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The Economics of Land Use Change

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Abstract

The aim of this paper is to provide a brief overview for non-economists of how land has been treated in economic theory. Land is an aggregate of many different attributes, providing many important functions, which are not part of market transactions. An analysis of the economics of land use change has to include the unique character of land. This uniqueness arises from its distinct *physical*, *ecological*, and *institutional* properties. Land use decisions are influenced by three groups of factors. First, physical, biological, and technical factors include the quantity, nature, availability and characteristics of land resources, which set definite limits on what operators can do in using land resources. These physical properties refer to the *raw land*. But what an owner of land really owns is not raw land but *real estate*. The existence of parcels of land or real estate is a matter of human institutions. Real estate comes into existence and is maintained in its existence as a result of complicated networks of institutional facts, whereas raw land is not. Second, institutional factors provide the 'rules of the game' in a society, establishing the human devised constraints and unconscious habits that shape human interactions. Contributing to this institutional setting are cultural, economic, political, religious, social, and traditional factors. Third, economic factors, such as supply and demand, shape present land use. Economic analysis of land use change should not be solely occupied with price signals and shadow prices but has to include historical and institutional factors as well. Land is as much a social product as it is a physical reality. Interdisciplinarity and plurality are therefore essential and irreducible requirements in land use research. In this spirit, it is hoped that this paper will promote exchange of ideas and concepts among disciplines.

About the Authors

Klaus Hubacek has been affiliated with the Land Use Change-project since June 1999. He has received a Ph.D. in Ecological Economics from Rensselaer Polytechnic Institute in Troy. From 1991-1996, he worked as an Assistant Professor at the department of Environmental Economics and Management at the University of Economics and Business Administration in Vienna, Austria. Klaus was a visiting scholar/instructor at Western Maryland College, MD, the University of North Carolina in Chapel Hill, NC, University of Economics in Budapest, University of National and World Economics in Sofia, Bulgaria, University of Copenhagen, Denmark, and the University of Technology in Vienna. He conducted studies for a number of public agencies and published on a variety of topics such as energy, appropriate technology, biodiversity, input-output modeling, and land use change.

Jose Vazquez is Assistant Professor at Hamilton College, Clinton, NY. Since 1998 he has been a visiting lecturer at the State University of New York at Albany. Jose received the Lincoln Institute of Land Use Fellowship in 1998 to study issues regarding watershed development and tourism in the Lake George Watershed region in New York. He has presented results from this and other similar studies at several academic and professional conferences. His main research interests include income distribution, tourism development and land use change.

The Economics of Land Use Change

Klaus Hubacek andJose Vazquez

1. Introduction

Virtually all resource allocation takes place on land. Land represents an aggregate of many different attributes. Different uses of land call for a different mix of land attributes and affect the land in different ways, some of which might be very long lasting.

Anthropogenic land transformation is as old as humanity itself but only in the last two centuries have land-cover[1] changes become truly global in scale and now occur at unprecedented speed. Even though these changes are undertaken at the local or regional level, they are repeated frequently and by patchwork addition reach global dimensions (Turner *et al*., 1990b). Human activities, rather than natural forces, have become a major force in shaping the environment (Committee on Global Change, 1990). Research shows that human induced changes in land use and cover have significant effects on the functioning of the various cycles, such as the nutrient, carbon, and hydrological cycles, on a regional as well as the global level. Transformed, managed, and directly used ecosystems constitute about half of the ice-free earth (Turner *et al*., 1990a). To meet human needs for fibers and foods, wilderness areas were converted into managed land. Large sections of woodland were used for harvesting wood or converted to cropland. Estimates on changes in global land use show that the world wood areas diminished by 12 million square kilometer (km^2) (-19%), grasslands and pastures declined by 5.6 million km^2 (-8%), and cultivated land increased by 12 million km^2 (+466%) since 1700 (Richards, 1990). Land used for forest products and livestock production constitute the two largest land uses, amounting to some 85% of total land. The sharpest reported growth rate has been in cropland. Settlement areas account only for some 3.5% of total land, with almost equal shares of rural and urban areas. Even though built-up land might affect only relatively small areas, their effects may often carry considerable long-term implications. Once a patch of land is sealed off and buried under tons of concrete it is extremely difficult to convert it back into a natural ecosystem (Heilig, 1996).

For most of human history, these types of land transformation have been caused mainly by the agricultural revolution and its associated population growth. With the onset of the Industrial Revolution, the globalization of the world economy, and the further growth of population,

[1] Land cover refers to the attributes of a part of the Earth's land surface and immediate subsurface, including biota, soil, topography, surface and ground water, and human structures. Broad categories can include boreal forest, tropical savanna, temperate grasslands, croplands, wetlands, industrial land, and settlements.

lifestyle changes, expansion of technological capacity and infrastructure, and changes of industrial production pattern, land transformation has further accelerated.

It is interesting to see how the treatment of land in the market economy over the past two to three centuries has been mirrored in economic theory.

2. Land in the History of Economic Thought

Despite its obvious importance, land has almost disappeared from economic analysis. In the early history of the economics profession, land had a much more prominent role than today, due to its importance in delivering foods and fibers, and due to its role as a source of social prestige. In ancient and medieval economies, agriculture and other extractive industries were foremost in the attention of "economists" (Haney, 1964, p. 136). For the Physiocrats, agriculture was the only sector being able to yield a net product, which is a disposable surplus over costs. Manufacturing and commerce were by contrast unproductive. The level of agricultural output determined the general level of economic activity. An increase in the net product allowed the landowner to make investments in improving the land. The final result of this process is the attainment of the maximum level of output consistent with the country's resources and the existing techniques (Meek, 1963, p. 21). The net product introduced the idea of a surplus due to the bounty of nature (Haney 1964, p. 182). The characteristic agricultural emphasis of the Physiocrats is reflected not only in the treatment of land but also in the stationary view of the economy. If the economy is organized according to the natural order it will rapidly attain a maximum level of output consistent with the country's amount of arable land and with its state of technology (Gilibert, 1987). Many writers belonging to what was later considered the Classical school of economics abandoned both aspects.

Classical economists were writing at the first swing of the Agrarian and Industrial Revolution. It was also the time of the rise of the industrialist class and the beginning of the decline of the importance of the landlords. The importance of technological progress and capital for productivity was recognized. The main research agenda of classical economists was to derive the relationship between prices and their inputs, labor, capital, and land. Classical economists took from the Physiocrats their special treatment of land. For Adam Smith, the productivity of land, next to productivity of labor and improvement in transportation, was a significant condition for economic development (Smith, 1776). The notion that economic growth must come to a halt due to scarcity of natural resources was maintained. But classical economists, reflecting changes in the economy and society, directed their attention from *land* as the main factor of production to the more abstract notion of *rent,* or money paid for the use of land. In Ricardo's theory, labor and capital shift from one unit of land to another, but land itself never shifts between alternative uses (Richardo, 1951-1973). Land is supposed to be taken up freely when needed; not from another rent-paying alternative, but rather from non-paying idleness. Resources shift between land and industry, never between different uses of land. As land has no alternative uses, rental payments do not affect the supply price of agricultural products. Whereas Ricardo focused in his concept of rent on different qualities of land, Johann Heinrich von Thuenen (1875) in his book, *Der isolierte Staat,* used distance as the central concept. He sought the principles that would determine the prices that farmers receive for their products, the rents that are earned, and the patterns of land use that accompany such prices and rent. He developed a system of concentric circles, in which bulky or perishable goods are produced closer to the city and valuable and durable goods can be imported from a further distance.

Classical economists laid the foundations for neo-classical economics. The move toward an increasingly homogenous measure of money and output allowed for a simple aggregation of all output into total product. For most of classical analyses, land retained its special role. Since fertile land was considered to be limited in supply, the classical economists believed that agricultural output would be subject to diminishing returns. On the other hand, industrial machines, although lacking independent productivity, could be replicated and could be extended indefinitely, given appropriate resources.

The production-based approach to value in classical economics, also referred to as *objectivism,* is in contrast to the *subjectivism* of the marginalist approach of neoclassical economics. For neoclassical economists, value is a subjective entity arising from the utility the good gives to the beholder and its relation to other goods. At the turn of the century, the milieu of neoclassical economics could be described by the longevity of the industrial revolution, the pace of technological developments, shifts from food and fiber-based economies to mineral and fuel-based economies, and economies in the industrialized world that seemed to be independent of extractive industries (Randall and Castle, 1985). Assuming continuous substitutability among factors of production, perfect competition, and a linear and homogeneous production function, rent is determined as the marginal product of land. To neoclassical economists land was no longer a dominant economic category. Land could be safely subsumed under the aggregate of capital, leaving two factors of production, capital and labor.

This type of neo-classical analysis is still solidly accepted as conventional wisdom. Within the logic of market economy, land has been reduced to a factor of production and an object of consumption. According to this utilitarian logic, different functions of land and land resources do not have any value in themselves and are only manifested as they are revealed by final demand. Value is only constituted as it provides utility to humans. The physical qualities of land are reduced in economics to the willingness-to-pay of economic agents represented in market transactions. Private production and consumption decisions, such as the allocation of land or resources between alternative uses, are taken with the objective of maximizing utility accruing to the individual producers or consumers, subject to constraints imposed by prevailing technology, resources, and policies. According to this logic, land-use decisions are mainly governed by the forces of supply and demand.

These assumptions, however, were countered by a number of economists, and the debate continues. A renewed discussion of natural resources in mainstream economics was instigated by the discussion of sustainable development put forward by the International Union for the Conservation of Nature in 1980 and the World Commission on Environment and Development (1987). Within this discourse two concepts of sustainability emerged. Advocates of *weak sustainability* maintain that the aggregate stocks of artificial and natural capital (including land) have to increase or at least stay constant, and that natural resources can be replaced by human made capital. Advocates of *strong sustainability* argue that a necessary condition for sustainability is that the stock of natural capital be maintained (Gowdy and McDaniel, 1999). In between is the viewpoint that there are certain stocks of "critical natural capital" for which no substitutes exist, and these critical stocks must be maintained in addition to the general aggregate capital stock (Victor, 1991).

3. Land and the Economic Process

Land use decisions are influenced by three groups of factors. First, physical, biological, and technical factors include the quantity, nature, availability and characteristics of land resources, which set definite limits on what operators can do in using land resources. Second, institutions, which are the 'rules of the game' in a society, establish the human devised constraints and unconscious habits that shape human interactions. Third, within these constraints, economic forces, supply and demand, are shaping present land use.[2]

To explain land-use change economic analysis uses a number of basic assumptions. The most important is that economic agents, consumers and operators, are rational entities that try to maximize their income (profit) or welfare (utility). The stimuli to which these market agents respond are prices. Prices therefore allocate scarce recourses, such as land or minerals. This cause-and-effect reasoning happens in a quasi-experimental condition of all-other-things-equal (or ceteris paribus). This allows us to make statements such as "other things equal, if the relative price of a good decreases (increases) people will buy more (less)." This brings about another assumption of more is always better than less. The condition of all-other-things-equal includes the assumption of given and constant preferences, constant technologies (e.g. no substitute of the good appears on the market), and no conspicuous consumption or prestige values (buying because the price is high) during the time period of analysis. In this model economy the so-called economic human has perfect information to be able to assess all the different opportunities and their associated advantages and disadvantages as well as prices.

Up to a certain point the assumption of self-interest is a good description of most economic activities. But individuals differ to the extent in which they measure their satisfaction in monetary terms or how economic goals rank within a set of live goals. Particularly, land has often been owned for other purposes in life than maximization of income. Individuals also differ in their assessment of risks and in their willingness to take these risks. Maximizing income might entail maximizing risks. Optimization might be replaced by rules of thumb, traditional behavior, and orientation toward the behavior of peers or competitors.

In a physical sense, land resources have both a quantitative dimension (hectares of space or cubic-meter of topsoil) as well as a qualitative dimension (e.g. fertility, solidity), which is dependent on the respective use. The supply of land in a physical sense is often considered as fixed and limited. The economic supply of land depends on the physical supply, institutional factors, the available technology, and its location. Economic supply may be defined as land units that enter particular uses in response to certain stimuli, such as prices and institutions. The owner of land decides the type and intensity of use dependent on the price the land will bring on the market. The present economic supply reflects current utilization practices, current economic availability, and current adaptability of the material base to required demand.

The economic supply may be increased in the following ways (Renne, 1947, pp. 23):

(1) Areas previously unused can be brought into production;

(2) Areas in use can be used more intensively;

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[2] Increasingly the logic works the other direction where the needs of the market influence and shape institutions, values, technology, and the environment.

(3) Removal of hindrances to the fullest utilization of land already in use; and

(4) Consumption of land-intensive products can be reduced.

Supply problems do not develop as long as each type of use can expand. Complications only arise when conflicting uses compete for the same land areas. Whereas supply is to some extent fixed, demand seems to be unlimited. The fulfillment of all our needs is based on land. Demand for products requires places to manufacture them and again infrastructure to transport those goods. Services depend on land too as they necessitate some capital goods and infrastructure. Demand for recreation calls for open space, nice scenery and infrastructure, such as roads and hotels. Even spirituality depends on land as spiritual activities involve some production of goods. Each of these demand categories has direct land requirements as well as indirect land requirements for the production of all the inputs necessary to produce the final product. Following this logic, the demand for land could be divided into two different categories: direct demand and derived demand. Direct demand for land is the demand for land that is used directly for consumption of land, guided by market signals such as land prices and land rent regulating supply and demand on the real estate markets. Derived demand for land comes through the implicit market signals on good and factor markets that consumers give to land users, such as farmers, as to what land uses will satisfy current demand for goods and services. The most common of these two is the derived demand for land. Consumers demand products, which producers supply using the available land as a factor of production.

The amount of land producers need to sustain the production of goods is directly influenced by the signals they receive from their customers by the way of prices. For instance, land resources tend to gravitate to those uses that command the highest market prices and offer the highest net returns to investment. Rising price levels usually encourage bringing more land into use and to use the land already in use more intensively. Nevertheless, producers are also faced with factors that can affect their desire of land, which can be understood as independent of the actions of customers. Most of these factors have to do with the way in which producers use land, in combination with other factor inputs such as labor and capital, to produce their economic output. In order to understand how producers make decisions about the combinations of its inputs, we need to introduce a few important concepts that are at the core of production theory in economics.

The first of these concepts is that of *diminishing returns*. Land, as well as other factors of productions is governed by the Law of Diminishing Returns. Whenever additional inputs are added to a production process, a point is eventually reached after which the additional product per unit of the input decreases and eventually becomes negative. Faced with this constraint, producers then have to know the point at which a further increase of factor inputs such as land becomes uneconomical. Their objective of course is to maximize net returns; net profits minus net costs. In order to accomplish this, they need information about the contribution of each input to total output, specifically the marginal contribution of each input to output. Economists call this the value of the marginal product (VMP), which is the value of additional unit of output produced by each additional unit of input. At the same time, producers also need to have information in which way inputs contribute to the overall cost of production. Again, the important information is the way production costs increase with every unit-marginal-increase in inputs. Economists call this the Marginal Factor Costs (MFC) of each input. Since producer's objective is to maximize their returns they will want to produce at a point where their total net profits minus their total net costs are at the highest. This point is reached when the VMP equals the MFC.

As mentioned above, producers treat land as another input to production. Land operators then, will try to find the proportion of inputs that derive the maximum returns for them. Therefore, they will evaluate not only the marginal value of their land by itself, but in comparison with the marginal value of other factor inputs. Competition among the owner of each factor ensures that land rents, wages, and returns to capital do not exceed the value of marginal product.[3] For this comparison to have any use for them, substitution between factors of production needs to be possible**.** In the short-run producers are unable to make this substitution between land and other factor inputs because land is a quasi-fixed factor of production. This stems from the fixed location of real estate resources, the ownership rights applied to them, and other institutional factors, which makes changes of production sites difficult (Barlowe 1986). Most of the time producers can make proportionate decisions between land and other factor inputs only when they are deciding over long-term investments. This fact is also referred to as the *concept of proportionality*. Here the main question to be asked is how land compares with other factor of production. This is when another main economic concept in land use comes into play: *intensity*. When applied to land use, the term refers to the relative amounts of capital and labor combined with units of land in the production process. At the margin, levels of intensity in land use are usually classified into two types: intensive and extensive. Intensive margin of land use occurs at points were any uses of a given tract of land with marginal or last variable inputs of capital or labor barely pay their costs. On the other hand, extensive margin of land use occurs when operators who are applying their variable inputs to the intensive margin for a given use of land find that they are using the lowest grade of land of decreasing use-capacity they can afford to operate. In practice, the intensive margin represents the economic point at which it does not pay to apply additional variable inputs to land; and the extensive margin represents the point beyond which it does not pay to bring additional land into production (Barlowe, 1986, pp.126). These two concepts are at the core of our last important economic concept for land use; that of land rent.

Rent is the price of, or income from, land and any real property computed per unit of time. This concept is called the *contract rent*. For tenants, contract-rent payments are operating costs. From an investor's point of view, rent is the return of investment amongst different investment possibilities. The rent paid by the user of the real estate compensates for the investor's opportunity costs, which represents the returns they could receive from alternative investments. In contrast to other concepts of land, contract rent involves an actual payment to the property owner, which may differ from the imputed rent as conceptualized in the following concepts.

Land rent in the classical sense is income derived from selling the services of a unit of land, independent of the services of capital or labor. It represents the economic return that accrues to land for its use in production. Differences in rent-paying capacity or different classes of land are often explained in terms of different locations or different qualities of land. The former may include closeness to water, infrastructure, amenities, and cultural centers while the latter might refer to soil types or factors related to climate, and human-made improvements, such as buildings. Today, economists frequently view land as part of capital, which has lead to a broader meaning in which rent is payment in excess of a necessary supply price. In this view, rent is defined as the short-run economic surplus that a productive factor

[3] The "adding-up" theorem in microeconomics shows, under the conventional restrictive assumptions, that if each factor is paid the value of its marginal product, the total output will be exactly exhausted, which establishes another reason for the equal treatment of land with other factors of production.

can earn because of unexpected supply and demand conditions. In the longer run, assuming perfect competition, these unexpected supply and demand conditions will disappear and the factors are expected to come into balance, and the phenomenon of economic rent disappears. But differences in land use-capacity that provide the basis for land rent do not disappear with a balancing of supply and demand conditions (Wessel, 1967).

Land resources are at their *highest and best use* when they are used in a manner that provides an optimum return to their operators or to society. The highest and best use is subject to change in the quality of the land resource, changes in technology, changes in the demand structure, or changes in zoning ordinances or other legal frame conditions. In modern societies, land resources usually earn a higher return when used for commercial or industrial purposes than for any other uses. This simple ordering of land uses manifests itself in a profile with successively lower rates used for residential, cropland, grazing or forestry purposes (Barlowe, 1986, p.13). The more highly valued and more economically productive uses usually take the better lands for their purposes leaving the lower-priority areas to other uses. Continuing expansion of high-priority lands leads to a discrimination of the economic supply of land available for other users and eventually reduces idle land for undisturbed succession of the environment.

4. Efficient Allocation of Land Resources

So far we have discussed the market forces governing the consumption and use of land. Nevertheless, the basic question still remains; do these laws of supply and demand assure the most efficient allocation of land for society as a whole, that is where the total net present benefits from its alternative uses are maximized? Decisions about land use usually affect individuals in a society in different ways and what is favorable for one person might be a disadvantage for others.

Since it is difficult or unfair to say that the welfare of one person is more important than the welfare of the other, how can we decide which land use option is better for the society? Economists have a specific way of identifying at which point the most "efficient" allocation of resources can be reached. We can think of occasions when it is in fact possible to move to a better state of affairs. We can say that a situation *B* is preferred over situation *A* when

(1) Everyone is better off in *B* than in *A*; or

(2) At least one person is better off in *B* and no one is made worse off by moving from *A* to *B*.

Those who gain by moving from *A* to *B* can, out of their gains, compensate those who lose and still be left with a positive gain.

If any of these conditions are met, either by governmental action or by contractual agreements, we can say that it is possible for society to improve its total net benefits. The potential for society to reach this efficient allocation of land resources depends in large part to its institutional arrangement. Although economic analysis usually assumes that the operators of land have unlimited freedom as to how, when, and what resources to use in their operations, in reality this freedom is restricted by the nature of their rights to use the land. These *property rights* refer to a bundle of entitlements defining the owner's rights, privileges, and limitations in the use of a particular land related resource. Therefore, property rights or ownership is by far the most powerful institutional constraint guiding the operation of land in economic systems. Property rights help to meet the following three requirements for the well

functioning of a market. First all benefits and costs from using the resource should accrue only to one owner. Second, owners should be able to transfer their rights as they wish. And finally, the right enforcement should be in place to make sure the first two conditions are met.

Therefore, the potential for the market system by itself to derive the most efficient allocation of resources given a private property approach is based on these three requirements. In the real world these requirements are not necessarily met in all instances. Particularly the first requirement, exclusivity, is frequently violated in practice. While economic analysis typically assumes that land operators bear all the costs and benefits from their activities, individual action usually affects third parties. For instance, if a developer does not take into consideration the loss of welfare to other people caused by his project an external effect exists. An externality (or a negative externality in this case) exists every time the action of one individual negatively affects the welfare of another, and the latter is given no compensation to account for these losses. Externalities are very frequent in land use situations given the multiple products and costs often associated with uses of land resources. For instance, forests can be used for timber production, recreation, watershed protection, and wilderness, and often it is not possible or to costly to avoid interference amongst these different uses. This has to do with the *public good* character of many environmental goods. The main feature of these goods is its open access, that is, nobody can be excluded as soon as it is provided. Also, public goods are said to be non-rival goods, since one person's consumption of a good does not diminish the use by others. Examples of public goods are sunshine, clean air, open space, and scenic amenities. Most of the goods represent a mixture of public good and private good elements.

By far the most popular approach to deal with externalities is by government intervention. There are many different ways by which the government can exercise its power to influence land use decisions. For example, the government has the power to tax. These taxes can be used for many different purposes such as encouraging land utilization, attain conservation and environmental goals, promote ownership, favor particular types of investment, and others. The government also has the power to purchase land for various reasons; highways, conservation, resource development. In the US approximately 39% of the surface land area is held in public ownership. Also, the government has the power to subsidize certain purposes, such as the promotion of particular land-use practices. But the central instrument of land use control is zoning. The idea of zoning means the division of land into districts having different regulations. Since zoning implies the separation of different uses of land, many of the negative effects resulting from physical interdependencies in production and consumption can be eliminated. Other important land use controls are subdivision controls, which impose restrictions to developers of land; and building and housing codes, which regulate construction, maintenance and use of structures.

A different possibility of dealing with conflicting land use options is negotiation amongst stakeholders. In this process all of the potentially affected groups and individuals of a land development project are invited to discuss the implications, alternatives, and modes of compensation.

Nevertheless, all government intervention modes have something in common. If the transaction costs (that is the costs of intervention, negotiation, collecting information) are high enough to exceed the benefits of intervention, a non-intervention policy might be the best option.

5. Land as a Distinct Factor of Production and Consumption

An analysis of the economics of land use change has to include the unique character of land. This uniqueness arises from its distinct physical or natural and institutional properties.

Land, like any other commodity, is composed of varying degrees of a pure natural resource component and a human-made capital component. The natural resource component consists of the innate conditions: soil, climate, and topography and the capital component results from previous investments in land reclamation, drainage, and soil improvements. But land has also distinct attributes or characteristics, which make it different from other market commodities. Land is physically *immobile*. Some of its resources may be removed and transported, but the geographic location of the site, its latitude and longitude, remains fixed. It is immobility that causes land to be classified as real estate. Because of this immobility, the markets for land tend to be local in character, which means that demand must come to the site, except perhaps in the case of speculation (Dasso *et al*., 1995, p. 8). Land as space is *indestructible*. Physically, land may last forever, but changing conditions may change its value. Another distinct attribute may be referred to as *non-homogeneity*: no two parcels are alike. Differences may arise due to unique locations, size, shape, topography, buildings, infrastructure and other location-specific attributes. Parcels might be part of an 'assemble', of a specific region with certain wind and weather conditions or exposed to positive or negative influences (externalities) from other parcels or its associated land uses. Differences in location cause otherwise similar parcels to have different functions and thus values. A major factor influencing the choice of location is *accessibility*; the relative costs (effort, money, time) to get to and from a property. Other factors influencing location decisions may include direction of prevailing winds and sun orientation, availability of services, infrastructure, and utilities, urban centers, centers of trade and manufacturing. Some of these factors may constantly change due to *interdependence*, which can be defined as mutual interaction of uses, improvements, and values of properties. The development of a bypass route may change the value properties or affect the environmental quality of the parcels close to the road by precluding certain uses, such as recreation or hunting. Thus the use and value of one property is dependent on decisions about the use of other properties. This is of considerable importance also in regard to the *durability of investment*. Drainage, sewage, buildings, and other facilities can not be easily dismantled and shifted to another location of new demand but are rather sunk into the property. Immobility and durability make real estate vulnerable to changing qualities of location, demand or social and political influences (Dasso *et al*., 1995, pp. 8).

These physical properties refer to the *raw land*. But what an owner of land really owns is not raw land but *real estate*. The existence of parcels of land or real estate is wholly a matter of human institutions. Real estate comes into existence and is maintained in its existence as a result of complicated networks of institutional facts, whereas raw land is not.

Institutional factors set the frame influencing (economic) behavior. Contributing to this institutional setting are cultural, economic, political, religious, social, and traditional factors, as well as organizations, representing manifestations of how things are done in a society.

Public regulations, such as community plans, zoning ordinances, rent controls, subdivision regulations, building codes, and laws pertaining to mortgage finance shape the development and use of real property.[4] Less tangible institutions are customs and traditions, which are the way of thinking and acting that is specific to an area or within a certain religion and culture.

Also in an institutional sense real estate resources differ from other resources used by companies or consumers. Real estate is three dimensional, extending above and beyond the land itself. It includes the soil underneath it and the space above the land. Therefore, the owner of a real estate might have the right to prevent his/her neighbor from building a structure on his/her parcel that might create too much shade. This right of ownership is influenced by zoning regulations and other legal restrictions. Another example of the institutional character is the use of the sub-surface. For example, in the U.S., oil resources on ones land belong to the real estate, whereas in many other countries they are owned by the state. These few examples show the great extent to which the value and nature of a real estate property is influenced by governments at all levels. The very existence of property rights in real estate depends on the government. The federal government influences real estate through programs such as depreciation allowances, monetary policies, urban renewal, and transportation programs. On the regional and local level, taxation, zoning regulations, building codes, regional master plans, legislation for sub-division and other policies affect property values.

As real estate resources are different from other resources, real estate markets also differ in many ways from other types of markets (Weimer, 1966). The real estate market is made up by the interaction of people involved in buying and selling, exchanging, using, and improving land. Each market participant is motivated to maximize self-interest, which in a wider sense can be equated to maximizing wealth, protecting purchasing power, hedging against inflation, following sentiments or helping others. The function of any market is the provision of price and value information to participants to allow trade and exchange.

Due to the physical characteristics of land, and the institutional features of the transaction, real estate markets are less efficient than other markets. Immobility and heterogeneity cause competition for real estate to be area-specific. The inability to move real estate in response to changes in supply and demand requires the potential buyer to come to the property to inspect and compare it with other properties. Without easy means of comparing different properties and different locations competition between parcels remains limited and local. Costs of collecting and analyzing data are increased by the fact that transactions tend to be confidential. Buyers and sellers usually meet in private, and their offering and prices are not freely disseminated. In addition to the problem of local markets, we are faced with stratified demand, that is, people generally seek and use real estate for a specific purpose, which is reflected in specialized markets (Dasso, 1995, pp. 10). Generally, we can distinguish between two distinct but interrelated real estate markets: the market for tenant space and the market for investment capital (Fisher, 1992, p. 161). The use decision is made in the space market, whereas the investment decision is made in the market for investment capital. The analysis of

[4] In the Anglo-American tradition, there exist in the common-law two forms of property: real property and personal property. Very roughly, property is termed real when courts must return to the owner whose right has been violated the very same thing which was taken away from him, property is personal when the courts would just give a compensation for the lost thing (Zaibert, 1999, p. 277).

real estate in capital markets focuses on how real estate should be priced based on its risk relative to other assets in the capital market and how much real estate should be held in an optimal investment portfolio. In the space market, on the other hand, the focus is on how demand and supply interact to establish market rental rates. Both groups of decisions finally have an influence on the prices and rents of land and space. In addition, changes in the values of real estate have some impacts on the general economy and vice versa.

6. Driving Forces of Land Use Change

Human activities that make use of various qualities and functions of land, and thus change land use and land cover, are considered proximate sources of change (e.g. Turner *et al*., 1993; OECD, 1996). These actions arise out of a wide variety of social objectives, such as the need for food, housing, recreation, or energy. They cannot be understood independently of the underlying driving forces that set the frame of production and consumption. Driving forces of land-use change have been grouped into a number of broad categories, such as population growth, level of affluence, technology, political economy, political structure, attitudes and values, lifestyles (e.g. Turner *et al*., 1993; Heilig, 1996).

One of the main factors directly and indirectly influencing the demand for land is population growth. The magnitude of this influence, the actual dynamics of the growth in population, and the context in which to analyze it are usually difficult to determine. For instance, Cornucopians and Neo-Malthusian reached opposite conclusions at the global level of aggregation, but agreed on effects on the regional level. For Malthusians, population and production follow different patterns of growth and in the long-run population is destined to outrun growth in the means of subsistence. On the other hand, the core of the anti-Malthusian argument is that there is no reason to think that production will grow at a rate lower than the increase in population. The source for the disagreement is the role of technological change and its impact in the growth of production. Anti-Malthusian arguments relied strongly on the fact that improvements of technology have enough capacity to increase standards of living regardless of the increase in population.

Technology itself can sometimes play an ambiguous role. Many of today's environmental problems are related to the sudden acceleration of technological innovations that began during the industrial revolution and with the enormous input requirements accompanying that development (Headrick, 1990). The quest for economic surplus and profit maximization in a competitive framework has been the major driving force for the outburst of technological development. Improvements in transportation were needed to link the centers of production with the areas providing factor inputs and with increasingly remote customers. New infrastructure such as roads, railroad tracks, irrigation, and associated changes in the quality of location considerably changed the cost structure and the pattern of land use. Technological developments, such as biotechnology and crop and pest management, alter the usefulness and availability of land and might therefore change the demand for a certain area.

Consumer's demand for land will not only depend on their number but also upon their ways of living. Particularly the demand for agricultural land will depend on the diet patters of the population. Some food products require larger areas of land than others. For instance, to provide the food-energy requirements of a moderately active human with beef takes up to 10 times as much land as for the production of apples, wheat, or beans. Therefore, for countries with diets dependent on a higher share of livestock products the per capita demand for land will be a lot higher than for those countries with a higher share of grains. Meat consumption

is a good example of a lifestyle change triggered by higher income. But income plays a role in the demand for land beyond merely the demand for agricultural products. Higher real incomes usually mean higher purchasing power. This increase in purchasing power is usually reflected in increasing demands of nonfood items such as cars, houses, household goods, recreation, and travel. The production of all these products and services is tied to land.

Tourism is another example of how changes in lifestyles can affect land use in many ways. Starting with infrastructure in the home and destination country, to land use associated with tourism related services, sanitation, entertainment, including all the second round effects in additional land use caused by the supporting infrastructure and its labor force. Many of which happen very often in environmentally sensitive areas. Lifestyle changes can also be exemplified by the consumption pattern and land use requirement of the urban population. Some 45 percent of the world population lives in urban areas and this share is increasing. Urbanization has become a major driving force for land-use change. Agricultural and forest sectors are not driven any more by local demand but by production and consumption centers often located in remote areas. Rural areas are becoming the 'hinterland' of industrial agglomerations to fulfill their demand for food, fibers, energy, minerals, and recreation (e.g. Richards, 1990).

The above-mentioned proximate causes of land use change are closely related to economic growth. The relationship between economic growth and environmental quality is often described by an inverted *u*-shaped 'Environmental Kuznets Curve' (EKC). This Kuznets curve relationship is characterized by deteriorating environmental quality in the initial stages of economic development, followed by a turning point, and environmental improvements at later stages of the growth path. Arrow *et al*. (1995) argued that the Kuznets curve for environmental quality does not pertain to global environmental goods such as biodiversity, land use land cover changes. A recent study by James (1999), focusing on agricultural land use, indicates that the developed regions have a declining cropland use without showing a turning point. Developing regions follow a EKC in the aggregate. However, the estimated turning point is so high that the question remains whether the developing countries will reach the turning point in agricultural land use before their reserve of potentially arable land has been fully converted. This study concludes that economic growth and yield improvements may ultimately reduce agricultural land conversion (James, 1999, p. 554).

Environmental change itself affects future land use. Of increasing interest are impacts of climate change, e.g., on land losses due to possible flooding of coastal areas, or other extreme events as well as changes in land productivity.

Finally tightly interwoven with these underlying causes are the political-institutional economy, including the system of exchange, ownership, and control; political structure manifested in governmental institutions and their ways of governance, and attitudes and values of people (Turner *et al*., 1993).

7. The Search for an Interdisciplinary Approach

To understand changes in human land use is no modest task. The difficulties of conceptualization and systematic data collection are formidable (Richards, 1990, p. 165). Our transformation of nature stems from complex interactions of many variables, analytically situated in a variety of disciplines, theories, and concepts. The increasing reductionism of mainstream neoclassical economics is perfectly well suited to describe the establishment of

prices of marketed goods and their interaction with supply and demand. To apply those approaches to other settings than the market can very often be misleading. A premise of neoclassical economics is substitutability between human made and natural capital. Treating land the same way as other commodities or factors of production means neglecting all the other important services provided by land. This view is extended with the discussion of welfare economics and its concepts of private and public goods, externalities, and open access resources. Economists' tool kit in this situation is privatization of public goods and adjustment of prices to reduce negative external effects to a social optimum. The public goods discussion was heavily influenced by the metaphor of the 'tragedy of the commons' (Hardin, 1968). In fact, the only tragedy about the commons is their misinterpretation of it as being subject to no rules and void of any social, moral, or other institutional agreements of how to use common land. Century-old experiences with the management of shared resources might provide useful examples of how to deal with the global commons in the future.

Another approach to deal with the public good problematic is cost-benefit analysis (CBA), which has become increasingly influential in environmental policy-making. Benefits and costs are measured in terms of the individual's willingness-to-pay for a good or to avoid a 'bad' as a quantified basis for rational decision-making. Time factors or long-term effects of human action are included in the discounting of future costs and benefits. The discount rate has the function to account for our myopia or preference for the present and to consider opportunity costs of various investments. Irreversibility of losses is only taken into account as it finds expression in the willingness-to-pay of the people included in market transactions. The implicit assumption is that of commensurability, that is different properties, goods, states of affairs, can be subsumed into a common denominator in order to compare them. This common denominator is money. The attempt in a CBA to rank alternatives along a single scale does not aid to rational decision making but rather poses a hindrance to reasoned discussion of the choices as different appraisals of a site ask for an irreducible plurality of values (O'Neill, 1996, p. 100). These values should not be treated as given and external to economic analysis but should rather be seen as cause as well as a result of market transactions. Humans cannot just be seen as individuals responding only to price signals. Individuals act within a social setting influenced and guided by institutions. Economic analysis of land use change should not solely be occupied with price signals and shadow prices but has to include historical and institutional factors.

Proponents of a widened approach towards land have used two other important concepts to support their arguments: *uncertainty* and *irreversibility*. *Irreversibility* has to do with the fact that once lost, natural resources usually cannot be restored to their previous state. For instance, tropical forest cannot be created, desertified land is very difficult to reclaim, and species lost are gone forever. Modern neo-classical economics argues that *irreversibility* is a problem of investment and time; given sufficient time any land can be reverted back to its original stage. Nevertheless, this has never been completely proven in the real world, which calls into question the veracity of the neo-classical argument on this issue.

On the other hand, the concept of *uncertainty* refers to the fact that most of the time our decisions are based on incomplete information about the consequences of our actions. For instance, research on the role of biodiversity in maintaining essential ecological processes is only beginning to establish conclusive theories about its critical importance and the ways in which, for example, natural forests protect soils, rivers, and microclimate and these areas still need considerable research. Without a comprehensive knowledge about benefits and costs of

substituting human-made capital for natural capital any trade-off between them could result in irreparable damages.

Both issues - irreversibility and uncertainty - seem to suggest a rationale that favors conservation of land resources. This fact is not very well accepted within neo-classical analysis since it means that conservation investments are necessarily too high at the margin. On the other hand, environmental solutions offered by the neo-classical approach, such as taxes, presume a mechanistic, equilibrating world. Yet, irreversibility and disequilibria are facts of life in ecological systems.

In summary we note that economic analysis of land-use change should not only be occupied with price signals and shadow prices but must also include ecological, historical, and institutional factors. However, the solution is not a *theory of everything* but rather to be achieved with an enhanced understanding and consideration of the complexities involved and improved ways of translating disciplinary information between natural and social sciences.

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