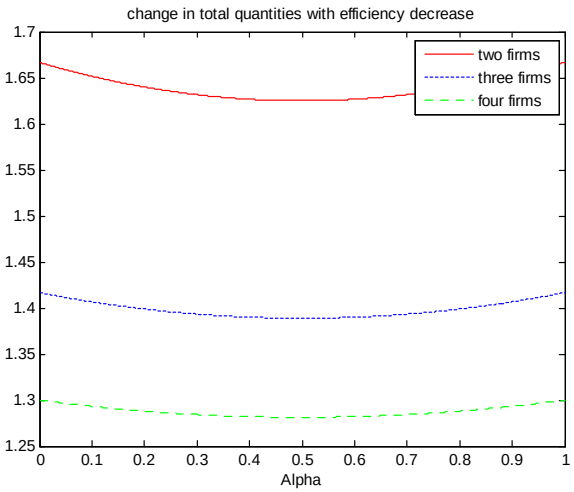

Figure 9: Change in Total Quantities With Efficiency Decrease

these two conditions and from Figure 9 and Figure 8, it can be seen that the total quantity is higher when there is no decreasing motivational efficiency . This is true for three and four firm cases too. Hence if the motivational efficiency is dependent to the number of firms, then the customers become worse off when compared to the no decreasing efficiency case. Considering the crisis again, this time we say if the number of firms decrease after the crisis, the prices become higher. An other point, the dependence of the quantity produced to the spillover parameter decreases, since the curves become smooth.

3. Conclusion

The known dynamics of the monopolistic market structure has been analyzed in a different way, under the intuition of the yardstick competition and

the R&D investments. We tried to bring out that under some real market assumptions, it can be shown that monopoly may not always give the best solution even to the *Monopolist*. Some competition may make the firms to run more efficiently. After answering this question here comes the next one. So if we say competition is even good for the *Monopolist*, do we mean that the more competitive the market the better it is.

Hence the results will be summarized in two parts, firstly the effects of competition on monopolist firms and how does it effect the results when the monopolist is an exporter or not; and secondly to what level the competition is good for the firms and for the market separately. The more the *Monopolist* is motivation efficient (can reflects its motivation to cost decreasing processes) the more profitable competition to this firm is. If motivation cost decreases, and firms can use the motivation efficiently, then the probability (here probability means number of α values satisfying this condition) of competition being better than monopoly for the *Monopolist*, becomes higher. When we consider the will of the market, then we say too little or a lot of motivation spillover is not good for welfare level. Low spillover level cannot utilize the competition fully and hence the prices do not fall as expected. Too much spillover decrease the will of the firms to be motivated which is reflected to the customers badly too. For the firms, as the spillover level is high the profits get higher. When we apply the same analysis for an open economy, we get even more positive results toward competition. So if the monopolist is running in an open economy, there is more opportunity for it to get benefit if the motivations of the employees are increased. Hence we say economy being open increases the profitability of the competition for the

Monopolist.

Increasing the number of firms involved in the competition, can expose different results. First it is seen that competition starts to lose it benefits. An additional firm added to the market instead of increasing starts to decrease the motivations, because the advantages it brings is smaller than the market share loss made by the added firm, plus now the free rider problem will increase. The parallel structure takes place as more firms are added, except moving form three firms to four makes less loss than moving from two to three. So the profit loss follows a decreasing returns to profit configuration. And finally we try to answer the question of 'what if added new firms also change other things in the market'. So as the new firms are added, the market share of the firms decrease so they now have less ability to utilize their employees' motivation, meaning they have less motivational efficiency. Decreased motivational efficiency decrease the negative effect of spillover, but there is competition still in the market hence the firms need to be motivated, which gives a better result for the market. At that part what we wanted to find was the effect of competition to the market, and we have found that in a case of motivational efficiency loss, adding more firms to the market simply decreases the prices more.

Appendix

Table 1: Decreasing Efficiency Optimal Levels

	Optimal Motivation Levels	Optimal Quantities
Monopolist Case	$\frac{\theta(a-c)}{(-\theta^2+2\gamma b)}$	$\frac{\gamma(a-c)}{(-\theta^2+2\gamma b)}$
2 Firm Case	$\frac{2\theta(2-\alpha)(a-c)}{(18\gamma b+\theta^2\alpha^2-2\theta^2-\theta^2\alpha)}$	$\frac{6\gamma(a-c)}{(18\gamma b+\theta^2\alpha^2-2\theta^2-\theta^2\alpha)}$
3 Firm Case	$\frac{3\theta(3*2*\alpha)*(a-c)}{(72\gamma b-3\theta^2+4\theta^2\alpha^2-4\theta^2\alpha)}$	$\frac{18*\gamma*(-c+a)}{(72\gamma b-3\theta^2+4\theta^2\alpha^2-4\theta^2\alpha)}$
4 Firm Case	$\frac{4*\theta*(3*\alpha-4)*(a-c)}{(200\gamma b-9\theta^2\alpha+9\theta^2\alpha^2-4\theta^2)}$	$\frac{40\gamma(a-c)}{(200\gamma b-9\theta^2\alpha+9\theta^2\alpha^2-4\theta^2)}$

Table 2: Comparison of Motivations for Decreasing Motivational Efficiency

2 firm motivation > monopolist motivation if	$\frac{\theta^2(3\alpha-\alpha^2-2)}{(10+4\alpha)} > \gamma b$
3 firm motivation > monopolist motivation if	$\frac{\theta^2(10\alpha-4\alpha^2-6)}{(54+12\alpha)} > \gamma b$
4 firm motivation > monopolist motivation if	$\frac{\theta^2(21\alpha-9\alpha^2-12)}{(168+24\alpha)} > \gamma b$

Table 3: Comparison of Total Quantities

	Decreasing Efficiency	Non-Decreasing Efficiency
2 firm quantity > monopolist quantity if	$\frac{\theta^2(2+2\alpha^2-2\alpha)}{3} < \gamma b$	$\frac{\theta^2(10+\alpha^2-\alpha)}{6} < \gamma b$
2 firm quantity > monopolist quantity if	$\frac{\theta^2(3+4\alpha^2-4\alpha)}{4} < \gamma b$	$\frac{\theta^2(51+4\alpha^2-4\alpha)}{36} < \gamma b$
2 firm quantity > monopolist quantity if	$\frac{\theta^2(12+18\alpha^2-18\alpha)}{15} < \gamma b$	$\frac{\theta^2(156+9\alpha^2-9\alpha)}{120} < \gamma b$

APPENDIX A.1

$2\gamma b - \theta^2 > 0 \Longrightarrow 9\gamma b > \frac{9}{2}\theta^2$

check $9b\gamma - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2 > 0 \Longrightarrow 9b\gamma > 2\theta^2(1+\alpha)(2-\alpha)$

if $\frac{9}{2}\theta^2 > 2\theta^2(1+\alpha)(2-\alpha) \Longrightarrow 9b\gamma - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2 > 0$

check for which values of α, $\frac{9}{2}\theta^2 > 2\theta^2(1+\alpha)(2-\alpha)$ holds;

$\frac{9}{2} > 2(1+\alpha)(2-\alpha) \Longrightarrow 2\alpha - 2\alpha^2 - \frac{1}{2} < 0$, this is true for all values of α.

Hence $9b\gamma - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2 > 0$

See the graph of $f = 2\alpha - 2\alpha^2 - \frac{1}{2}$

APPENDIX A.2

We need to check whether $\frac{m(duopol)}{m(monopol)} = \frac{\frac{2\theta(2-\alpha)(\theta i(\alpha+1)+a-A)}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2}}{\frac{\theta\cdot(a-A+\theta\cdot i)}{-\theta^2+2\gamma b}} > 1$

$\Longrightarrow \theta(2-\alpha)(\theta i(\alpha+1)+a-A) > \theta\cdot(a-A+\theta\cdot i)$ but for the sake of simplicity let's assume, equality; so we will check the values of α where

$\frac{\frac{2}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2}}{\frac{1}{-\theta^2+2\gamma b}} > 1 \Longrightarrow 2(-\theta^2+2\gamma b) > 9b\gamma - 2\theta^2(1+\alpha)(2-\alpha) \Longrightarrow$

$\theta^2(2+2\alpha-2\alpha^2) > 5b\gamma$

the values of α satisfying $\theta^2(2+2\alpha-2\alpha^2) > 5b\gamma$ will certainly support $\frac{\frac{2}{9b\gamma-2\theta^2\alpha+2\theta^2\alpha^2-4\theta^2}}{\frac{1}{-\theta^2+2\gamma b}} > 1$.

But for the α values not satisfying this we can not say that monopoly motivation is higher,

because we need to take the nominators into account too.

APPENDIX B.1

$\gamma b - \theta^2 > 0 ==> 9\gamma b > 9\theta^2$

check $9b\gamma - 4\theta^2\alpha + 4\theta^2\alpha^2 - 8\theta^2 > 0 => 9b\gamma > 4\theta^2(1+\alpha)(2-\alpha)$

if $9\theta^2 > 4\theta^2(1+\alpha)(2-\alpha) => 9b\gamma - 4\theta^2(1+\alpha)(2-\alpha) > 0$

check for which values of α, $9\theta^2 > 4\theta^2(1+\alpha)(2-\alpha)$ holds; $9 > 4(1+\alpha)(2-\alpha) => \alpha - \alpha^2 - 1 < 0$, this is true for all values of α.

Hence $9b\gamma - 2\theta^2\alpha + 2\theta^2\alpha^2 - 4\theta^2 > 0$

See the graph of $f = \alpha - \alpha^2 - 1$

References

[1] *Football Money League*, Sports Business Group, February 2009

[2]La ont, j.j., Tirole, J., Using Cost Observation to Regulate Firms, The Journal of Political Economy, Vol. 94, No. 3, Part 1. (Jun., 1986), pp. 614-641

[3]Shleifer, A. , *A theory of yardstick competition.* Rand Journal of Economics*, vol.16, No.3, 1985*

[4]D'Aspremont, C., Jacquemin, A., *Cooperative and noncooperative R&D in duopoly with spillovers*, The American Economic Review, vol.78, No.5, 1988

[5]Petit, M. L. , Randaccio, F., *Endogenous R&D and foreign direct investment in international oligopolies,* International Journal of Industrial Organization, vol.18, p.339-367,2000

[6]Petit, M. L. , Randaccio, F., *Technological Innovation and Multinational Expansion: a Two-way Link?*, Journal of Economics, vol.68 No.1, p.1-26, 1998

[7]Spence, M., *Cost Reduction, Competition, and Industry Performance,* Econometrica, Vol. 52, No. 1, pp. 101-121,1984

[8]Stephan, G.G., *Determinats of Direct Foreign Investment*, The Review of Economics and Statistics, Vol. 69, p. 149, 1987

[9]Hart, O. D., *The Market Mechanism as an Incentive Scheme,* The Bell Journal of Economics*, Vol. 14, No. 2, pp. 366-382, 1983*

[10]Sah, R. K. and Stiglitz, J. E., *The Invariance of Market Innovation to the Number of Firms,* The RAND Journal of Economics, Vol. 18, No. 1, pp. 98-108, 1987

[11]Nickell, S. J., *Competition and Corporate Performance,* The Journal of Political Economy, Vol. 104, No. 4, pp. 724-746, 1996