Internalizing Externality in the Case of Joint and Separate Productions: Property Rights Regulation as the Public Economy Solution

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Abstract

Externalities as a market failure hinder markets to allocate resources effectively by causing a loss of economic efficiency. Internalizing externalities through free market system without government interventions is limited. Public solutions are particularly important in the use of public resources by the manufacturers affecting each other mutually and choosing to act together or separately. Regulation of property rights as a public solution both increases the success of market solution and enables the compensation of the external effects, since it sets the initial conditions of markets.

Key Words: Externalities, Public Resources, Property Rights, Market Failure

1. Introduction

Economists think that externality is created when benefits and costs which cannot be evaluated affect the firms and individuals. The factors that are both the reasons and results are complicated and ever intensifying trade activities, population increase, and industrial production enforcing the limits, increasing number of the vehicles, violation of ecological balance, urbanization, and climate change. There are large numbers of externalities in the production, consumption, and the way of living which have becoming more overcrowded and complicated over time. Moreover, these external effects generally cannot be evaluated within the pricing mechanisms. Therefore, it is a necessity to organize every activity area of people via a set of regulations.

The most widely discussed aspect of externalities is them causing some market failures. The market failure is defined as any action that cannot internalize the benefits and costs of decision makers in the free market system; in other words, the system cannot determine their price precisely. The non-priced externalities result in both private benefits and costs becoming smaller than the public benefits and costs. The differences between private and public benefits and costs cannot be priced, therefore the decision makers decisions are not effected (Miller, 1991:832). The market mechanisms cannot be efficient in the case of existence of non-priced benefits or costs. In that case, those who do not bare the full cost of negative externalities will produce as more as possible, while those who cannot collect the full return of positive externality will produce as little as possible (Stiglitz, 1994;93). In other words, in the existence of externality, the resource allocation will be too high or too low which is considered as a market failure (Haines, Shockleton, 1990:191).

There is a common belief that without government intervention it is not possible to have efficient resource allotments in the market system and to remove the externalities completely. However, there is no commonly shared belief on the government intervention that solves the externality problem in the most effective way. Because of the different characteristics of externalities there is no agreement on this issue. The ways of public solutions are affected due to the utilization of different public solutions for different externalities. In this study a special emphasize is given to the ownership rights as one of the public solutions to externalities. In this respect the basic thesis is the externalities created mutually by the producers when they produce separately or under a single ownership can be eliminated by ***ownership rights regulations***.

2. Theoretical Framework of Externalities

Generally accepted in economic history that A. Marshall contributed to the externality subject by developing the initial theory of externality. However, many other economists like Pigou, Baumol, Meade, Nath, Mishan, and Coase also handled the same subject. Marshall (1961), following the study of effects of changes in supply and demand upon firms, determined that sectorial behavior would cause industrial development, but the individual behaviors of single firms cannot be shown as the result of the past. Moreover, he emphasized that the individual producers-market power and the industry-market power relations are different.

Marshall also claims that the gradual development[1] in industry will cause price decline due to the increased productions of the firms. Additionally, he indicates that the new firms entering the developing industry will contribute to the production which results in cost reductions of the existing firms. Conclusively, Marshall names external economies created by following the chain of events, production increase, cost reductions, and price decline (Marshall, 1961: 264-267). According to Marshall's view on the internal and external economies the long-term production cost of a single firm depends not only on her own cost, but also on the production costs of the other firms exist in that industry. Pigou (1923) analyzed this theory by discussing it at three stages. At the first stage, he claims that the cost of a single firm depends upon her output. At this point there are no external economies, positive or negative. At the second stage cost of a single firm depends upon two variables, the firm's own output (internal costs) and the output of the entire industry (external costs). External costs consist of expenses made for machinery and production factors prices of which depend on the changes in industrial demand for them. The third and the last stage has the complicated relationships among individual firm's output, industry's outputs, and their costs. As is seen here Pigou contributed to Marshall's theory by separating externalities into two; positive and negative externalities (Pigou, 1932: 450-451). Moreover, Pigou showed that marginal social net product would be equal to marginal private net product at the point of maximum utility or ideal output level.

At the equilibrium point marginal price of supply will be equal to the demand's price. At this point he analyzed the externality concept from the standpoint of welfare economics by showing us in a monopolistic market marginal price of supply is lower than demand's price and monopolistic output level is less than amount of ideal output (Pigou, 1932:460-463). So while Marshall analyzed the theory under the conditions of perfect competition, Pigou merged the market failure with the externality concepts by analyzing the theory under the conditions of imperfect competition. Meade (1952) separated positive and negative externalities by solid lines by means of adaptation of marginal analysis in competitive situations. For this Meade constructed a simple model based on competition in two different industries. In his model Meade investigated whether activities in one industry affect the production conditions in the other industry in the same way and if it is possible to affect the production factors or output prices by those activities in the first industry. Meade expressed these two effects as negative or positive effects. He called the production-increasing and production-decreasing effects of one firm on another firm as positive externality and negative externality, respectively. Activities of a firm affecting only her own industry are called internal effects.

Moreover, Meade classifies externalities into two groups, "unpaid production factors" and "creation of atmosphere for other industries." The former one is a social issue and there should be an appropriate taxation for the labor force to be paid according to their net marginal social production. In the second case the industries creating positive atmosphere must be subsidized as incentive (Meade, 1952:54, 56, 67). Scitovsky (1954) claimed that equilibrium theory is a static analysis and can be partial and general equilibrium depending upon the characteristics of economic system. He also indicated that many analytical results were built upon the assumptions of perfect competition and complete divisibility of inputs and outputs in every market system in order to support Pareto Optimality. However, Pareto Optimality cannot exist in the technology market due to the technological externality. Under the influence of Meade Scitovsky expressed that the production of a single firm depends not only upon her own resources but also the activities of other firms in the industry which is called "mutual interdependence of the firms" or "positive and negative external effects" known more commonly.

In his production function the dependent variable is the firm's output while the independent variables are external economies, amount of production factors of other firms, and their output quantities. Scitovski calls this as "technological external economies", since the production function might take different forms due to types of externalities (Scitovsky, 1954:143-145). Bator (1958) evaluated the meaning and extends of the market failure. According to Bator the modern welfare economics (duality theory) takes place between Pareto optimality and market performance. Bator investigated externalities related to the market failure under three classes, ownership externalities, technical externalities, and public goods externalities. To Bator ownership externalities are the same as Meade's "unpaid production factors". Cost externalities consist of goods and services being limited, depletive, indivisible, and sensitive only to individual's consumption. Technical externalities present a new map with a set of Samuelson-type social indifference curves bounded by the maximum production possibilities boundary. An entrepreneur searching for the welfare point will have increasing return to scale and decreasing marginal costs due to existing technological externalities and force those who work with high marginal costs out of the market structure (natural monopoly).

[1] By the "gradual development" Marshall wanted to emphasize that perfectly competitive structure of a market would not be violated as a result of growth of an industry.

As a result the existence of technological externality price will be determined by monopolistic behaviors (Bator, 1958:351-369). Although Buchanan and Stubblebine (1962) accepted Scitovsky's externality theory in general, but they indicated some missed points in it. They classified externalities as "marginal" and "inframarginal externalities" at one side and as "related to Pareto" and "unrelated to Pareto" at the other side (Buchanan and Stubblebine, 1962:371). Baumol (1964) accepted the principle of an economic unit's marginal private benefit being equal to social benefit which is necessary condition for Marshall's and Pigou's externalities. However, Baumol expressed that marginal private benefits would not be equal to the marginal social benefits, if the economic actors are not paid at a regular basis. Externality like this will create a nonoptimal competitive equilibrium. Thus Baumol sees mutual interdependence as a necessary condition but not sufficient for a classic externality concept through which he criticizes the theory by following Buchanan and Stubblebine (Baumol, 1964:371-372).

Mishan (1971) defines externality as "the effects of benefit of a consumer or output of a firm on the activities of other individuals and firms". Mishan observing that his definition is insufficient accepted the following notion of Walras' General Equilibrium Analysis: There is a possibility of change in the equilibrium in factor and product prices as a result of external changes in an individual's behavior. Therefore an "indirect effect" that shows the affect of a decision maker on another decision maker must be derived from Mishan's external effect definition (Mishan, 1971: 1-3). Baumol (1972) investigated the correct tax principles for controlling externalities. Baumol showed that Pigou's externality perfectly works within its own conditions. Even though it is criticized by the economists who contributed to the externality theories it is necessary to have a "Pigou's tax-subsidy system" for an optimum resource allocation. As a result Baumol showed that in order to control the externalities it is necessary to utilize Pigou's tax and subsidies. Even at the end of usage of this system though, it should not be expected an optimal resource allocation being realized within the realistic world of complex relationships (Baumol, 1972: 307-308).

Greenwald and Stiglitz (1984) presented a simple but a wide framework for analyzing the effects of externalities. They expressed that the model eases the problem identification by means of defining monetary effects of externalities, when intervention via taxation takes place for Pareto improvement. Four results are derived from the general procedure of Greenwald and Stiglitz who developed it for a through analysis of market-mediated externalities. Firstly, in Arrow-Debreu economy model monetary externalities can be ignored, since the effects of individuals on the prices are very nil. Secondly, in the competitive market economies that have market-mediated externalities with imperfect competition and lack of information realize market equilibrium in Pareto inefficiency. Thirdly, by the repeated and perfectionist applications of envelope theory various welfare levels can be calculated and monetary effects determined. Lastly, nonmonetary externalities like knowledge-based ones enable us to determine the direction of political measures and to perform observable and successful applications (Greenwald and Stiglitz, 1984: 1-24).

Stiglitz (1986) claimed that it would not be a surprise to expect the Pareto improvement by means of a government intervention in an economy with externalities. According to Stiglitz imperfect competition in the markets, lack of information, and externality are generally curtailing to reach to the Pareto optimality. For example tax and subsidies can be levied for improving everybody's welfare conditions. Moreover, analytical examination of technological externalities, lack of information, and imperfect competition issues will help us to determine the results of government interventions. Stiglitz developed a general procedure to analyze the external effects and to calculate the optimal corrective tax rates. He handled the issue as within the limits of technologic externality. As a result, externality will make general equilibrium ineffective and necessarily call for increasing welfare-taxation measures (Stiglitz, 1986: 229-260). By his model Wong (2000) examined the validity of five international trade theories and some subjects of the theory of externality. In the model it is possible to observe the externality of a firm in her sector and in other sector simultaneously. Additionally, the conditions that will enable to levy government interventions to correct the externalities.

Wong's model differs from the neo-classical framework in terms of only one result. This situation makes it possible to compare the Wong's model with the well-known results of neo-classical model. Another superiority of the model is that it allows us to analyze two countries-single factor situation having the same capital-labor ratio (Wong, 2000:1-24). There are too many definitions of externalities in addition to the above mentioned theoretical approaches. Here is one; *"positive or negative effects of production or consumption activities of one of the individuals-real or entity- in a society upon the utility or cost functions of other individuals"* (Nadaroglu, 2000: 62). By Stiglitz; *" a situation that is an individual or a firm effecting another individual or firm; a situation that is even though a firm creating some cost over other firms without compensating their losses; or alternatively, a situation that is a firm creating some benefits over other firms, but getting no contribution from them in return."* (Stiglitz, 1994:92).

It is possible to increase the number of this kind definitions. Externality as non-priced benefit-loss relation is a kind of basic market failure like public goods issue. However, we must not limit ourselves only in markets. There are non compensated externalities in all aspects of life. In this sense some activities not seen in the market can create some positive or negative externalities and do some market results. For instance you may arrive at your home safely in a crowded highway where all the drivers behave sensibly and drive according to the traffic rules. However, in the opposite case you might pay very high costs due to an irresponsible driver. For this reason externalities can be created due to many different reasons and observed in many types. Cultural background that affects behaviors of individuals and firms, ill-designed ownership regulations, and ineffective administrative bodies may cause many externalities. In this framework externalities can be defined as, *"an individual's or a firm's production or consumption activities or their activities or inactivities affecting other individuals, producers, or consumers positively (benefits) or negatively (costs) and not being able to price them properly".*

In other words, externalities are non-priced benefit-cost relations. Externalities can be positive or negative depending upon resulting effects. Positive externality means the third parties besides the seller and the buyer of a product or service deriving some benefits from this economic activity. Positive externalities are not reflected in the product prices. For example smoke alarms bought by a landlord may create some positive externality to other home owners by preventing the extension risk of a possible fire. On the other side, negative externality means bearing the third parties some costs due to any kind of production and/or consumption activities of producers or consumers. Negative externalities are not reflected in the product prices same as the positive externalities. In this sense losses of industrial wastes on the third parties can be considered as examples.

Externality as a market failure emerges from the situation of all the decision makers in the market cannot internalize (or cannot price) their benefits and costs totally. In this case, from the stand point of parties involved with externality, private costs and benefits are respectively less than social costs and benefits. The differences between benefits and costs cannot be priced therefore, they do not affect the decision makers' decisions. The market system containing non-priced benefits or costs may not be efficient in the resource allocations. In that case the individuals who do not bare the full costs of their negative externalities will increase their activities, while those who cannot collect the full benefits of their positive externalities will desire to produce less (Stiglitz, 1994:93). In other words, in the existence of externalities resource allocations in the market system will be less or more which is considered as a market failure (Haines, Shockleton, 1990:191). Therefore, there is a common belief that an efficient resource allocation in the market will not be possible, viz. pollution level will be extremely high, without any government intervention. In other words, pollution checks create positive externality and it will be produced less than necessary, if there is no government intervention.

3. The Results of Externalities: Positive and Negative Externalities

Any production or consumption activity for which externalities not being considered is inefficient economic activity for the society. And it increases when positive externalities are internalized. When the externalities are internalized, in the case of negative externality production level declines and in the case of positive externality it increases. In other words, the production and price levels determined by the point where marginal social cost (MSC=P) intersecting marginal willingness to pay (MWTP) function creates an efficient market system.

The following transaction between two parties may spill some positive or negative externalities on the third parties who do not have any relations with the transaction what so ever.

(Eq. 3.1) $NPB^{(1)} = TPB^{(1)} - TPC^{(1)}$

(Eq. 3.2) $NPB^{(2)} = TPB^{(2)} - TPC^{(2)}$

Here, $NPB^{(1)}$ and $NPB^{(2)}$ are net private benefits of the 1st and 2nd parties, respectively, and TPB is total private benefit, and TPC is total private cost. If there is a spill out effect in this transaction, a third party (or parties) will be involved as shown below:

(Eq. 3.3) $\pm NB^{(3)} = TB^{(3)} - TC^{(3)}$.

In this case the third parties' transaction will be negative (external diseconomies) or positive (external economies). In other words, if some harm created by the transaction of the first two parties larger than the benefit of it, the net result will be negative. For example, a person buying a fire alarm system for his/her house will also be related the his/her neighbors as the third parties. The 1st party is the buyer of the alarm system, the 2nd party is the seller of it, and the 3rd party is the his/her neighbor who will get some benefit from a possible fire by not contributing to the purchase of the alarm system. In this case $NB^{(3)} > 0$, and has "+" sign.

On the other side a person buying few packs of cigarettes expect some kind of benefit (!) from it. The cigarette seller generates some return by selling them. But a 3rd person, a passive smoker, is affected negatively by this transaction without any contribution or intervention into this economic activity. In this case $NB^{(3)} < 0$, and has "– " sign.

Thus the net benefit on society (NSB) covering all kinds of transactions will be

(Eq.3. 4) $\pm NSB = \Sigma[NPB^{(1)} + NPB^{(2)} \pm NB^{(3)}]_i$

$\pm$ NSB = NPB $\pm$ NB*

where, NPB is the private net benefit covering the sum of the bracketed terms, and NB* is the sum of the third parties' net benefit, Figure 3.1.

As a result,

if $NB^* < 0$ and NPB < NB*, NSB < 0;
if NB* > 0, NSB > 0; but
if NB* = 0, NSB = NPB.

In marginal analysis,

(Eq. 3.5) $\pm$ NSB = NPB $\pm$ NB*

(Eq. 3.5a) $$\pm \frac{\partial NSB}{\partial q} = \frac{\partial NPB}{\partial q} \pm \frac{\partial NB^*}{\partial q}$$

(Eq. 3.5b) $$= \left[\frac{\partial TPB}{\partial q} - \frac{\partial TPC}{\partial q}\right] \pm \left[\frac{\partial TB^*}{\partial q} - \frac{\partial TC^*}{\partial q}\right]$$

(Eq. 3.5c) $= [MPB - MPC] \pm [MB^* - MC^*]$

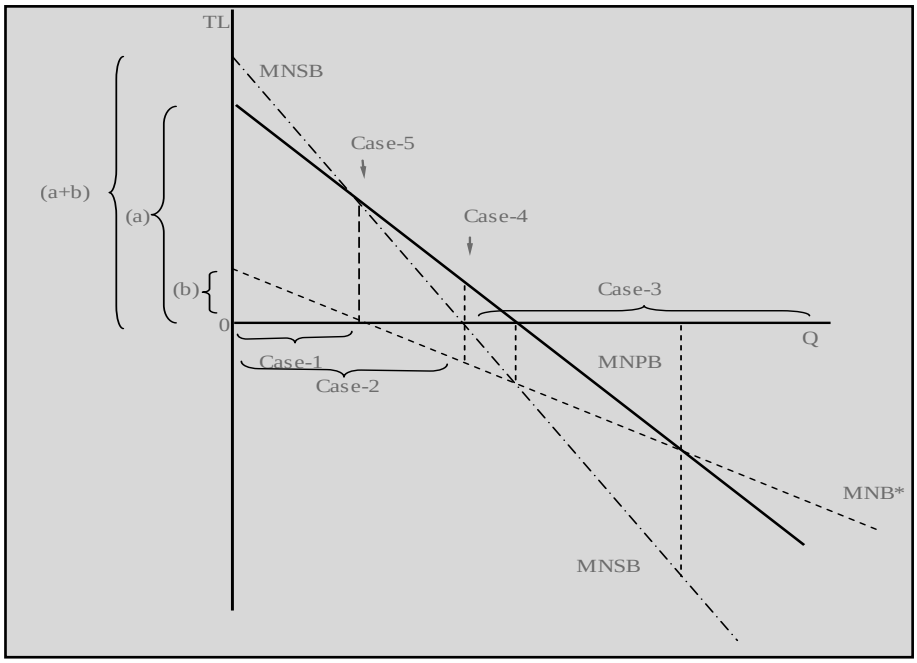
In short,

(Eq. 3.5d) $\pm MNSB = MNPB \pm MNB^*$

Here,

if MB* > MC*, then MNB* > 0 is called *positive externality (external economy);*
if MB* < MC*, then MNB* < 0 is called *negative externality (external diseconomy);*
if MB* = MC*, then MNB* = 0 is called *no externality.*

Figure 3.1- Marginal Net Benefit of Society



Source:(Özsabuncuoğlu, Uğur, 2005:249)

The discussions above are illustrated in Figure 3.1. MNSB (broken line) and MNPB (solid line) curves have negative slopes due to the law of diminishing marginal productivity. Note that the vertical sum of MNPB and MNB* is called MNSB. The following cases discussed earlier are shown in Figure 3.1

Case (1): Positive eternality (external economy):

MNB* > 0, then MNSB > 0, assuming that MNPB > 0.

Case (2): Negative externality (external diseconomy):

MNB* < 0, and, |MNB*| < |MNPB|, then MNSB > 0.

Case (3):

MNB* < 0, and |MNB*| > |MNPB|, then MNSB < 0.

Case (4).

MNB* < 0, and |MNB*| = |MNPB|, then MNSB = 0.

Here in Case-4, the magnitude of marginal net benefit of the third parties is just offset by the marginal net benefit of the private parties, since these two will have opposite signs.

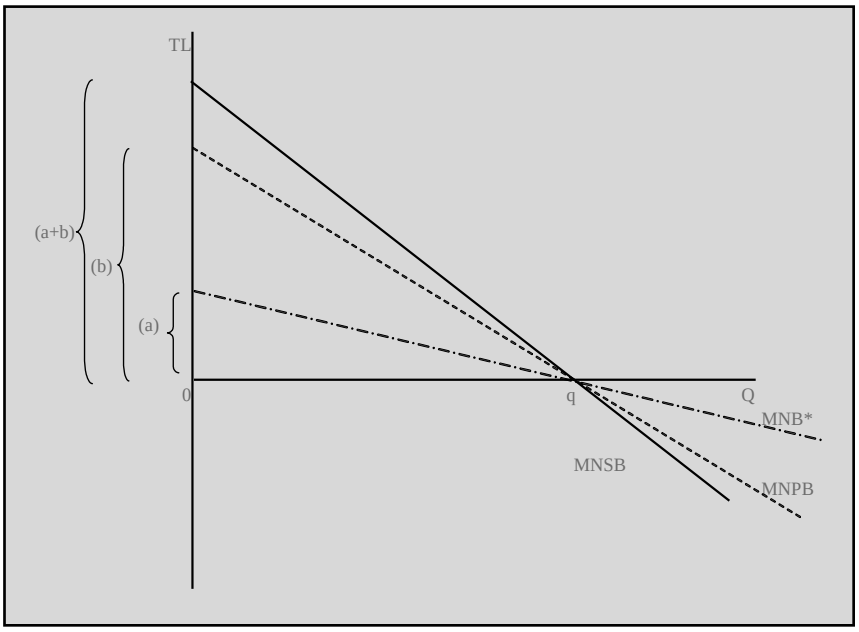
Case (5). No externality:

MNB* = 0, then MNSB = MNPB

This is socially desirable transaction. The vertical distance of MNSB is just the same as MNPB. As is noticed here, the socially desirable level of transaction (5) does not correspond to the maximum social net benefit. This can only be realized if,

MNSB = MNPB = MNB* = 0, for which
MPB = MPC and
MB* = MC* must be provided.

Figure 3.2- A Special case of Marginal Net Social Benefit



Source: (Özsabuncuoğlu, Uğur, 2005:249)

Here, in Figure 3.2 at point "q" MNPB, MNB*, and MNSB are all intersecting each other which can only be realized if these three functions equal to zero at that point. Moreover, at this point MNSB=0 that corresponds to the maximum net social benefit (Ozsabuncuoglu and Ugur, 2005:249).

4. Externalities as the Problem of Public Resources

There is an externality type that emerges from the usage of public goods or limited resources known as *the problem of public goods.* Nobody can be excluded from the usage of public goods but they are competitive. The public goods users not being able to limit the usage of any other competitive users means less amount of goods remaining to the rest of the users. In this case the public goods left in the market faces the problem of excessive usages. The individuals tend to ignore their usages reducing the resources remained for the rest of the users in the society (Krugman and Wells, 2010:469). There is neither a market mechanism nor a directive market price to determine the effective and efficient production and consumption levels of the public goods and services (Samuelson, 1969:182). In this sense public goods is a kind of market failure. Not being able to price the public goods and to exclude some from consumption create problems in the usage of these goods. Therefore, since natural resources are collectively consumed (public) goods, ***free rider*** problem exists for them. It is indicated that public goods provide services for everybody either you pay to buy that good or not.

Therefore, there will be a strong tendency among people to consume as much as possible by paying as little as possible. In other words, the valid principle for public goods is minimum contribution-maximum benefit. Public goods and some natural resources, specifically, are open-access resources and their usages cannot be controlled effectively. For example highways, ocean fisheries, grazing pastures, forests, and wild life inhabited in these areas are open to the individual usages with no control (Downing, 1984:58-59). Since those who uses this type of resources cannot control the ownership rights of them, every new individual who starts using the same resource will create some additional costs upon the existing users.

Suppose four plants are using water from a lake in order to cool their engines and dumping their wastes back to the same lake after some pollution treatment. Annual treatment cost is, say 40,000 TL per plant per year. Further suppose that a fifth plant decides to use the water of the same lake in the similar way, by which action annual water treatment cost for each plant increases by 50%. As a result, total treatment cost will be 60,000 TL per year for the 1st, 2nd, . . . , and the 5th plant. The problem here is that the fifth plant considers only 60,000 TL annual water treatment cost should be paid by himself, but does not face the additional cost incurs on the already existing plants at all. In other words, the additional cost of existing plants due to the entrance of the 5th plant is 4x20,000 TL = 80,000 TL per year. In this case the total cost falling upon entire society due to the last plant is

TCS = 4x20,000 TL + 60,000 TL
= 140,000 TL per year.

The same problem is seen in traffic congestion in state highways. Every new car entering to the streets contributes to the problem of traffic jam, which fall on the entire society in the form of additional travel time or additional cost of wasted time.

Table 4.1-

Cars		Av. Travel Time		Added Time to Existing Travelers	Added Time due to the Last Traveler	Total Travel Time to the Society(1)
Number	(Δ)	(Min.)	(Δ)			
1	-	10	-	0x0= 0	1x10=10	0x10+0+10= 10
2	1	10	0	1x0= 0	1x10=10	1x10+0+10= 20
3	1	10	0	2x0= 0	1x10=10	2x10+0+10= 30
4	1	11	1	3x1= 3	1x11=11	3x10+3+11= 44
5	1	12	1	4x1= 4	1x12=12	4x11+4+12= 60
6	1	14	2	5x2=10	1x14=14	5x12+10+14= 84
7	1	18	4	6x4=24	1x18=18	6x14+24+18=126
8	1	24	6	7x6=42	1x24=24	7x18+42+24=192

Note (1): (Total Travel Time to Society) ≡ (Number of cars already traveling) x (Average travel time per car before entering the last car) + (Added time to existing travelers) + (Added time due to the last traveler).

In Table 4.1 the additional cost falling upon the other cars already travelling in a highway, an open-access resource, due to entrance of a new commuter is illustrated. Note that when the number of cars in the highway becomes 4 or more, traveling times of not only the new entrant, but also the existing travelers (the 4th, 5th, and the 6th traveler) start increasing gradually. This is because of highways being open-access cultural resources, capacity of which cannot be not be changed even if some usury toll is charged for traveling on highways and/or nobody can be excluded from using that highway. Therefore, while the average travel time of the first three cars is 10 minutes, following the 4th car the average travel time of each car increases by 1 minute. These additions become 2, 4, and 6 minutes due to the 6th, 7th, and 8th cars, respectively and the average travel time of all the cars increased from 10 minutes to 24. Total time spent in the highway of entire society (all of the cars) is 10 and 20 minutes, when there is a single car and two cars, respectively. Following the 3rd car, total travel time starts increasing at a faster pace and reaches to 192 minutes, when the 8th car enters the highway. Public goods (or collectively consumed goods) like highways supply the same services regardless their tax payments. In other words, benefits derived from the collectively consumed public goods are not based on the taxes. Thus, for a person it is rational to expect maximum benefits from every single tax lira he/she pays. This situation results in excessive usage of collectively consumed public goods and especially natural resources. In mathematical terms per capita average utility ($\bar{U}$) generated from 1 TL paid as tax will be

(Eq. 4.1) $$\bar{U} = \frac{U}{T} \quad \text{utils.}$$

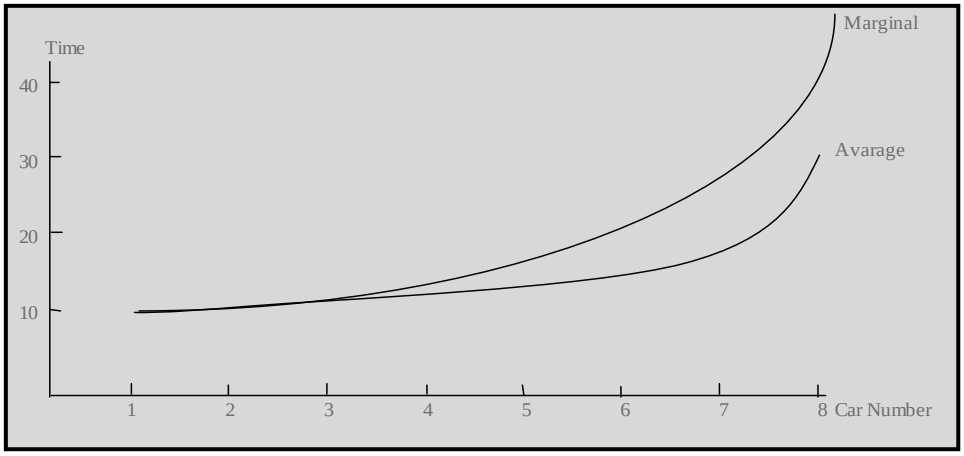
Here, U is the total utility obtained from the highway, T is total tax money paid by a person. As is seen in the formula it is possible to increase $\bar{U}$ by two ways, either U will be increased or T will be decreased. It is impossible to increase U, since a highway supplies certain amount of total utility.

However, it is possible to reduce tax payment by tax evasion and/or tax diversion ways, i.e. you try to pay less tax. In limiting case, if T approaches to zero, Ū will approach to infinity. This situation is shown below in a short way:

(Eq. 4.2) $$\lim_{T\to 0}\bar{U} = \lim_{T\to 0}(\frac{U}{T}) \to \infty$$

As is observed here, free rider problem diverges private and social benefits in the utilization of public goods or collectively consumed natural resources (Ozsabuncuoglu and Ugur, 2005:113).

Figure 4.1. The Avarage and Marginal Travel Time In Traffic (Source:Table 4.1)



On the other side, public goods problem, ill-regulated ownership rights, lack of effective legal systems, or inefficient administrative structures create too many externalities. In this sense, both the number of individuals using those resources and at the same time, the way they use them are equally important in existence of externalities. When the persons use public goods, they do not behave as sensibly as they do for their privately owned goods. This situation can also be evaluated as a moral danger. Actually this behavior of persons is considered as their free rider propensity, however, it creates externality also. That is there are number of externalities transferred to other individuals by users of resources from a common pool. Although these externality-creating activities are not emerging from market behaviors, but they create some market results. The boundaries placed in front of schools for preventing some cars driven fast and irresponsibly create negative externalities to those who derive their cars responsibly and need to use that road.

A person who pollutes his/her environment with garbage and do not put the fire out creates negative externality causing some market results. It is possible to increase similar examples. But unfortunately, there are no legal bodies to get someone to subsidize this type of externalities. For this reason three basic techniques are utilized in internalizing external costs falls upon other parties in the usage of common public resources (Krugman and Wells, 2010:469). The first of them is taxation or organizing public resource usages. For instance, charging extra in rush hours in highways or allowing cars with odd and even number license plates in different days of the week to be driven in highways. The second way is establishing a tradable license system for getting the usage rights of a public resource. The third way is establishing property rights that enable the exclusion of consumption of some resources. This is important for eliminating the efficiency loss created by externalities that originating from excessive usage of some resources not owned privately.

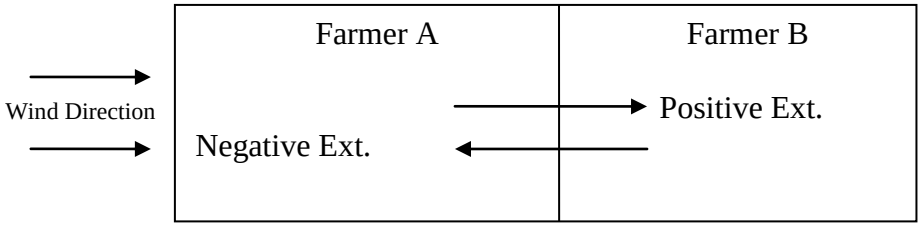
5. Externalities within the Framework of Ownership Rights

The technique of establishing ownership rights means determination of initial conditions of market or setting the rules of game. The solution of the problem will be expected from the market relations. According to the ***Coase approach*** externality can optimally solved through a bargaining process between the parties (Coase, 1960:1-44). In the transaction between the parties who is going to pay to whom and the amount of payments all depend upon the way of ownership and usage rights regulations drafted. As is seen here, regulating the ownership rights is a public solution, but it is also a private solution, since it will be a reference for the parties who will agree on some issues. However, it is not necessary to search a private solution; the parties can use their legal rights without digging any private solution. Thus the ownership rights means series of legal regulations. There is no private ownership in collectively consumed resources. In fact Bator claims that the situation of not being able to use the ownership rights in collectively consumed goods and services is one of the factors that creates externality (Bator, 1958:353-377).

Since the private ownership rights of the goods contain a set of welfare properties in them, there is a quality approach in usage of them. However, it is difficult to say the same things in the usage of public goods and it is also difficult to define the thin line between public goods and externalities (Musgrave and Musgrave, 1989:50). In the case of a well-designed ownership rights situation when the rights of owners are violated or they face some negative externalities or they create positive externalities for the other parties, they would be able to compensate their violated rights in legal ways. By means of internalizing externalities this way efficiency will be obtained. Of course there will be some cost of following legal procedures, time loss, and extra burden on the justice system in the country. From a rational individuals' point of view the legal procedures may not be chosen, if the cost of following legal procedures is greater than the subsidy expected to be obtained (Demsetz,1967:348-350). Generally in the case of the externalities emerging from the usage of common public goods, people do not follow legal procedures. In this respect the success of private solutions is eliminating externalities to be faced.

It was indicated that the ownership rights mean a set of legal regulations. In this content the possibility of subsidizing externalities causing some efficiency loss is closely related to a legal system which can allow and evaluate reasonable demands for subsidy. It is possible to explain this subject by the following example: Suppose there are two neighboring farmers (A and B) both growing wheat, Figure 5.1 Farmer A poisons his field against rodents (mice), but farmer B does not take any such measures. In this case A creates some positive externality for B, while B creates negative externality for A which shown by arrows in the figure below. In other words, assuming that dominant wind is from west, part of the chemical applied in A's field will possibly flow over B's field and kill number of mice. Moreover, since there will be almost no mouse in A's field B's wheat crop will not be harmed by the mice coming from A's field. Thus there will be some positive externality from A to B.

Figure 5.1- Plot of Two Farmers Mutually Creating Externalities (Hypothetical)



On the other hand, B not fighting against mice will create some negative externality on A, since number of mice still living in B's field will migrate to A's side where more wheat grows. Here B obviously is creating some negative externality on A. Both farmers acting together at the same time is rational. If there are no regulations or consensus making them to act together, some externalities will be created that cause efficiency loss. It is also possible that the farmers may not know that acting together will increase their productivities. In this sense regulations of ownership rights will prevent emerging externality at the beginning and also enables compensation of created externalities. In above example the farmer A may make B to apply rodenticide in his field also by legal actions, or he can claim to be compensated for the loss he faces due to B not fighting against mice together with him. The importance of ownership regulations can be shown by another example. There is no such mechanism that limits the number of wells in an arid area where there is limited underground water capacity. Therefore, large number of wells drilled to pump out underground water without considering the replenishment capacity of the reservoir.

Thus, each well spills some external diseconomy over other wells. If there were a single owner of this water resource, the number of wells would be controlled according to the renewal capacity of the reservoir. Since the economic efficiency can be realized by giving the ownership of the wells to a single firm or person, a better equipped person or organization can undertake the ownership of this resource to increase the efficiency. Thus economic efficiency may necessitate a single ownership. This can only be done by legal regulations of ownership rights. For example, if a single well in an area can be set as an initial condition, then the market solutions can be obtained according to these initial conditions. Even if the ownership rights of a common resource are not granted to a single person, the market system can handle this externality problem one way or another. The owners of the wells get together often for ***joint production*** and this way they can prevent drilling too many wells in the area. Similarly, fishermen using together the same fishery may agree upon some limits in the amount of fish caught in order to eliminate excess fish catching.

6. Public Economy Solutions for Externalities

Inclusion of externalities- a market failure- into the pricing mechanism is an important issue discussed in economic literature. For many economists externalities should not be allowed to emerge at the beginning.

This idea, however, becomes meaningless, when externalities can be taken within the pricing mechanism. Persons may stand for externalities as long as they are compensated. Like the necessity of valuation of benefits and costs of any economic activity, in the externality creation case also one must compare benefits and costs. However, from angle of the parties involved with externality the problem is whether this analysis and pricing should be done in the market conditions or by government intervention. Since market mechanisms are not successful for eliminating efficiency loss due to externality every time, it is accepted by some economists that government intervention to externalities is necessary. For this reason there are four solutions are recommended: Government can levy tax or fine; subsidize the expenses made for reducing negative externalities; regulate the market for reducing negative externality spilled over other groups; or through legal system it may regulate ownership rights system in order to eliminate negative externality (Stiglitz, 1994:270).

In the following hypothetical example tax and subsidy tools of a government used for internalizing of externalities are given by employing cost and return functions of two producers who create externalities mutually. In the earlier discussions it was shown that externalities can totally be eliminated or greatly reduced by joint ownership case of producers. It was also shown that by means of a well-designed ownership rights the parties can force each other to act together. In the following example, initially, the externality created by the producers when they work separately will be presented; then their joint ownership case will be discussed; and finally amount of tax and subsidy for internalizing externality created will be calculated. Suppose two persons A and B are in a transaction, first of whom produces external diseconomy on B who causes external economy on **A** (Henderson and Quandt, 1971: 272-276).

6.1. The Case of Separate Firms

Total cost of A and B (C_a and C_b) and their marginal costs (MC_a and MC_b) are given below (Eqs. 6.1-6.41):

(Eq. 6.1) $C_a = f(q_a, q_b)$

(Eq. 6.2) $C_b = g(q_a, q_b)$

(Eq. 6.3) $MC_a = P_q$

(Eq. 6.4) $MC_b = P_q$

which imply that profits of A and B are maximized, if they produce $q*_a$ and $q*_b$ that correspond intersection of their respective marginal costs and marginal revenues (or unit price of the product they produce).

6.2. Joint Ownership Case

In this case the functions of total revenue (TR_{a+b}), total cost (TC_{a+b}) and profit (Π_{a+b}) are given below by summing up the individual TR and TC functions of A and B:

(Eq. 6.5) $TR_{a+b} = P_q(q_a + q_b)$

(Eq. 6.6) $TC_{a+b} = C_a + C_b$

(Eq. 6.7) $\Pi_{a+b} = \Pi_a + \Pi_b$

$= P_q(q_a + q_b) - f(q_a, q_b) - g(q_a, q_b)$

(Eq. 6.8)
$$\frac{\partial \Pi_{a+b}}{\partial q_a} = P_q - \frac{\partial f(q_a, q_b)}{\partial q_a} - \frac{\partial g(q_a, q_b)}{\partial q_a} = 0 \rightarrow$$
$$P_q = \frac{\partial f(q_a, q_b)}{\partial q_a} + \frac{\partial g(q_a, q_b)}{\partial q_a}$$

(Eq. 6.8a) $P_q = PMC_a + SMC_a \rightarrow$

(Eq. 6.9)
$$P_q = \frac{\partial g(q_a, q_b)}{\partial q_b} + \frac{\partial f(q_a, q_b)}{\partial q_b}$$

(Eq. 6.9a)
$$\frac{\partial \Pi_{a+b}}{\partial q_b} = P_q - \frac{\partial f(q_a, q_b)}{\partial q_b} - \frac{\partial g(q_a, q_b)}{\partial q_b} = 0$$
$$P_q = SMC_b + PMC_b$$

Here $\partial g/\partial q_a$, indicates A's negative externality on B and $\partial f/\partial q_b$ does B's positive externality on A. That is they are external negative economy and external positive economy, respectively.

These general formulas can be expressed by using specific cost functions. Let C_a and C_b be specific total cost functions of producer A and B, respectively.

(Eq. 6.10) $C_a = 0.1q_a^2 + 5q_a - 0.1q_b^2$
(Eq. 6.11) $C_b = 0.2q_b^2 + 7q_b + 0.025q_a^2$

As is observed in Eq. 6.10 and Eq. 6.11 while B's production reduces A's total cost (positive externality), A's production increases B's total cost (negative externality). Because of external economy A's real cost function (C_{aR}) is higher than his apparent cost function (C_a). For this reason C_{aR} located above left of C_a in Figure 6.1(a) below. In the lower part of Figure 4(a) the cost function of A is changing depending upon the volume of the good produced by **B**. Since $C_{a(b)}$ is exponential, as one moves right on the horizontal axis, the **B**'s production increases and so does the difference between C_{aR} and C_a. For example, when
$q_a = 10$, and $q_b = 0$,

$$C = C_{aR} = 0.1x10^2 + 5x10$$
$$= 60.$$

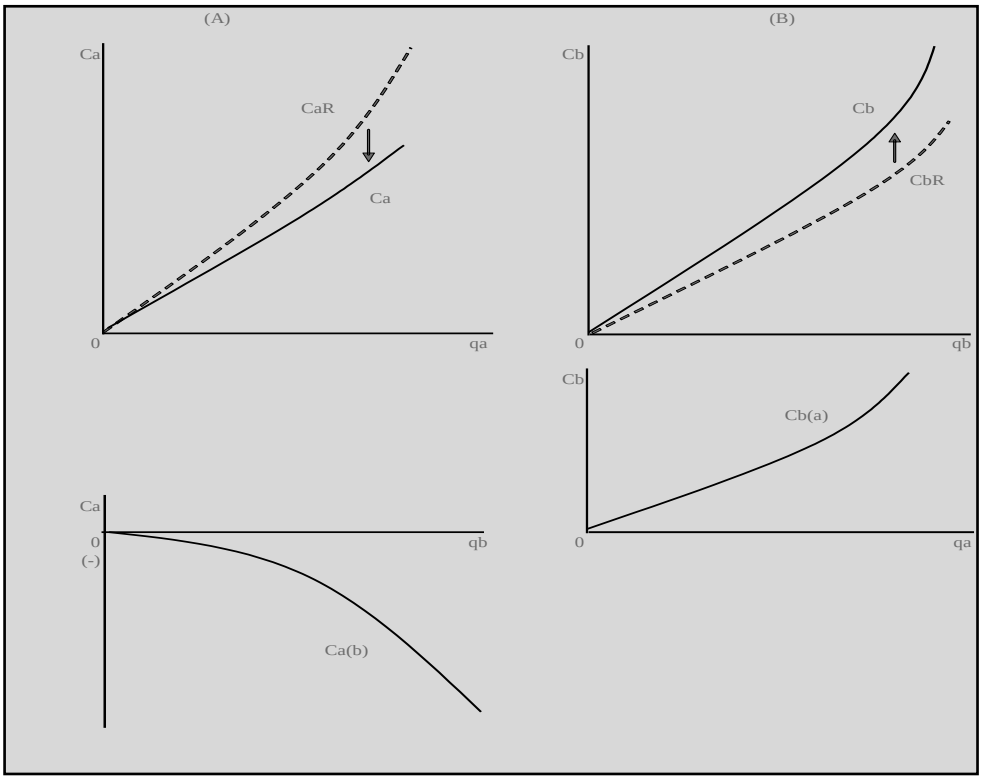
If $q_b = 10$, then

$$C_a = C_{aR} - 0.1x10^2$$
$$= 60 - 10$$
$$= 50.$$

If we increase the goods produced by A and B to 30 units, i.e. $q_a = q_b = 30$, then

$$C_a = 0.1x30^2 + 5x30 - 0.1x30^2$$
$$= 240 - 90$$
$$= 150.$$

Figure 6.1- Total Cost Functions with Externality.



However, the situation for B is different, i.e. as A produces more, B's cost function increases as is seen in Figure 6.1(b). Here the real cost function of B is C_{bR} (broken line) located below right of C_b (solid line), due to the external diseconomies created on him by **A**. On the other side, B's cost function related to A's production level ($C_{b(a)}$) increases depending on B's production and is given in the lower part of Figure 6.1(b).

6.2.1- Separate Ownership Case

Now returning to our example, as we know MC = MR = Pq will determine the optimum output level of a producer who wants to maximize his profit. If the price of output Pq =15TL, we can follow the calculations given below:

$MC_a = \frac{\partial f}{\partial q_a} = 0.2q_a + 5$

$MC_b = \frac{\partial g}{\partial q_b} = 0.4q_b + 7$

$0.2q_a + 5 = 15$,

$q_a^* = \frac{(15-5)}{0.2} = 50$

$0.4q_b + 7 = 15$,

$q_b^* = \frac{(15-7)}{0.4} = 20$

$TR_a = 15 \times 50$

$= 750$

$C_a = 0.1 \times 50^2 + 5 \times 50 - 0.1 \times 20^2$

$= 460$

$\prod_a^* = 750 - 460$

$= 290$

$TR_b = 15 \times 20$

$= 300$

$C_b = 0.2 \times 20^2 + 7 \times 20 + 0.025 \times 50^2$

$= 282.5$

$\prod_b^* = 300 - 282.5 = 17{,}5$

6.2.2- Joint Ownership Case

Considering the same example for joint firms, if the production level that maximizes profit is MC=MR=P_q and P_q=15 TL, the following calculations can be performed:

$TR_{a+b} = P_q \times q_a + P_q \times q_b$

$= Pq \times (q_a + q_b)$

$TC_{a+b} = (0.1q_a^2 + 5q_a - 0.1 q_b^2) + (0.2 q_b^2 + 7q_b + 0.025 q_a^2)$

$= 0.125q_a^2 + 5q_a + 0.1q_b^2 + 7q_b$

$\Pi_{a+b} = P_q \times (q_a + q_b) - (0.125q_a^2 + 5q_a + 0.1q_b^2 + 7q_b)$

The first order conditions for P_q = 15 TL and $\Pi = \Pi_{a+b}$,

$\frac{\partial \Pi}{\partial q_a} = P_q - 0.25q_a - 5 = 0,$

$q_a^* = \frac{(15-5)}{0.25} = 40$ $q^*_a = (15 - 5) / 0.25 = 40$

$\frac{\partial \Pi}{\partial q_b} = P_q - 0.2q_b - 7 = 0,$

$q_b^* = \frac{(15-7)}{0.2} = 40$

Here q_a declined from 50 units to 40, while q_b increased from 20 units to 40. That is the negative externality producing q_a is reduced while positive externality producing q_b is increased in the case of joint ownership. The maximum profit in this case is

$\Pi^*(q^*=40+40) = 15x80 - 40(0.125x40 + 5 + 0.1x40 + 7)$

$= 360$.

When the firms produces separately for $q_a = q_b = 40$,

$\prod_a^* = 40x15 - 40(0.1x40 + 5 - 0.1x40)$

$= 400$

$\prod_b^* = 40x15 - 40(0.2x40 + 7 + 0.025x40)$

$= -40$

6.3- Public Economy Solution for Externality: Taxing and Subsidy

Since it is not possible to bring the firms under the joint ownership every time, the things can be done is levying tax on the external diseconomy producers and subsidy the external economy producers. Then what should be the tax and subsidy rates? Let t: tax TL/unit of q_a and s: subsidy TL/unit of q_b. Then the respective cost functions,

(Eq. 6.12) $C_a = 0.1q_a^2 + 5q_a - 0.1\ q_b^2 + tq_a$

(Eq. 6.12a) $\dfrac{\partial f}{\partial q_a} = 0.2q_a + 5 + t$

(Eq. 6.13) $C_b = 0.2\ q_b^2 + 7q_b + 0.025\ q_a^2 - sq_b$

(Eq. 6.13a) $\dfrac{\partial g}{\partial q_b} = 0.2q_b + 7 - s$

$MC = MR = P_q$

$0.2q_a + 5 + t = 15$

$0.4q_b + 7 - s = 15$

For joint ownership case substitute $q^*_a = q^*_b = 40$ above to find,

$0.2 \times 40 + 5 - 15 = -t$ and

$t = 2$ TL/unit of q_a;

$0.4 \times 40 + 7 - 15 = s$ and

$s = 8$ TL/unit of q_b .

According to these results A is going to pay 2 TL/unit of q_a produced and B is going to be paid 8 TL/unit of his production of q_b. Thus at $q_a^* = q_b^* = 40$ units both profit will be maximized and at the same time the externalities will be internalized.

Results

Externality has been interested in as a result of increasing industrialization and urbanization rates. As the number problems of environmental effects, like pollution, ecological deterioration, and the problems emerging from the usage of collective (public) goods increases the interests of the economists in this matter have also increased. Basically, externality is a kind of market failure and results in efficiency loss in an economy. Positive and negative externalities are observed as the results of economic activities every time. Sometimes this type of externalities may be created outside of the market system, in terms of their effects however, they produce market results. Whatever the reasons creating positive or negative externalities are, getting the externalities under the pricing mechanism eliminates social efficiency loss.

A kind of externality originating from the usage of public goods or scarce resources is called *problem of collectively consumed public goods* and it is observed as a result of excessive usage of goods. Consumers of collective (common) goods cannot be excluded from consumption and thus they are competitors of each other. Externality is emerging because of the consumers who use the same goods and not being able to control the usage of each others, i.e. excessive usage of one consumer means less amount of goods will remain for other consumers. With that respect the goods consumed in the market system will be overused. The individuals tend to ignore the fact that their usage is going to reduce the volume of goods for the other users. There are three basic procedures followed to internalize the cost falling upon the others du to the usage of common resources. The first one is taxing or regulating the common goods' usages. Second one is establishing a tradable license system for getting usage rights of a resource. The third one is establishing an ownership system to exclude the common resources from usage.

Administration of ownership rights means establishing a series of regulations. In this framework regulating the ownership rights is determining the initial conditions of the market or rule of the game. Following this regulation the solution of the problem is expected to be derived from the market relations. ***Coase approach*** to the problem explains that externality makes the parties to bargain and realizes an optimal solution at the end. In the transaction between the parties who is going to pay to whom and the amount of payments all depend upon the way of ownership and usage rights regulations drafted. Although, regulating the ownership rights is a public solution, but it is also a private solution, since it will be a reference for the parties who will agree on some issues. In the existence of a well-designed ownership rights regulation emergence of externality will initially be eliminated and compensation of created externalities will also be possible. It is extremely important to act jointly or separately in the externality-creating activities (or inactivities) for elimination of the efficiency loss due to externalities.

Therefore, a set of well-designed ownership rights may push the firms to act together and the efficiency loss of working separately can be eliminated. Acting jointly enables us to conserve and use the common resources more productively at one side, and eliminate the efficiency loss of externality-creating productions or consumptions on the other side. In the case of two firms mutually creating positive or negative externalities their total costs, total revenues, production levels, and profits are all changing depending upon whether they are acting separately or jointly. If there are two interrelated firms, A and B, former of which creates negative externality on the latter firm, and vice versa, then some results are reached for separate and joint ownership cases. In the case of separate ownership the production level of negative externality-creating firm A is higher, however, the production level of positive externality-creating firm B is lower. Total profit of the firms producing separately is less than the profit of the jointly operating single firm. In the joint ownership case the production level of the negative externality-creating firm A declines, while the production level of the positive externality-creating firm B increase and the profit generated jointly becomes grater than of the separate firms. In the case of impossibility of joint ownership, taxing the firm that generates external diseconomy and subsidy the one that creates external economy are emerging as the solutions of public economy.

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