
THE IMPORTANCE OF ENERGY AND ENERGY RESOURCES IN ECONOMIC THEORY, WITH SPECIAL EMPHASIS ON RENEWABLE ENERGY SOURCES

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Abstract

During the historical development of economic thought energy is viewed only as an intermediate good. However, driven by problems in practice, economic theory is increasingly turning towards the adoption of energy as one of the key factors of economic prosperity. In classical economic thought energy is involved in economic activity across the country as a key factor of production, while neoclassical economics classify the land as part of the capital, as the country becomes productive only functioning labor and capital. Research interests were directed towards the primary inputs such as capital and labor and the intermediate inputs (energy) data indirect relevance. But the fact is that energy to the continuity and sustainability of overall economic activity, without production generally, would not be possible. It is certain that there must be some driving force that allows the factors of economic prosperity, such as land, labor, capital, organization, technology and knowledge in every economic sector and in every process of economic activities resulting in the growth of domestic product. This driving force is energy, because the production process (and economic growth as well as the final outcome) involves the transformation of matter from one form to another (ie the conversion of inputs ie. Raw material in the final product and that transformation requires energy. According to environmental economics and ecological economics is precisely the most important energy is the primary factor of production. From the above economic attitudes on energy arises goal of this work, and that is determination of significance and the role of energy in terms of economic theory.

Keywords: economic theory, energy, theory of economic development, economic evaluation of energy resources

JEL Classification: B13, E23, Q40

Introduction

From the time of Adam Smith and classical economic thought, land, labor and capital were considered the main factors of production and the main sources of economic growth. Over time, these factors added to the organization as a constituent of the fourth, and recently

added the knowledge or intellectual capital. During the development of economic thought in the whole economic theory, is generally not given direct and explicit the importance of the role of energy as one of the key factors of economic growth. Energy remains present and recognized in economic theory and practice as well as the intermediate, the current models of neoclassical economics; economic growth is attributed to technological progress and knowledge. Classical economic theory has held that the amount of energy available to a particular economy endogenously determined, of course, influenced by the biophysical and economic constraints (Stern, and Cleveland, 2004, p. 5). But, just energy to the continuity and sustainability of overall economic activity not only as a supplement to traditional (neoclassical) production inputs, but so that without it production would not have been possible. According to Alam (2006), each economic activity consists of energy flows that are directed towards the production of goods and services. Putting energy into the focus of economic activity identifies precisely the energy and the use of energy as an important source of economic growth and the indispensable driving force of all economic activities (Stern, and Cleveland, 2004). In other words, the economy should be seen as an energy system which consists of energy flows and conversions of energy resources in certain forms of energy, which culminate in the production of goods and services, and energy as a key source of economic growth, industrialization and urbanization. According to ecological economics is precisely the most important primary energy production factor.

1. Place and significance of energy and energy sources from the standpoint of classical economic thought

Although representatives of classical economic theory emphasizing the key role of the country in economic growth, though not directly recognize energy as a factor of production. Namely, when the classics of economic thought using terms such as "natural fertility" (Adam Smith), "productivity and indestructible power of the soil" (David Ricardo), "natural and inseparable (inherent) power floor" (John McCulloch) or when the earth use the term "wondrous chemical workshop mixed materials and elements" (Jean-Baptiste Say) indirectly nonetheless highlight the fact that energy contributes to economic activity. Similarly, John Stuart Mill argued that the material contains "active energy which cooperates with work or even be used as a substitute for work" (Alam, 2008, p. 5). Also, identifies the different types of energy that contribute to agricultural production (such as: light, heat, wind, gravity) together with the other mentioned implicitly includes the classics of energy in economic activity. This inclusion of energy in the economic system was achieved by recognizing the country as a factor of production.

Classical economic theory divided the economy into two sectors, thereby defining agriculture as the sector with the labor and capital benefits the country as a third factor of production. According to one author (Kljajić, 2010, p. 579), even physiocratic school, which was created as a sharp reaction to mercantilism, were based on the fact that the earth is the only source of all wealth. Agriculture is, however, considered only the most noble, the most natural and most useful economic activity that produces pure product (fran. *Produit net*), ie. surplus value that exceeds the value of the entire work and *troškooa* invested in tillage (Lunacek, 1996, p. 243). Likewise, John Locke argues that the country ie. Nature has "enough for anyone and even too much, more than one who is not protected can spend" but that "he who appropriates land operation does not diminish but increase the common property of mankind, because inventories that serve man as a means of life

produced on hectare processed and cultured countries are ten times greater than those given just one hectare of rich countries standing fallow "(Rifkin, 2002, p. 36-37).

In connection with the rent Ricardo (1983, p. 104) says: "if any land had the same properties when the land would be unlimited in amount and equivalent in quality, would not be able to seek a fee for their usage except when had special advantages by position. Renta, therefore, pays for the use of land only because the land is not unlimited in quantity is not the same kind of quality and because population growth handle land of poorer quality and less favorable position. When, due to the progress of society begins processing second grade land appears immediately rent the land first rate, and the amount of that annuity will depend on the difference in quality between the two lands." Height land rents therefore varies according to the intensity of the treatment, according to the position of land towards the market according to the creditworthiness of land (Lunacek, 1996, p. 290). Thus, classical economic theory assumed that the earth is available in fixed quantities and sometimes variable quality. In the past, the so-called. Organic economies necessary condition for continuous and sustainable growth were abundant yields of the country ie. land. In these economies, virtually all the raw materials used in the production process were either animal or vegetable origin. If they were raw materials of mineral origin then it was necessary to use thermal energy (eg, smelting using wood and / or charcoal) converted into man-worker useful form (Wrigley, 2006, p. 435). Smith (1776, I.9.14) summarized the problem as follows: "In an economy that has acquired the entire wealth of the country and due to climatic conditions and that there are no more potential for progression nor regression, wages and profits are likely to be low." Ricardo (1983, pp.95) is solving the same problem came to a similar conclusion about the limited productive force of the country. According to Wrigley (2010, pp.243), ie increased use of coal. fossil fuels and, consequently, the first industrial revolution was the only exit option from the limitations inherent in all so-called organic economies. Although the energy in classical economic theory implicitly or rather tacitly involved in economic activity (through the country as a key factor of production), neoclassical economics distinguishes nature (earth) and energy sources.

2. The ratio of neoclassical economics to energy and energy resources

Neoclassical economic theory does not even implicitly positions the energy in its macroeconomic framework while economic growth model for which Robert Solow won the Nobel Prize does not include natural capital ie. energy and energy resources. Neoclassical economics land that is set aside. land as a factor of production. The reason for separation is in the classification of land as a capital good due to the fact that the land becomes productive functioning of labor and capital (Alam, 2006, pp.154). The neoclassical economic thought classifies capital (and land as part of the capital) and the work of the primary factors of production, while, for example. fuel, raw materials and intermediate factors considered. Research interest is directed towards the primary factors of production and the intermediate inputs (in this case energy) attributed only indirect relevance. Some models of economic growth that include technological progress as an exogenous factor in trying to explain the role of technological change as a source of economic growth. Since in this model, energy and energy resources are not involved, the assumption of neoclassical growth theory is to be separated from economic growth in demand for energy resources and environmental services. The Solow growth model assumes that the production factors are mutually independent. This means that the change in the amount of one factor independent

of changes in the quantity of other factors which are considered as factors of production (almost) perfect substitutes. In this case, the resources are exploited or degraded service environment can be replaced by equivalent forms of other natural resources or physical capital, such as, for example, workers, machines, factories, etc. or equivalent substitutes can be used as a way to achieve stable and sustainable economic growth in times of scarcity of energy resources Solow model of economic growth once it was extended and as such included inputs ie natural capital. non-renewable and renewable energy.

3. Criticism of the neoclassical growth theory

The neoclassical economic thought is not recognized as a key energy resource production while the Solow model of economic growth defines the economy as a closed system in which goods and services are produced using capital and labor. In such a system, the economic growth achieved by larger amounts and / or higher quality inputs invested or technological progress, and energy inputs have only an indirect role and treated as intermediate goods (Vlahinić-Dizdarević and Žiković , 2011, p. 6). Therefore, the growth is considered the major factor in demand for energy while only advanced economy with a high level of innovation capacity can reduce energy consumption and not slow down economic growth. Also, argue that the neoclassical economic paradigm literature on this point is somewhat limited. While business and financial analysts attach significant attention to the impact of oil prices and other energy on economic activity, neoclassical growth theory marginalizes the role of energy and energy resources. It was a significant increase in oil prices after the first oil crisis initiated a debate on the reasons for a slowdown in productivity and initiated a deeper consideration of the macroeconomic importance of energy resources. Until then largely limited neoclassical consideration of the role of energy and energy resources has become a subject of interest and criticism of various economic schools that do not belong to the so-called mainstream economy.

3.1. Institutional economics

According to North (1994, pp.64), the institution designated formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, self-imposed codes of conduct) and their enforcement. Institutions in the broad sense defined formal and informal "rules of the game" in society, that determine relationships between people (North, 1990, pp.80). In a narrower sense under the institutions are considered only organizational units, procedures and regulatory framework. Economic institutions are important because they affect the efficient allocation of resources, distribution of profits and the right controls. If institutions are defined to encourage those activities that increase productivity and reduce costs, then indirectly through the allocation of resources increase output and stimulate economic growth. Special attention is given to the transaction costs associated with the measurement and enforcement of contracts. Institutional changes and the development of institutions that increase the mobility of capital reduce the cost of information, reduce costs and improve risk-bearing contract enforcement, serves to reduce transaction costs, increase productivity and improve economic performance. Institutional Economics developed at the turn of the 19th and 20th century. New institutional economics has developed around the mid 70-ies of XX century as an alternative to the then prevailing liberal and neo-classical economic thought. That is, in response to market failures neoclassical economic theory.

3.2. Development theory

After the first two oil shocks (1973-in 1974. 1980 and 1981)., The issue of energy resources has become very interesting in economic theory. Development theory and literature dealing

with the development of the administration during the 70s and 80s of the last century focused on the question of the influence of natural resources on economic growth and development. It was observed that the possession of oil, natural gas and other important energy resources does not necessarily lead to rapid economic growth. In the seventeenth century Holland poor in natural resources has surpassed Spain in spite of the influx of gold and silver from the Spanish colonies. In the XIX and XX century, Switzerland and Japan, although certainly more generally, do not have the energy and other natural resources, in economic terms, surpassed the natural resource rich Russia. Some East Asian countries such as South Korea, Taiwan, Singapore and Hong Kong have achieved high rates of GDP growth in the last 40 years, although certainly also more generally, do not have natural resources. This phenomenon is also known as i called natural resource curse.

On the other hand, in parts of Latin America and Africa (eg. Mexico, Nigeria and Venezuela), where natural resources are greater, you need a huge capital investment for their exploitation, and so much funding can be obtained with the sacrifice of a substantial portion of control over natural resources. Models associated with the phenomenon of the curse of natural resources are known as so-called disease models, and are based on the theory of Rybczynskog who came to the conclusion that the increase in the available amount of one factor with unchanged quantities of other and with unchanged technology cause a decline in production is that the product which intensify the use of Production factor which the available volume not changed.

3.3. Ecological economics

Although natural resources (energy) seem to get the importance of the extended neoclassical model of economic growth, it does not satisfy critics of neoclassical growth theory primarily Nicholas Georgescu-Roegen. It was among the first to comment on the lack of energy in economic theory. Georgescu-Roegen (1971, pp.318) noted that neoclassical economists abstracted, natural resources and energy flows in and that at the same time ignore the waste as a byproduct of economic activities. According to the understanding of Georgescu-Roegen, a new area of ecological economics claims that entropy imposes constraints to economic growth. That is, members of ecological economics argue that the so-called. physical dimensions of economic production requires greater attention and explicit in the theory of economic growth because economic systems exchange energy and matter with the environment. The economic system is seen as an open thermodynamic system with particular emphasis on the law of entropy. Ecological economics is a term for the "new" economy imbued with environmental requirements. She looks at the world of nature and society in an extremely different way from conventional economics. It examines the excessive use of materials and thermodynamic basis for economic activity and is focused mainly on the inevitable interaction between people and ecosystems in the broadest sense. Ecological Economics examined the fundamental relationship between the physical and biological systems, problems of ecosystem management in a sustainable way and the impact of social systems on ecosystems. The global economic system depends on four basic biological systems (agricultural land, fisheries, forests and grasslands). According to Rifkin (2002, pp. 323), these four systems not only provide all the food, but also, with the exception of minerals and oil, and all the raw materials for industrial production. This way of looking at the economic system involves the absorption of waste as a by-product of economic activity and preserving climate that facilitates human life. What is most important for ecological economics is to

give nature the laws of thermodynamics in the process of economic activity. In the view of ecological economics, energy is the most important primary factor of production.

3.4. Evolutionary economics

If that is the availability, power consumption promotes economic growth and environmental economics suggests just that, there is an urgent need for the so-called, low carbon energy supply as well as the development and adoption of energy-efficient technologies. Evolutionary economy, under the previously-mentioned institutional economics, one of the areas relevant for the stimulation of non-polluting energy efficient technology. According to the conceptual definition, evolutionary economics focuses on the processes that bring constant changes in the economy, and thus affect all businesses (manufacturing and consumer) and institutions. These processes are the result of the action and interaction of various individuals (natural or legal) that make up the system (and want to maximize profit and survive in the market), and are based on information available to them, their determination, intent and ability to adapt. In simple terms this means that there is no one model can not be permanent.

According to evolutionary economics, economic model, like all other models, is subject to constant changes that are caused by constant innovation, primarily the so-called, radical innovation, because only they have the result of structural changes in the economy. It is a creative change (ie. Creative destruction) responsible for the creation of new technologies, new products and services which then consequently induces a new demand. So there is a certain degree of macroeconomic stability that market actors "destroy" the introduction of new technologies and innovation and thus ejected from the use of outdated technology. That is, the role of technology is to create a state of constant imbalance, and the greater the imbalance greater economic and social incentives to resolve it. These changes come as a natural process, ie. a certain form which promotes the evolution of the system. When a part of evolutionary economics mentioned "various individuals who want to maximize profit and survive in the market" can not be concluded that there is a similarity with the theory of Darwin's theory of biological evolution and the concept of survival of the fittest.

Environmental economics studies economic laws in korišćenju natural resources and protecting the environment. The basic assumption underlying economics of the environment is the recognition that the environment is not an entity that is separate from the economy but all the changes that are happening in the economy affect the environment and vice versa. In other words, the starting point of environmental economics is the concept that the market is not perfect the economic mechanism and effective instrument of resource allocation. Market driven by personal interests of individuals often do not give positive results, but the main reason, if the environment is considered as a measure of social utility, is the difference in what an individual will do so under the influence of a price that determine its production and what the society wanted to do with the standpoint of environmental protection (eg. a factory for the production of polluting the environment, or in the formation of prices of products does not take into account the damage that it causes to society and the environment because the resource does not have to pay, so the damage borne by the whole community). There is also the problem of joint ownership of the limited good. Namely, when a large number of individuals have (un) limited access to a common good, (eg, fossil fuels), each of which is guided solely by the interests of maximizing profits, then in the long run leads to the destruction of the common good, and in the end not used individuals who have caused the destruction of goods guided by its own interests. to mention the problem of public good, which is most pronounced when it comes to protecting

the environment. Privacy p,rotection of the environment is seen as a public environmental management and the environment as a public good, which does not fall into any competitive market and common to all. This means that an investment in a country's environmental protection can not be regarded as another country and does not create any competitive advantage, while the long-term adverse exclude any country from the environmental protection programs. According to Ayres (2009, pp.168), evolutionary economics has created an explicit and measurable macroeconomic model by which could be explained by economic growth in the past or have a more realistic projections of economic activity in the future. Such a complex undertaking would require economists knowledge of history, psychology, sociology, biology and physics. In conclusion, the economy of the environment by using economic instruments such as environmental taxes, permits for emissions trading, subsidies for environmental protection and ecological security seeks to confront and cutoffs with the above problems and to establish a permanent balance between economic growth and environmental quality.

4. Endogenous growth theory and energy

Endogenous growth models explain the reasons of technological progress by means of elections and economic decisions made by individuals and companies. An important implication of endogenous growth theory is related to the role of economic policy measures such as subsidies for research and development and investment in education. As for the technology in the energy sector, there is no perfect technology that could be the answer to the energy crisis. In fact, all conventional technologies that create greenhouse gases do not pay for the damage consisting of environment and climate. Therefore, it emphasizes the importance of correcting this situation of energy policy measures such as. Ecological taxes, limit emissions, incentives for use of renewable energy sources. According Vlahinić-Dizdarevic and Žiković (2011, pp. 9), even the endogenous growth theory failed to take into account the fact that endogenous technological change aimed at rational energy use and improve energy efficiency necessary for long-term economic growth.

Conclusion

Following the history of development of economic theory at the level of classical and neoclassical economic doctrine, especially the part that relates to economic growth, more precisely the role of energy in economic growth and development, we can perform a simple conclusion. Although the energy in classical economic theory implicitly (or rather tacit) involved in economic activity, neoclassical economic theory can completely ignore the energy, that distinguishes the nature (earth) and its energy sources that are implicitly included classics. Neoclassical economic theory does not even implicitly puts energy into their macroeconomic framework. Therefore, the role of energy is historical, theoretical and watching the models of economic growth is underestimated in economic theory. Even so understated that it is not the basic model of economic growth for which the Solow won the Nobel Prize does not include energy and so-called energy resources. Although this model was subsequently extended to non-renewable and renewable resources, as such, had its application in standard macroeconomics. Due to the country's isolation from the macroeconomic framework, neoclassical economics has broken any connection between economy and nature (natural resources), which led to the inevitable criticism from different economic schools (eg, institutional economics, development theory, evolutionary economics), primarily from by members of the so-called. Ecological Economics. With

formal paying attention to energy resources and their impact on economic growth and endogenous growth theory distanced itself in relation to the standard neoclassical theory of growth. Energy is one of the important, if not the most important cornerstone of the functioning of society and human life that ějednu economy. Many authors emphasize the fact that we are in the space of just two centuries of life passed from rural to industrial society, from hoes to computers, from hand labor to machine labor, and all this thanks to the energy. Produce, transmit, accumulate and innovate energy is an imperative of which depends on the growth or decline of society and the economy more generally. All social and ultimately economic activity associated with a dense network of energy that connects all production and service activities. When such a network would not exist, everything around us would collapse or would not have existed. In the modern world, the efficient provision of energy and its availability has a large and vital city and is the basis of the entire economic activity among countries around the world through innovation and technological progress. For good energy management tends to be a fuel consumption of equal benefits. Otherwise, the residual energy development becomes a limiting factor for economic growth because of energy shortages causing major disruption and significant production losses. According to the importance, power is put in the same category of essential activities such as production of food and raw materials provide the necessary amount of water. The lag in these forms of production limits the overall economic growth and development of a country. Thus, the problems of energy development can be seen and studied outside the context of the overall development of socio-economic system of a country, or even outside the context of the development of international political and economic relations. Given the indisputable theoretical and practical importance of energy can be concluded that it is a factor that is an important foundation for economic growth and development. The impact energy is omnipresent, and the economic, political, social but even psychological, and ethical consequences are mutually intertwined, not only because it improves the productivity of labor, capital, technology and other production factors, but also due to the fact that increased consumption affects economic growth.

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