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CLASSIFICATION OF EXTERNALITIES: MACROECONOMIC PERSPECTIVE

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ABSTRACT.

Externalities as a source of the market failure is an important empirical issue one can encounter in the modern day world`s economic life. However, economics has analyzed it only in microeconomic analysis. We believe it has important effects in macroeconomics such as in macro accounting and growth theory. Therefore, in this paper we try first to put a formal analysis frame classifying externality types using literature definitions and then discussing the effects of externalities in macroeconomics we suggest a basic classification for that. In this sense, the ecosystem services are the main type macro externalities that we called as global externalities and discussed their properties briefly in this paper; moreover, their replacement with human technology has been the main motive of recent growth characteristic.

Keywords: *Ecosystem services; externalities; Macroeconomic accounting; global externality; macroeconomics; sustainable development. JEL Codes, D62, E01, Q01, Q57.*

1. INTRODUCTION

In the literature on externalities one can see different definitions and the classifications according to perspective and approach to the concept. As one of the first writers on the theory of externalities, Marshall defines the externalities as a situation that comes out "in any market of the goods and services, by the means of the market saturation an entrant companies pull the production costs of the other companies of the same industry down". In this definition, Marshall (1920) takes the externalities in the concept of the scale economies and firm theory; accordingly the followers of him also took the externalities concept in the frame of static analysis and partial equilibrium. Apparently, biggest part of the Marshall analysis stands in the concept of pecuniary externalities according to the current literature (Kapp, 1969, 338).

Pigou and his followers focused on the inefficiency of the externalities being connected with the marginal private net product and marginal social net product concepts (see, Pigou, 2009, 131-35). We can see that the individual and social solutions for the externalities constitute the biggest part of their studies conducted in the concept of the wealth economics.

It is possible to set a more concrete and inclusive classification by the help of the theoretical infrastructure in the economics. Mathematically, externalities are defined as the variables defined out of an equation or equation system. Applying this equation into the economics, we can take that definition as the positive and negative effects of the economic agents that are not included in the production or utility function to the other economic agents (Lipsey et al., 1993, pp.402-03). According to the size of the frame that we would use, such as firm, industry or country level, the externality definition will also change. Still, taking externality concept into account on the basis of the 'externality to the market mechanism' as dominantly used in the literature will be the solution for the issue. Following this perspective, externality defines the elements that are not included by the market mechanism independent of being whether in firm, industry or country level. To put it even clearer, it can be defined as the elements that are not included in the prices which works as an invisible hand and constitute the fundamental of the market functioning.

A comprehensive definition can be done as: "An externality happens whenever the activities of one agent affect the activity of another agent in ways that are not reflected in market transactions." (Nicholson, 1998, p.730). This definition can also embrace the findings of the wealth economists on the differentiation of the individual and social utility. In this case, the agent`s activities that are external to the scale of analysis but affects the prices of the agents are defined as pecuniary externalities. Being included by the price mechanism, pecuniary externalities are not included by the externality definition; all other type of externalities can also be defined as technological externality in the literature (Unsal, 2001).

Drawing a frame for externalities to the market economy we are ready for dealing with the classification of externalities. Having said that, we thought it is better to analyze formally first the inefficiency in allocation of the resources as the critical point of the subject; and then to set the externality classifications in the third section. Fourth section sets the importance and the meanings of externalities in today`s macroeconomics. Fifth section concludes the paper.

2. EXTERNALITIES and EFFICIENCY OF RESOURCE ALLOCATION

The existence of the externalities to the price mechanism eliminates the ability of the transmission of knowledge coming from the producers and consumers by the means of the prices; and therefore, it leads us to inefficiency of resources.

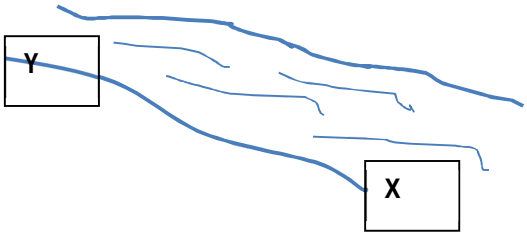

Figure 1. River example: factory Y creates pollution, factory X is affected from pollution

We can analyze this situation in an example. In our example given in Figure 1, Y is an industrial production company creates pollution; and X is another company which is situated on the lower part of the river and is getting affected by that pollution. If the production function is a single variation function, i.e. function of labor, the relationship between the production function of the firms will be as in (1) and (2):

$$Y = g\,(L_y) \tag{1}$$

$$X = f\,(L_x;\, Y) \tag{2}$$

L_x and L_y are the labor of the factories X and Y respectively. In Equation (1) production of the firm Y depends only on its labors. However in Equation (2), the production of the firm X depends on labor of the firm and the production of the firm Y because the production of Y polluting the river affects the output of the X.

At the Pareto efficient point the social marginal productivities (SMP) will be equal each other:

$$d\,(SMP_x)/\,dL = d\,(SMP_y)/\,dL \tag{3}$$

P_x and P_y represent the prices of the products of firm X and Y respectively.

$$d\,(SMP_x)/\,dL = P_x\,(\partial f/\,\partial L) \tag{4}$$

$$d\,(SMP_y)/\,dL = P_y\,(\partial g/\,\partial L) + P_x\,(\partial f/\,\partial Y)\,(\partial Y/\,\partial L) \tag{5}$$

Equation (4) gives the standard form of the value of the marginal product of the firm X. However, as in Eq. (5), the social marginal revenue product of the marginal labor of Y is more complicated. Every additional labor creates more production; however, at the same time, it will cause a decrease in the production of X by producing more pollution. The second term in the right side of Equation (5) reflects this external effects of Y on X`s production.

On the other hand, X and Y decide on their productions independently from this fact of externality and independent of each other. They continue to the point that their marginal revenue of product will be equal to wage.

$$w = SMP_x = P_x\,(\partial f/\,\partial L) \tag{6}$$

$$w = SMP_y = P_y\,(\partial g/\,\partial L) \tag{7}$$

In terms of the market equilibrium, not the social marginal revenue of products which includes the externality effect but the individual marginal revenue of products which does not include the externality will be equalized to each other. This means unless the second term in the Eq. (5) is zero, i.e. unless the $(\partial f/\,\partial Y)$ term zero, because the others are positive, Eq. (5) and Eq. (7) will not be equal. That means, as long as there are externalities, the individual producer decisions will not be enough to reach to Pareto optimum.

3. SPECIFICATIONS OF EXTERNALITIES

As mentioned above, externality definitions go back to Marshall whose definition is placed in the pecuniary externalities in today`s literature. In this paper, as in the most part of literature, externality is defined for the situations that the price mechanism does not reflect the information from externalities. The reason of this isolation can be thought as that the effects valued in the price have not any uncalculated effects on the resource allocation. Therefore, it should be underlined that in pecuniar – technological externality separation, only the second one has effect on the resource allocation. In other words, technological externality is used commonly as just 'externality' referring to all type externalities other than pecuniar externality.

Externalities can be classified as positive and negative externalities according to their effects, and can be separated as production and consumption sourced according to their sources (Parkin, 2010, p.374).

The positive not priced effects of the activities of an economic agent on the activities of another economic agent constitute the positive externalities. This positive effect can happen in the production and consumption and also might affect the utility. A common example given for the positive externality is the example of apple garden and apiary farm. If an increase happens in the apple production, the bees are also fed better and the honey production increases. Not being priced, this increase directly affects the honey production and therefore constitutes a positive externality (Meade, 1952, pp.56-60).

Similarly, the negative not priced effects of the activities of an economic agent on the activities of another economic agent constitute the negative externalities. This positive effect can happen in the production and consumption and also might affect the utility.

The economies which have positive externalities in it are often called as external economies in the literature and similarly the economies which have the negative externalities in it are often called as external diseconomies. Similarly, beneficial externalities and detrimental externalities definitions are also used in parallel way.

The other important classification can be applied as production and consumption externalities. In each classification naturally there will be positive and negative externalities.

Instead of direct effect of one economic agent`s activities on the other`s, sometimes it shows up directly in the utility function. This situation can be called as externalities in utility (Nicholson, 1998, pp. 731-32).

A further classification for production and consumption externalities can be done by subtitles as production externalities caused from production and consumption activities and consumption externalities caused by production and consumption activities.

3.1. Production Externalities

Production externalities is an externality type that can occur when the activity of a producer`s activities come into another producer`s production function or into a consumers consumption function. It can be held as positive and negative externalities. Similarly, beneficial – detrimental production externalities or external economies in production and external diseconomies in production definitions are also used in this subject.
We see the positive production externality on the Figure 2. D curve represents the demand curve. On D demand curve there is no differentiation between individual and social utilities. However, on the supply part, because there is positive externality for the marginal cost curve (MC), the social marginal cost curve (MC′) of consumers shifts right and down. At the social equilibrium point that counts the positive externality the

production increases amount of |QQ*|. On the other hand this amount of production does not come into reality because the positive externality information is not represented by the prices. As a result, the allocation efficiency does not occur.

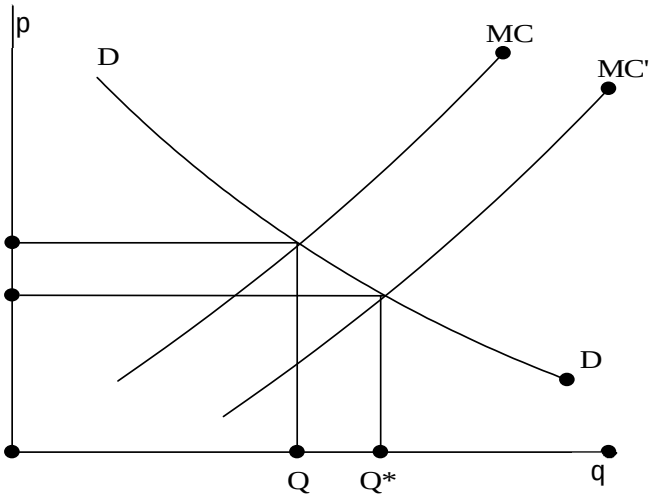

Figure 2. Positive production externality

The example of apple garden and apiary farm falls into this class. Analyzing this example in parallel manner, we can indicate that the cost of apple garden is lower to the society because of the positive externality that apple garden cause on the production of the apiary farm. Hence, while, the apple production could be higher in amount of |QQ*| in the society[1] that can take this information into account, the market will not reach to the Pareto optimum point because of lack of the information of the externality in prices. In other words, there is an inefficiency pretends to allocate the sources efficiently.

Many other examples can be given for the positive production externalities. If a company supplies trainings for its employees the general level of labor qualifications increase and the sector utilize this non- priced externality. In some developing countries such as Turkey almost the all of pilots came from the retired military pilots for long years until the recent times. Airlines in the country utilize this high quality experienced pilots and the non-priced part of this positive effect constitutes the positive externality for the industry. This feature of Turkish airlines sector can be given as example to the external economies.

Negative production externalities can also be explained on figure similarly. On Figure 3, D is demand, MC is supply curve which is equal to marginal cost of individual producers. The marginal cost curve (MC) of producer shifts to left and up reflecting the social marginal cost (MC′) including the negative externalities. At the social equilibrium point that takes the negative externality into account the production level will be lower by the amount of |QQ*|. However, because this information of negative externality is not represented by the prices the necessary production decrease in order to accommodate the Pareto optimum does not come into reality. This inefficiency pretends to reach resource allocation.

[1] Here society can be thought as a united company. If the apple producer and apiary farm can be deemed as one company the positive externality is calculated by the united company and the production will be on Q*.

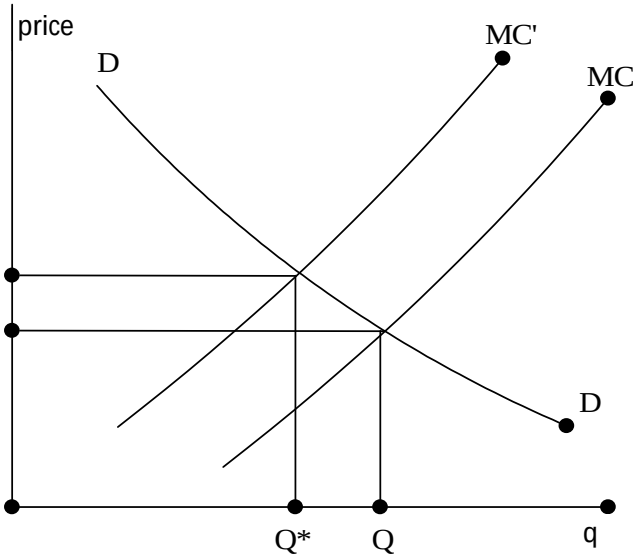

Figure 3. Negative production externality

As an example we can take two factories, X and Y, operate on the same river. Supply curve of factory Y is equal to its marginal curve MC and corresponding equilibrium is Q. The equilibrium at Q includes inefficiency. Because the social cost of Y to the society, or to the united company, will be higher MC′ because of the negative effect of Y`s production on X. For this case the equilibrium should be at Q*. In contrast, the lack of externality information in the MC leads to market equilibrium at Q. As a result, there will be a gap because of the excessive production of |QQ*| and resource misuse.

It is possible to give several other examples for negative production externality. One can notice that a big part of the cases for the negative externalities is constituted by environment related applications. Individuals and companies conduct their activities in common ambient of environment hence the most of the examples of negative externalities are becoming related with the environment. For example, a factory that pollutes the sea creates a negative externality for the fish farms on the sea and for the individuals who do fishing and consume them.

3.2. Consumption Externalities

The negative effects of the consumption of a person on another consumer or on production of a producer companies can be called as consumption externalities. The negative effects of the smokers on the other consumers can be given in this class. Especially the environmental externalities (most of them are negative) fall into this class. As in production externalities, the consumption externalities can be classified as positive-negative externalities (or useful and detrimental externalities).

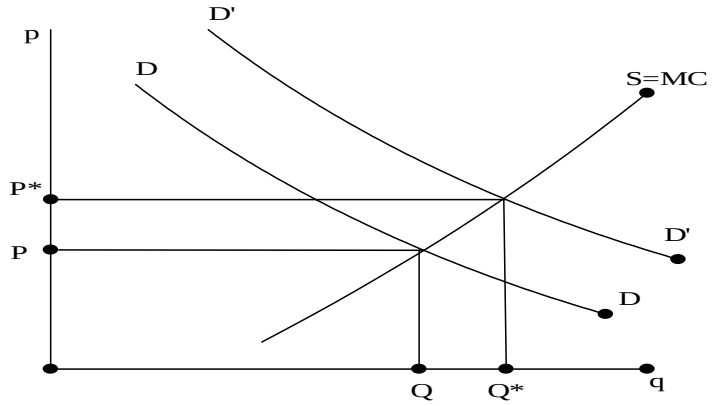

Figure 4. Positive consumption externality

On Figure 4, supply curve (S) will be equal to marginal cost, having no differentiation between individual and social costs. D curve represents the demand of consumers that they arrange according to the utility from their consumption and to their budget allocated for consumption. In the case of a positive consumption externality, the consumption of consumers can increase the consumption or utility of other consumers. In such situation, demand curve should be D′ having this positive effect in it and the social equilibrium which takes this positive externality into account should be at Q*. However, when this positive externality cannot be represented in the prices, the equilibrium occurs at Q. At Q, there is an insufficient consumption of |QQ*| and the resources allocated insufficiently. The use of deodorants can be given as example: the use of deodorants in the society can increase the general utility of the society.

Negative consumption externality can be analyzed similarly (Figure 5). As mentioned before this case is common in the environmental issues. In this situation the Pareto optimum point is missed because of the excessive consumption of |QQ*| and there is an inefficiency which leads to allocate resources inefficiently.

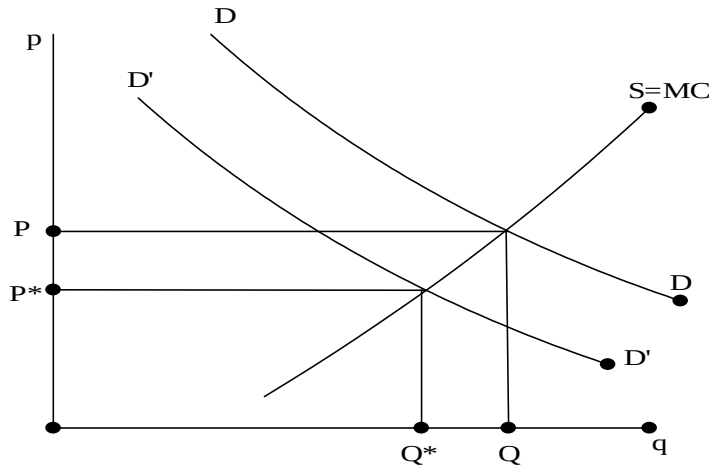

Figure 5. Negative consumption externality

Examples for the negative consumption externalities focus generally on environmental issues, other than smoking example, the trash effect of general consumption, the pollution effect of consumption on the seas, rivers and generally on the environment. Other than environmental examples, the luxury consumption or Veblen effects can be evaluated in this class.

4. MACRO ECOSYSTEM SERVICES: GLOBAL EXTERNALITY

So far we have seen externalities are dealt with in microeconomic concepts. Externalities are taught traditionally among the microeconomic concepts. However, its macroeconomic applications are getting more attraction in recent times. Two important subjects in which externalities play important role should be mentioned here. Regarding to that distinction, the role of externalities in macro accounting and growth theory must be counted.

Insufficiency of the calculation method of GDP has been one of the discussions in the economic literature (for the discussion see, for example, Leipert, 1986; Dasgupta et al. 1997; van Dieren, 1995; Vincent, 2000). In this manner not just GDP, the flow variable, but also the stock and flow evaluation of worldwide adopted System of National Accounts (SNA) is also criticized for not accounting the wealth by focusing market prices and excluding externalities (see, Commision of the European Communities et al., 1993, par. 1.1, 3.61, 2.178). Ecological economy criticizes the main stream neoclassical approach for that ecosystem services are not been included in the GDP calculations and the contribution of ecosystem to wealth stays out of calculations[2]. These uncalculated ecosystem services are external to the market system pricing mechanism and consist a positive externality to firms and individuals. Those macro level externalities can be called 'global externalities'. This global externality is different from the other types of externalities defined in the literature and these differences need to be classified more clearly.

The difference with the regular externality should be articulated first in terms of classifications. First of all, the geographic advantages and disadvantages creating positive externality for some are not the subject of interest here. Because this kind of advantages can create positive externality but when they create positive externality they automatically create negative externality at the same extent for the others. These relative advantages and disadvantages are reflected to their prices; for that reason they actually cannot be classified as externality because of their not being 'external' to the price mechanism, that is they are internal to the price mechanism.

On the other hand, the macro ecosystem services are the services that the globe produces and serves to habitants living on the globe. Those 'produced-by-earth' services have been subject to the academic scrutiny in recent times. Of course, this issue is utmost important so long as to they consist of the main critiques of the calculation method of macro accounting of GDP and GNP. For example, System of integrated Environmental and Economic Accounting (SEEA) despite its attempt to include the environmental assets into the macroeconomic accounts (and improve itself by reviews in time see, United Nations, 1993; United Nations et al., 2003) still lacks of ecosystem services. In this sense, *Green GDP* calculations (Akira and Nakamura, 2001) try to achieve this difficult task.

Having ecosystem services in macro evaluation, most of the ecosystem services can be still regarded as related with geographic location; on the contrary, their produced services add up to the global services and produce utility for wider body of society instead of sticking to the geographical features and creating utility for just the owners of the land.

Many examples can be given to this type of externality: a forest on the land can raise the value of the land but without calculating its photosynthesis services that the all global system and humanity facilitates we cannot calculate its real economic value. It can affect also the individual cost-benefit calculations on big industrial and environmental projects such as controversial pipeline projects, nuclear or hydraulic power plant projects or even land transportation and highway projects. Yet as our focus is on the macro valuation

[2] There have been different endeavors trying to overcome those criticisms. Ecological footprints-*EF* (see, Rees, 1992; Wackernagel et al., 2002), Genuine savings-*GS* (Pezzey, 1992; Pezzey and Toman, 2009, Dasgupta, 2009) and Material flow-*MF* (Spangenberg, 1999), System of integrated Environmental and Economic Accounting-*SEEA* (United Nations et al., 2003) and *Green GDP* calculations (Akira and Nakamura, 2001) can be counted among them.

of ecosystem services, those macro ecological production should be included in the GDP calculations to make it possible to compare the economies including their global productive valuation before waiting the real transformation of expensive human industry replace those global services[3] (for the discussion on transformation of ecosystem services see, Antoci et al., 2005; Bartolini, 2003). If we add even more specific industrial global externalities or more general social externalities such as genetic store for medical and chemical industry, which enabled by biodiversity that forests host, or recreational or even cultural effects to the artistic production then the differentiation in macro calculation would be even sharper. If we can achieve including the macro ecosystem service production to the accounting of the macro production such as GDP, the direction of the economic endeavor would change into different way. In this aspect, to give a notion for that potential we should remember the first attempts to calculate this ecosystem production proposes a 1-2 times of ecosystem production value should be added to the GDP numbers[4].

At this point, when we are talking about the replacement of ecosystem services with the expensive human industrial production we face the place of externalities in growth theory. This issue has been scrutinized in several aspects. Yet here we underline the point that the main characteristic of the growth of modern economies in recent times are based on this expensive replacement of ecosystem services. This type of replacement expenditures are also called as defensive expenditure. As for Daly and Farley, "Regrettably necessary defensive expenditures, or 'defensives expenditures' for short, are those expenditures that we have to make to protect ourselves from the unwanted consequences of the production and consumption of other goods by other people" (Daly and Farley, 2004, p.231). In this sense, defensive expenditures indicate the costs of protecting to the deterioration of environment (Antoci et al., 2005, p.227).

We called the ecosystem services as global externalities above. Following the same logic, the removal or depletion of the global externalities leads us to defensive expenditures. However, the growth of human economy or urbanization of human society also directly creates the negative externalities and this constitutes another reason for defensive expenditures. Both effects are among the substantial dimensions of recent era growth. Depletion of natural resources, transformation to the urban life and deterioration of the environment suggest many examples for this type of negative externalities or removal of global externalities. Tap water expenditures, pollution related medical expenditures, air condition expenditures, noise related window isolation industry or expenditures of obligatory moving and relocation can be counted among those defensive expenditures. The effects of such a path for economies and the representation and interpretation them into the economic growth theory can be subject of a wider and another research. We will draw a line for this paper by indicating the growth theory as another important area that the externalities should be taken into account.

5. CONCLUSION

Externalities as a source of the market failure is important subject in the modern day world`s economic life. However, its analysis has been narrowed only into microeconomic analysis. In this paper we try first to put a formal analysis frame classifying externality types using literature definitions and then we suggest the effects of externalities in macroeconomics. We discussed its important effects in macroeconomics. Macro accounting and growth theory are among them. The ecosystem services can be classified as macro positive externalities and we called them as global externalities. In the midst of the discussion on calculation method of GDP, their inclusion into the macro accounting system might produce bigger results then being a mere development in the theory. So long as changing comparison of economies it can affect the direction of macroeconomic policy. Such a transition would also affect the growth policies because the recent modern economic growth based on the negative externalities that are replacement of the ecosystem production or services as we stressed in this paper.

[3] Costanza et al. (1997) list 17 ecosystem services: 1- Gas regulation, 2- Climate regulation, 3- Disturbance regulation, 4- Water regulation, 5- Water supply, 6- Erosion control and sediment retention, 7- Soil formation, 8- Nutrient cycling, 9- Waste treatment, 10- Pollination, 11- Biological control, 12- Refugia, 13- Food production, 14- Raw materials, 15- Genetic resources, 16- Recreation, 17- Cultural.

[4] More specifically, Costanza et al. (1997) calculated it as $16-54 billion

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