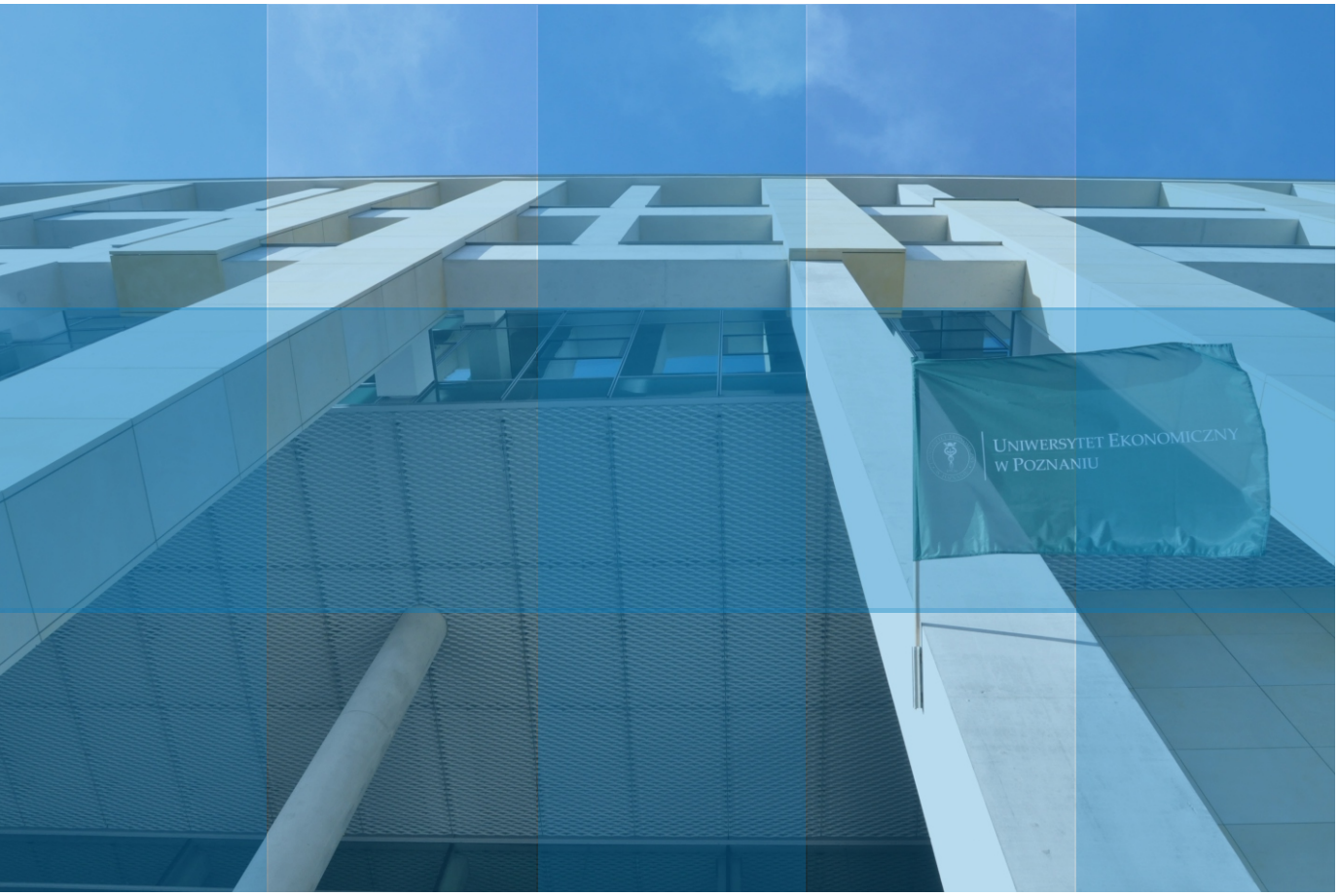
Research Papers in Economics and Finance

Vol. 2, No 1

ISSN 2543-6430



Poznań University of Economics and Business

Faculty of Economics Publishing

Faculty of Economics
Poznań University of Economics and Business
Aleja Niepodległości 10, 61-875 Poznań, Poland

Published Scholarly Papers

RESEARCH PAPERS IN ECONOMICS AND FINANCE

ISSN 2543-6430

Vol. 2, No 1

doi: 10.18559/ref.2017.2

2017

Research Papers in Economics and Finance
ISSN 2543-6430
Publisher: Faculty of Economics, Poznań University of Economics and Business
Aleja Niepodległości 10, 61-875 Poznań, Poland
Email: ref@ue.poznan.pl
www.ref.ue.poznan.pl

Research Papers in Economics and Finance

RESEARCH PAPERS IN ECONOMICS AND FINANCE

ISSN 2543-6430

Vol. 2, No 1, 2017

CONTENTS

Preface 5

The economic and environmental productivity of agriculture in the process of development
Jakub Staniszewski 7

Income inequality in Israel between 2003 and 2014
Beny Tzarfati 19

Ukrainian perspectives of using world experience in investing energy innovations
Dmitry Lazarenko, Iaroslav Krutogorskyi 27

RESEARCH PAPERS
IN ECONOMICS AND FINANCE

JOURNAL HOMEPAGE: www.ref.ue.poznan.pl

doi: 10.18559/ref.2017.1.0

PREFACE

Dear Readers,

We have the pleasure of presenting to you the next issue of our research journal entitled "Research Papers in Economics and Finance" (REF), published by the Faculty of Economics at Poznań University of Economics and Business. Caring about the highest level of the content of our publications, we publish only the manuscripts which have received two reviews under the "peer review" procedure, after initial verification done by the Editorial Committee. The articles published within REF are available online in English, in an open mode.

REF is a quarterly journal, with the third issue containing three research articles. Two of the articles focus on the economic aspects of development, one of which discusses the relationship between agricultural productivity growth and economic development, and the other describes the relationship between income inequality and economic growth. The final article presents the world economic trends of alternative energy. Let us bring you closer to the outcomes of the works presented in volume 3.

The article entitled *The economic and environmental productivity of agriculture in the process of development* by **J. Staniszewski** reviews the economic theories which describe the relationship between agricultural productivity growth and economic development. The review proves that improvements in the productivity of agriculture is both a precondition for economic development and its catalyst. The article also describes a negative impact of agriculture industrialization on the environment. The present process of extending the traditionally understood economic sense of productivity to ecological aspects is also explained. Finally, calculation of environmental productivity is presented as a still unsolved problem.

The article entitled *Income inequality in Israel between 2003 and 2014* by **B. Tzarfati** aims to describe the distribution of income in Israel and provide solutions for a more equal distribution of income. The author also discusses the impact of income inequality on economic growth. Empirical studies show the fact that the increase in inequality measured by the share of the highest income is positively related to the economic growth. While in the case of the overall dispersion of income (measured by the Gini coefficient), the results of empirical studies are inconclusive.

The article entitled *Ukrainian perspectives of using world experience in investing in energy innovations* by **D. Lazarenko** and **I. Krutogorskyi** presents the world economic trends of alternative energy. An analysis of international programs and innovative projects that are implemented and used in the energy sector is introduced. Conceptual proposals and innovative research in the field of alternative energy are represented. The authors also suggest ways of formation of effective energy management and rational energy policy.

This issue of Research Papers would not have come to fruition if it had not been for the help, work, trust and support of the Reviewers, Authors, the members of the Editorial Committee and others who have been engaged in editing and publishing. Let this issue of our journal become an enjoyable reading as well as an inspiration for scientific research and discovery in the field of contemporary finance and economics.

Yours faithfully,

dr hab. Edyta Małecka-Ziembińska, prof. nadzw. UEP
– Member of the Editorial Committee

doi: 10.18559/ref.2017.1.1

RESEARCH PAPERS
IN ECONOMICS AND FINANCE

JOURNAL HOMEPAGE: www.ref.ue.poznan.pl

The economic and environmental productivity of agriculture in the process of development

Jakub Staniszewski[1]

[1]Poznań University of Economics and Business, Poland

ABSTRACT

The paper reviews the economic theories that describe the relationship between agricultural productivity growth and economic development. Historical examples of such relationships are also presented. The review proves that improvements in the productivity of agriculture is a precondition for economic development and its catalyst. The article also describes a negative impact of agriculture industrialization on the environment. The present process of extending the traditionally understood economic sense of productivity to ecological aspects is also explained. Furthermore, the author presents how increase in environmental productivity of agriculture can be a catalyst for development, analogous to the past increases in economical productivity. Calculation of environmental productivity has been presented as a still unsolved problem. A short review of methods and metrics used as so far gives general idea about the future area of compromise in that field.

Keywords: development, agriculture, environmental productivity, eco-efficiency.

1. Introduction

In economics the category of productivity is of fundamental importance. This science essentially deals with the problem of managing scarce resources and optimizing their use for the production of goods and services [Czarny and Rapacki 2004, pp. 21-22]. Optimizing „applies to all activities aimed at finding the best solutions, that is, optimal under given conditions, with established assumptions and criteria" [Dowgiałło 2004, p. 256]. By defining productivity as „a measure of the effect achieved on each factor of production" [Woś 1984, p. 579], we can consider it as a basic criterion for optimization. Although the use of productivity to assess the degree of optimization of manufacturing processes is more prevalent in enterprise research (so on a micro scale[1]), references to this category are frequent also in the macroeconomic studies. Assuming that the factor involved in the production process is a human factor, represented to some extent by the number of inhabitants of a given country, and the effect of this process is GDP, GDP per capita indicator can be identified as a national labor productivity index. Of course, the above assumptions, both on the side of the inputs and outputs included in the model, are very easy to undermine, but it only proves the imperfection of this commonly used index. It does not question in any way treating it as an indicator of productivity. The basic determinant here is the combination of two categories - inputs and outputs. By pointing out three basic resources – labor, tools (capital) and natural resources (land) and comparing them to the size of the final social product (GDP), we can identify input-output relationships, which together express the overall economic efficiency [Pajestka 1981, p. 38]. This procedure can also be applied to individual sectors of the economy (mesoeconomic scale). This paper addresses the issue of agricultural sector productivity, considering it as a specific sector of the economy that is fundamental to its development. The purpose of the undertaken review is to identify the role that agriculture productivity increase has played over the centuries in the overall economic progress and signaling the expected change in the shape of these relationships in the future. This subject is already well recognized. A Survey of Agricultural Economics Literature Vol. 4 [Martin 1991], which covers the topic of Agriculture

[1] In recent years, a number of publications related to the issue of resource productivity in the context of agricultural holdings can be cited in Polish literature. This subject has been taken by Smędzik and Stępień [2011], Czekaj [2008], Kulawik [2008].

in Economic Development, is followed by 200 pages of references related to that topic. Knowing that the survey refers only to less developed countries, deals with the post-World War II period and lists only works in English, French, Spanish, and Portuguese published before 1990, we can see how large the total scope of the literature in the given subject may be. Thus, it might be considered supercilious to claim that the presented review is comprehensive in the matter. It stays in line with a similar paper considering the role of agriculture in development [Timmer 2002, Dethier and Effenberger 2012]. However, it widens the category of agriculture productivity to the environmental dimension. The examples of the interconnections between growth in agriculture and overall economy from the history are used as an analogy to changes taking place nowadays. The article consists of an introduction, three subsections and a summary. The first subsection presents some examples from the history when agriculture productivity influenced overall economic productivity. The second subsection synthesizes the most important views on the role of agriculture in the economy in the economic thought. The third subsection presents a contemporary approach to the role of agriculture in the economy and the new dimension of productivity associated with it.

2. Agriculture supporting economic development – examples from the history

The basic role of agriculture in economic development is reduced from the dawn of history to the creation of appropriate „starting" conditions for further development, which results from a permanent compulsion of food consumption. The need to satisfy hunger is among the basic needs of man. When people are hungry, all activity and desire to meet other needs is abandoned [Maslow 1943]. This psychological presupposition can be transferred to economics, as evidenced by the economic history of the world. Already during the Neolithic Revolution, the transition to sedentary lifestyles and the replacement of harvest and hunting by cultivation and rearing resulted in an increase in food production, which gave incentive for population growth and specialization in activities not connected with ensuring survival [Ziółkowski 2009, p. 31]. It is precisely the phenomenon of the release of resources from agriculture, thanks to the increase in its productivity. Throughout the ages, this process has been gradually progressing through technical and organizational improvements.

In the times of the Roman Empire, the concentration of land within large farms (so called latifundium), which was necessary for feeding the growing population, contributed to the increase in agricultural production, but also caused a number of negative changes in the social sphere. Due to the demand for labor in growing farms, the phenomenon of slavery and the colonate was widespread, which in turn led people directly involved in land cultivation to be underprivileged and was one of the first premises of the "agrarian issue" [Czyżewski, Matuszczak 2011, p. 7]. In this context it is worth to take a closer look at the colonate system. It was based on renting land from landowners, by free peasants, in return for rent in kind and money. However, often in the inability to settle the obligations, the peasants fell into debt, which over time caused them to lose their freedom and become subjected to landowners. The development of this system combined with the rise of the importance of large land properties is considered one of the causes of the fall of the Roman Empire [Zientara 2006, pp. 9-12]. Thus, in the ancient times, the importance of agriculture in the social sphere emerged, the balance of which is also a condition of economic development.

The colonate system, common in the late years of the Roman Empire, was also the foundations of the feudal system of the Middle Ages. In a situation of money economy disappearance, land has become the basic form of wealth possession and accumulation. And peasants cultivating the land were permanently bound to it. Also characteristic of the Middle Ages was the organization of villages in the form of territorial communities. Within these communities, the peasants were farming on the land they owned and on common land, which most often included pastures, forests and water. For the possibility of land using, peasants paid to the landlord feudal land tenure. Such an organization caused inefficiencies. It contributed to the over-exploitation of common land (see "the tragedy of the commons" [Hardin 2008]), maintained a fragmented agrarian structure and was not conducive to innovation.

This ineffectiveness was ended by the enclosure process, which began in England in the 15th century. At that time, due to the rising prices of wool, the richest landlords began to strip off common areas and allocate them to private pastures. Their growing incomes also enabled them to take over land from small peasants. Combined with the more advanced cropping techniques that improved labor productivity, it was possible to meet the food demand of the growing population with reduced employment in agriculture. This process has obviously been unevenly spread across Europe and the world,

nevertheless, agriculture once again emerged as a sort of „reservoir" for the production capacity of the economy and an „initiator" of economic change. The agrarian revolution that has been taking place in Europe in the sixteenth, seventeenth and eighteenth centuries is therefore cited as the cause of the industrial revolution [Overton 1996, p. 206]. Rapidly developing industry has created the job opportunity for people no longer employed in agriculture.

Kula [1983, pp. 33-34], however, negates the assumption that agriculture, and in particular small farms, were merely an „unlimited source of labor supply" in the growth mechanisms of that period. He points out that „just as they [farms] are unburdened from unnecessary workers ballast - they increase their degree of commercialization and accumulation, they begin to invest and thus increase productivity, they are starting to be the market for industry, and therefore for the commercialized sector". Nevertheless, it must be borne in mind that while agricultural productivity has been stimulated by improvements in manufacturing structures and technical progress, its dynamics was significantly different from the overall dynamics of the economic growth. The research by Allen [2000] shows that even in countries with the highest growth in agricultural productivity in the period 1500-1800 - England and the Netherlands, the growth was 43% and 36%, respectively, while the GDP growth per capita in the corresponding period (1500-1820) increased by 139% and 142%, respectively [Maddison 2005, p. 25]. At the same time, the importance of agriculture in the economy declined. Initially for trade. In the longer term for the developing industry. However, it does not mean that the history of agriculture development ends in the 18th century. Actually the years 1800-2000 is the period of the most spectacular growth in agriculture. Federico [2005, pp. 221-222] sums up this period in the form of 15 stylized facts. These facts can be systematized in the four main domains (table 1).

Table 1: Fifteen stylized facts about agriculture in the 19th and 20th century

Agriculture productivity
- Output has increased in the long run, enough to provide more food per capita to a population six times greater than that of 1800.
- The growth in Total Factor Productivity accelerated throughout the period, achieving very high rates in the OECD countries after World War II.
- Agricultural production grew thanks mainly to the increase in inputs ("extensive" growth) in the nineteenth century and to TFP growth ("intensive" growth) in the twentieth century
Markets
- A relative price of agricultural products rose until the 1850s and remained constant or declined slightly (depending on time series) from then on.
- Markets for factors and goods were quite developed even in traditional agrarian societies and they developed further, well in advance of modern economic growth.
Agriculture production organization
- The quantity of all factors grew quite fast until the early twentieth century; after (about) 1950, the growth of capital continued unabated, while that of land and labor slowed down.
- Agriculture has always been a very competitive sector, because economies of scale are modest, and large farms are plagued by serious incentive problems.
- "Traditional" property rights on land, which still prevailed throughout the world in 1800, have gradually been substituted by "modern" ownership, but the process is not yet over.
- Most states implemented land and tenancy reforms in the twentieth century, with mixed results.
- "Family farms" were already fairly diffused in the nineteenth century, and their share substantially increased in the twentieth century.
- The average size of farms fell in the LDCs throughout the whole period, while, in the "advanced" countries, it remained constant until about 1950, and it has increased fast since then
- Collective socialist agriculture proved to be very inefficient, and the process of collectivization wrought havoc in agriculture, causing great suffering.
Agricultural policy
- Public investment in R&D and extension have played a major role in fostering technical progress.
- The 1930s marked a watershed in agricultural policies, from a period of almost perfect "benign neglect" to an era of massive intervention
- After 1950, agricultural policies in the "advanced" countries favored agriculture, at the expense of consumers, while in the LDCs, they sacrificed agriculture for the mirage of fast industrial growth.

Source: own elaboration based on: [Federico 2005, pp. 221-222].

The impact of most of these changes can be summed up in 3 channels: (1) product role – providing goods to feed the population and to earn foreign currency; (2) market role – purchasing manufactures, both for consumption and for investment; (3) factor role – supplying manpower and capital to industry and services [Federico 2005, p. 223]. Also in the 19th and 20th centuries this impact was researched intensively by the science of economics.

3. Links between agriculture and the economic development – examples from the economics theory

Among the early schools of economic thought, most attention to agriculture was given by the French physiocrats, organized around Francois Quesnay. By examining the flows of resources and products between different sectors of the economy (input-output model), physiocrats concluded that the source of wealth lies in agriculture, as only the land is capable of producing natural added value (the amount of production which outweighs the costs incurred). At the same time the physiocrats called the rest of the economy „barren". However, the analysis based on physical measures, not on the units of values expressed in money, and the description of reality from the French perspective (lack of industrial activity on a large scale) has determined the lack of popularization of this school outside France [Landreth, Colander 2005, pp. 71-76].

In the later reflections of economists dominated the view that agriculture was a barrier to economic growth. Firstly, Thomas Malthus paid attention to the problem of farming lagging behind the other sectors of the economy and the negative impact of this situation on the economic development process. Assuming that the world population is growing geometrically and food production only arithmetically, he concluded that in the long run this is the cause of poverty [Landreth, Colander 2005, p. 122]. However, history has shown that Malthus made a significant mistake by not considering technological progress in his deliberations. Another economist, who referred to the specifics of agriculture was David Ricardo, who developed the theory of land rent. His idea was that land rent exists due to the scarcity of land and the diminishing returns, and their value is determined by market prices. When the emergence of rent results from relatively higher fertility of the certain land and is not in any way owed to the owner, it seems natural to postulate their taxation to minimize market inefficiency [Landreth, Colander 2005, pp. 131-137].

What is also worth mentioning here are the views represented in the topic of agriculture by John Stuart Mill [1920]. In opposition to Malthus and Ricardo, he envisaged that the diminishing returns for agricultural production could be overcome through the advancement of agricultural knowledge, and the cost of buying food reduced by decreasing transport costs. In addition, he noted that if non-agricultural sectors increase productivity faster than the rate of increase of agricultural products prices, the decline in the cost of purchasing non-agricultural products will compensate for the increase in agricultural commodity prices, and overall welfare may even improve. However, the progressive industrialization of the economy pushed the agricultural sector into the margin of the economics mainstream. In more and more formalized science, it became typical to assume land factor to be constant, considering only the changes in the capital and labor resources, as decisive for economic growth. At the same time, the share of agriculture in the GDP creation decreased significantly, while the progressive mechanization of production processes and the use of fertilizers and new varieties of crop plants allowed to meet the food needs of the growing population in developed countries.

Unfortunately, there was still no significant improvement in the living conditions of the rural population, which drew the attention of socialists. Rosa Luxemburg [1913], explaining the theory of capital accumulation, pointed that the non-capitalist participants of the system are crucial to its survival. These were largely peasants in capitalist countries and colonies. Kautsky [1911] saw the sources of the crisis of capitalism precisely at different rates of productivity growth in agriculture and industry. In his opinion, a situation in which the agriculture sector, not only a consumer of industrial goods but also a food supplier, is failing to keep up with industry development must lead to crises. Krzywicki [1967] explains this problem in the context of agrarian structure: "The issue of large and small farms cultivation is not just a matter of higher or lower economic efficiency; Their contradiction lies in the difference between a large farm, which allows all powers of centralization and knowledge to be used, but by using the hired labor force, it does not have a spiritual incentive among the workers […] and a small self-contained farm that can be run very routinely, but it has a caring and attentive job, which in agriculture means a lot. Both large and small farms harm economic development: large because of the impossibility of applying diligent and caring work, small - because of lack of knowledge and technical progress".

At the beginning of the 20th century Swedish agrarians[2] represented views similar to the socialists on the issues of agricultural development, however, they drew conclusions from the research on price changes. They observed that under conditions of dynamic economic growth, prices of industrial goods grew faster than agricultural commodities, resulting in the "price gap" widening and the deterioration of the material situation of farmers [Deszczyński 2013, p. 12]. In that period also Alfred Marshall [1936] took part in the discussion, stating rather positively, that even in the face of the constraints associated with the law of diminishing returns in agriculture, both population and well-being can be increased, mainly through the supply of new types of goods, communication costs decrease, improved organization and better knowledge.

The question of the role of agriculture in economic development returned in the 1950s and 1960s. At that time a number of new countries emerged on the wave of decolonization, significantly different in the levels of development from the industrialized part of the world. These events also gave origin to a new branch of economics - the development economics. The goal was to introduce these countries into the path of stable economic growth, taking into account their specificity, which in most cases included agriculture as a sector with a main role in GDP creation. Walt Rostow's work is particularly important here [1960]. He distinguished five stages of development: (1) traditional society; (2) preconditions for take-off; (3) take-off; (4) drive to maturity; (5) age of high mass consumption. The distinctive feature of these phases, among others, was the level of domination of the country's production by agriculture and the level of basic needs satisfaction. In addition, Rostow [1960, p. 8] pointed out that „revolutionary changes in agricultural productivity are essential for a successful start-up phase".

Development economics re-introduced agriculture into the circle of interest of a broader group of economists. Numerous studies on the role of agriculture and its productivity in economic development can be identified. At the outset, it is worth mentioning Jorgenson's work [1961], which points to fundamental differences between the theory valid for developed economies and the theory actual in the situation of less developed countries. While the former focuses on the balance between investments and savings, the latter places special emphasis on the balance between capital accumulation and population growth. The author, as an element that bonds both theories, introduces the notion of a dual economy in which the developed industrial production sector and backward agriculture coexist. The economy operates under the asymmetry of productivity of both spheres, which results from insufficient number of technical devices in agriculture. In this model, growth depends on permanent surpluses generated in agriculture[3]. If they exist, part of the population employed in the agricultural sector can be relocated to the industrial sector. In addition, to begin industrial production, certain initial capital stock is required. When these conditions are met, further growth of the modern sector depends on the price gap of agricultural and industrial products and the rates of savings and investment in the modern sector.

In the alternative model of Clark [1951], the increase in agricultural productivity was associated with income elasticity of the demand for food products, which is less than unity and declining along with the increase in real incomes per capita. Increasing productivity in agriculture enables the transfer of labor from agriculture to the rest of the economy, where productivity also rises, in a situation of balance of demand and supply of agricultural products, with constant or even decreasing real prices. The relocation of labor resources is a response to differences in wages in all sectors.

A wider approach to the role of agriculture and its productivity in economic growth processes is pointed out by Johnston and Mellor [1961, pp. 571-572]. They distinguish five channels of influence: (1) economic development is accompanied by an increase in demand for agricultural products, which unmet can limit further growth; (2) the export of agricultural commodities may contribute to the growth of

[2] At the beginning of the 20th century a philosophical movement of agrarianism became popular. Among the main assumptions of this school can be mentioned: (a) agriculture as the only profession that offers total independence and self-sufficiency; (b) the rural population, with its community of work, is a model community; (c) farmers, thanks to their attachment to traditional values such as family, religion, culture or place of origin, have a strong and stable position in a dynamically changing world [Inge 1969].

[3] With the reduction of the role of agriculture only to the production of surpluses that may be transferred outside the sector. Ruttan [1972, p. 594] points out that in some economies agriculture acts as a reservoir of labor and in others the rate of return on investment in agriculture can be high enough to attract savings from other sectors, which is particularly evident in open economies where investments in technological advances contribute to increasing agricultural productivity and reducing raw material costs for the processing industry.

income and the acquisition of foreign currency, especially at the early stages of development[4]; (3) human resources employed in developing industries and other sectors come mainly from agriculture; (4) agriculture, as a leading sector in less developed countries, is a source of capital necessary for the development of industry; (5) the growing income of the rural population contributes to the development of industry. Corresponding functions of the increasing productivity of agriculture in the process of economic development are distinguished by Mackie [1964, p. 2]: (1) raising the level of food and fiber production above the necessary minimum, as well as minimizing costs and facilitating the development of the non-agricultural sector; (2) stimulating the development of the food processing industry and the means of production for agriculture industry; (3) the release of labor resources that can be used in other sectors of the economy; (4) providing capital for the developing industry and financing state services through taxes; (5) providing opportunities for higher wages for a part of society by increasing production and specialization.

4. A new dimension of agricultural productivity

In the model of economic development outlined above, the increase in agricultural productivity is the primary source of economic development. But what is the role of agriculture in countries that have already developed, and using Rostov's terminology, are at the "age of high mass consumption"? By assessing the importance of agriculture in the richest countries in the world only through the sector's contribution to GDP, it could be considered as marginal and decreasing. According to UN [2016] data, between 1970 and 2014 the share of agriculture, hunting, forestry and fisheries in GDP fell in Australia from 5.93% to 2.29%, in Canada from 4% to 1.6%, in France from 6.96% to 1.5%, in Germany from 2.94% to 0.61%, in the United Kingdom from 2.16% to 0.61%, and in the USA from 2.34% to 1.24%. Of the 176 countries for which the United Nations has data[5], this share has fallen, on average, from 20.1% to 11.1%. In addition, from a sector that is a source of capital and tax revenue, agriculture became a recipient of public transfers. This phenomenon is called „the development paradox in agricultural policy" [Poczta-Wajda 2009, p. 204]. According to World Bank data [2016] in 2011 agriculture support[6] was highest in countries like Japan (80%), Norway (78%), South Korea (74%), Iceland (58%) and Switzerland (53%). The smallest, among others, in Uganda (-20%), Bulgaria (0.4%) and Romania (2%). But the key question is how the developed countries managed to increase the productivity of agriculture. It was done mainly through industrialization of agriculture. This process is well described by Czyżewski and Henisz-Matuszczak [2005]. In the first phase of implementation of the industrial model, significant expenditure is spent on intermediate consumption and on redeploying land and labor resources released from agriculture. In the next step, it is necessary to use price regulations that compensate for the increase in intermediate consumption costs. These in turn imply the need for trade policy for defense of domestic, non-competitive production, against cheaper, imported commodities. In the long run, the costs of this policy (through differences in domestic and world prices) are transferred from taxpayers to consumers. At the same time, the industrial paradigm encourages increased production, which, in the face of inelastic demand for food, leads to surpluses, which must be handled by the government. In addition, because of the diminishing returns law, in each successive production cycle, the increase in intensification, concentration and mechanization of crops, causes less increase in yields. Thus, the efficiency of the industrial model is undermined both on the demand and the supply side, which ultimately determines its failure to maintain the farmer's income parity.

Unfortunately, the way of increasing the productivity of agriculture described above has negative consequences not only in the economic sphere. This is well illustrated by the example of „green revolution". It is based on the introduction of high-yielding varieties of wheat and rice, the increase in fertilizer consumption and the modernization of irrigation systems [Rozłucki 1979, p. 19]. As a result of these activities,

[4] Prebblech's [1959] study on terms of trade in agricultural products shows that the situation of countries basing on this type of production is deteriorating in the long term, which is related to the differences in the income elasticity of demand for agricultural and industrial products. Thus, the long-term effectiveness of a development strategy based on increasing agricultural productivity and exporting the food surpluses is questioned.

[5] The dataset does not include the countries that changed their political status at that time, among others countries of the former Soviet Union and Yugoslavia.

[6] The Nominal Rate of Assistance (NRA) was used to measure the level of total agricultural support. It specifies how much gross farmer income is higher (or lower in the case of taxation) than would be, if there was no support from the state [Anderson et al. 2008].

which required substantial capital expenditure, the productivity of the land was increased in the areas covered by the program, especially in India. Thanks to the actions taken, the Punjab and Haryana states, which were the main experimental plots of new cultivation methods, significantly higher yields have been achieved. In the years 1962-1974 wheat yields increased in those states by 84% and 44%[7], respectively [Rozłucki 1979, p. 61]. Although changes made in subsequent years have allowed food security to be achieved, there is great concern about the impact of the new cropping system on the environment. In particular, the negative impact of new agrotechnics on the quality of soils and the excessive use of groundwater are highlighted [Singh 2000, p. 102]. In Europe, a model of agriculture based on intensive fertilization, mechanization and concentration has led to deterioration in the quality of the environment manifested mainly by: (1) the reduction in the diversity of rural landscapes; (2) the reduction of rural biodiversity; (3) land abandonment in peripheral areas; (4) soil erosion; (5) eutrophication of waters; (6) excess greenhouse gas emissions [Stoate et al. 2009].

The recognition of the significant negative impact of industrialization on the environment coincided with the formulation of the concept of sustainable development, in the context of agriculture and the economy as a whole. The evolution of the concept is well described by Paszkowski [2001, pp. 47-48]. Although the birth date of the paradigm of sustainable development is most often set in 1987, when the Brundtland Report was published, this term has been in use before, as evidenced by the conference organized under the theme „Towards Sustainable Agriculture" in 1977 in Swiss Sissach. However, it was the Brundtland Report that was a „milestone" for shaping this concept in its modern meaning. What began in 1987 was eventually confirmed by the Earth Summit, taking place in June 1992 in Rio de Janeiro. At that time, a program called Agenda 21 was agreed, under which, in Chapter 14, the proposal for the implementation of the Sustainable Development and Rural Development[8] (SARD) principle was articulated.

According to Czyżewski [2012, p. 166] „at a certain stage of economic development of the country, the functions of the agricultural sector extend beyond the role of a supplier of agricultural raw materials". On the one hand, achieving food security reveals higher needs such as the need of keeping ecosystems in an unspoiled form and the need of consuming higher quality agricultural products [Czyżewski, Kułyk 2011, p. 18]. On the other hand, in the face of the agriculture development model basing on the exploitation of environmental resources, they become more and more scarce, which increases their relative value, in comparison to the resources traditionally treated as inputs in agriculture (especially capital). An example of the process of a shift between traditional and modern perception of agriculture can be seen in the evolution of the functions of common agriculture policy (CAP) in the EU. We can read in Article 39 of the Treaty of Rome [1957] that the objectives of this policy are: "(a) to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour; (b) thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture; (c) to stabilise markets; (d) to assure the availability of supplies; (e) to ensure that supplies reach consumers at reasonable prices". Article 11 of the Treaty of Lisbon [Consolidated version… 2016] added to the above list a rule that: "Environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development". Thus, with time agriculture evolved from a food provider to a multifunctional sector which serves economic (food production, positive externalities for real estate and tourism markets), social (rural viability, health improvement) and environmental (con-

[7] These achievements cannot be perceived completely uncritically. Firstly, doubts are aroused by the spatial limitation of program implementation to the most developed states. Because of that, its overall results have not been so significant and have contributed to deepening economic inequalities between states. The emphasis on the technical aspect of change also resulted in the postponement of socio-institutional reforms [Rozłucki 1979, pp. 83-87]. The importance of the impact of the „green revolution" on the reduction of poverty is also questioned. Das [2002, p. 70] indicates that development was occurring in all Indian provinces, regardless of the implementation of modern crop technologies.

[8] Since the introduction, the concept of sustainable agriculture has been defined in many ways. Woś [1992] points to the term's ambiguity and reviews it definitions, finding their common features. The most often sustainable agriculture definitions refer to: (1) the use of natural resources in a way that enables them to renew themselves; (2) an increase in agricultural production that is achieved only by increasing the productivity of the resource rather than by consuming it; (3) low susceptibility of sustainable agriculture to fluctuations and shocks; (4) symbiosis of agricultural and ecoregional objectives.

serving agri-ecological and agri-environmental systems) development [Van Huylenbroeck et al. 2007]. So it is clear that agriculture can contribute nowadays to economic development by improving its productivity on many fields. In CAP agricultural sector is even, to some extent, remunerated for providing these services. Farmers have to follow cross-compliance rules on environmentally friendly ways of production to be eligible for direct payment support and fulfil additional requirements to obtain the "green" part of the payment [European Commission 2013].

While the environment has become an essential part of modern development agenda, the use of natural resources should also be taken into account when calculating agricultural productivity. So a new category is needed – the environmental agriculture productivity. Defined also as natural resources productivity (NRP), in simple words can be presented as a ratio of units of agricultural output, to units of natural resources consumed or qualitatively depleted [Rickard 2013, p. 49]. Knowing which practices have the best performance, not only in economic but also in environmental sense, is essential at least for three reasons. Firstly, it helps to assess present agricultural techniques, which might be adapted in the future, in less developed countries. Knowing their environmental productivity we can prevent those countries from depletion of natural resources, which has been caused by agriculture in the developed countries. Secondly, all the new technologies should be assessed for their environmental productivity, so that they bring the benefit to the farmer at the lowest possible environmental cost. Thirdly, values of environmental productivity might be an important signal for policymakers which kinds of agricultural practices should be more supported. Dominating contemporarily economic performance assessment could be complemented by environmental productivity, and it's improvement may be beneficial to overall economic processes as well to the economical productivity improvements in the past. In reference to three basic roles of agriculture in the historical development by Federico [2005] it is possible to point out new roles. In the product role, environmentally productive agriculture provides public goods such as clean air and agricultural landscapes and can earn foreign currency from agritourists. In the market role, it purchases green agriculture technologies and invests in renewable energy sources. In the factor role, it supplies spared land and environmental resources to industry (i.e. CO2 emission limits) and services (i.e. plots for tourist infrastructure).

Knowing how vital environmental productivity of agriculture is, in the context of the sustainable development paradigm, appropriate measurement methods should be developed. However, as so far no universal method of assessing environmental productivity has been developed. The main reason for that might be lack of agriculture environmental impact data available for a large sample of countries and over a longer time horizon. Methods proposed as so far are suited for limited set of data available, for certain countries, regions, areas or farms. A review of the examples is presented in table 2.

A brief review of publications concerning the issue of environmental productivity of agriculture presented in table 2 gives a general picture of the state of the art in this matter. We can notice that the most commonly used indicators of environmental inputs or outputs were greenhouse gases (GHG) emissions and nitrogen (N) balance (soil contamination). Less often indicators of diversity were taken into account. As an economic input, land, labor and capital (represented by different metrics), was used. The most obvious metric for the output was the value of agricultural production, presented either in money or in physical units. The methods varied from simple single input/output productivity indices and scatter plots to more advanced total factor productivity (TFP) indices. The characteristics presented above set the most probable area of a future compromise about the universal method of measuring the environmental productivity of agriculture.

Table 2: Environmental productivity of agriculture – methods of measure

Scale	Author	Metrics	Method
National	Linquist et al. 2012	GHG emission, yield, N fertilization	productivity index
	Hoang 2010	land, labour, fertilisers, pesticide, machinery,	Moorsteen-Bjurek TFP index
	Hoang and Coelli 2011	energy, total water withdrawal, feed and seed, crop and livestock production	nitrogen use efficiency and cumulative energy efficiency
Regional	Caviglia and Andrade 2010	water and solar radiation capture, yield	land equivalent ratio, intensification sequence index
	Gottchalk et al. 2010	land use diversity crop diversity, farmland bird population,	alternative cost calculation, public support efficiency
	Ball et al. 2005	crop and livestock production, capital, land, labor and material input, pesticides runoff and leaching	Malmquist TFP index
Farm	Gadanakis et al. 2015	labour input, machinery, fertiliser, crop protection, water, fuel and energy cost, gross margin – values per ha	DEA
	Firbank et al. 2013	GHG emission, N losses, food production, biodiversity index	scatter plots
	Dillion et al. 2016	GHG emission, N surplus	productivity index

Source: own elaboration.

5. Summary

The review of economic development theories based on increasing agricultural productivity, as well as historical evidence of their accuracy, provide an insight into the fundamental importance of this sector for initiating development processes. In the past, agriculture played mostly the role of the producer (providing goods to feed the population and to earn foreign currency), market creator (purchasing manufactures, both for consumption and for investment) and factor supplier (supplying manpower and capital to industry and services). These traditional roles are still vital among developing countries, where the economic structure has not yet reoriented towards industrialization and servicisation. In highly developed countries the catalog of agricultural functions has been extended to the environmental ones. In accordance to them, agriculture can play a role of the producer (provider of public goods and positive externalities), market creator (for green agriculture technologies) and supplier (of land and environmental resources) as well. A good example of this extension is the European Union. While part of modern perception of the development process is maintaining the environmental welfare, this paradigm should be included also in the assessment of agricultural productivity. However, with the present data availability, finding a universal and comprehensive method of environmental productivity measurement is difficult. Previous attempts of measurement were based on a single and total factor productivity approach, using the data for land, labor, capital, GHG emission, N balance, and production value output. This characteristic of research methods presents the most probable area of the future compromise about the universal method of measurement.

References

Adamowicz, M., 2004, *Wielofunkcyjność rolnictwa jako podstawa przewartościowań w polityce rolnej*, Wieś i Rolnictwo, Vol. 4, pp. 9-30.

Allen, R., C., 2000, *Economic structure and agricultural productivity in Europe, 1300-1800, Review of Economic History*, Vol. 3, pp. 1-25. http://www.helsinki.fi/iehc2006/papers3/ Allen122.pdf [access: 28.04.2017]

Ball, E., Färe, R., Grosskopf, S., & Zaim, O., 2005, A*ccounting for externalities in the measurement of productivity growth: The Malmquist cost productivity measure*, Structural Change and Economic Dynamics, Vol. 16 (Special Issue 3), pp. 374–394. https://doi.org/10.1016/j.strueco.2004.04.008 Special Issue

Caviglia, O. P., Andrade, F. H., 2010, *Sustainable Intensification of agriculture in the Argentinean Pampas: Capture and use efficiency of environmental resources*, The Americas Journal of Plant Science and Biotechnology, Vol. 3 (Special Issue 1), pp. 1–8. https://doi.org/10.1016/j.fcr.2003.10.002 [access: 28.04.2017]

Clark, C., 1951, *The Conditions of Economic Progress*, Macmillan, London.

Consolidated versions of The Treaty on European Union and The Treaty on The Functioning of The European Union, Official Journal of the European Union, vol. 59, http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C:2016:202:FULL&from=EN [access: 28.06.2017]

Czarny, B., Rapacki, R., 2004, *Podstawy ekonomii*, PWE, Warszawa.

Czekaj, T., 2008, *Techniczna efektywność gospodarstw rolnych a skłonność do korzystania ze wsparcia inwestycji środkami publicznymi*, Zagadnienia Ekonomiki Rolnej, Vol. 3, pp. 31-44.

Czyżewski, A, Kułyk, P, 2011, *Dobra publiczne w koncepcji wielofunkcyjnego rozwoju rolnictwa; ujęcie teoretyczne i praktyczne*, Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego Vol. 11(2), pp. 16-25, http://www.wne.sggw.pl/czasopisma/pdf/PRS_2011_t_11_XXVI_z2_s16.pdf [access: 28.04.2017]

Czyżewski, A., Henisz-Matuszczak, A., 2005, *Makroekonomiczne uwarunkowania rolnictwa industrialnego i społecznie zrównoważonego. Refleksje na temat sprzężeń regulacyjnych i realnych*. [in:] Zegar, J., S. (ed.), *Koncepcja badań nad rolnictwem społecznie zrównoważonym*. IERiGŻ, Warszawa, pp. 53-71.

Czyżewski, A., Matuszczak, A., 2011, *Dylematy kwestii agrarnej w panoramie dziejów*, Zeszyty Naukowe SGGW, Ekonomika i Organizacja Gospodarki Żywnościowej, Vol. 90, pp. 5-23. http://www.wne.sggw.pl/czasopisma/pdf/EIOGZ_2011_nr90_s5.pdf [access: 28.04.2017]

Czyżewski, B., 2012, *Produktywność zasobów w rolnictwie w Polsce wobec paradygmatu zrównoważonego rozwoju*, Studia Ekonomiczne, no. 2, pp. 165-188. http://www.inepan.pl/pliki/studia_ekonomiczne/Studia%202012%202%2002%20Czyzewski.pdf [access: 28.04.2017]

Das, R., J., 2002, *The green revolution and poverty: a theoretical and empirical examination of the relation between technology and society*, Geoforum, Vol. 33, pp. 55-72. https://doi.org/10.1016/S0016-7185(01)00006-9 [access: 28.04.2017]

Dethier, J. J., Effenberger, A., 2012, *Agriculture and development: A brief review of the literature*, Economic Systems, 36 (2), pp. 175-205. http://www.sciencedirect.com/science/article/pii/S0939362512000271 [access: 28.06.2017]

Deszczyński, P., 2013, *Konceptualne podstawy pomocy rozwojowej*, Wydawnictwo UEP, Poznań.

Dillon, J., E., Hennessy, T., Buckley, C., Donnellan, T., Hanrahan, K., Moran, B., Ryan, M., 2016, *Measuring progress in agricultural sustainability to support policy-making*, International Journal of Agricultural Sustainability, 14 (1), 31–44. https://doi.org/10.1080/14735903.2015.1012413 [access: 28.06.2017]

Dowgiałło, Z. (ed.), 2004, *Nowy słownik ekonomiczny przedsiębiorcy*, Wydawnictwo Znicz, Warszawa.

Eurpean Commision, 2013, *Overview of CAP Reform 2014-2020, Agricultural Policy Perspectives Brief, no. 5*, https://ec.europa.eu/agriculture/sites/agriculture/files/policy-perspectives/policy-briefs/05_en.pdf [access: 28.06.2017]

Federico, G., 2005, F*eeding the world: An Economic History of World Agriculture 1800-2000*. Princeton University Press, Princeton.

Firbank, L. G., Elliott, J., Drake, B., Cao, Y., Gooday, R., 2013, *Evidence of sustainable intensification among British farms, Agriculture*, Ecosystems & Environment, 173, 58–65. https://doi.org/10.1016/j.agee.2013.04.010 [access: 28.06.2017]

Gadanakis, Y., Bennett, R., Park, J., Areal, F. J., 2015, *Evaluating the Sustainable Intensification of arable farms*, Journal of Environmental Management, Vol. 150, pp. 288–298. https://doi.org/10.1016/j.jenvman.2014.10.005 [access: 28.04.2017]

Gottschalk, T., K., Dittrich, R., Diekötter, T., Sheridan, P., Wolters, V., Ekschmitt, K., 2010, *Modelling land-use sustainability using farmland birds as indicators*, Ecological Indicators, 10 (1), 15–23, https://doi.org/10.1016/j.ecolind.2009.05.008 [access: 28.04.2017]

Hardin, G., 2008, *Tragedy of the Commons, The Concise Encyclopedia of Economics*. Library of Economics and Liberty, http://www.econlib.org/library/Enc/TragedyoftheCommons.html [access: 26.04.2017]

Hoang. V.-N., 2010, *Measuring and decomposing changes in agricultural productivity, nitrogen use efficiency and cumulative exergy efficiency: Application to OECD agriculture*, Ecological Modelling, 222, 164–175. https://doi.org/10.1016/j.ecolmodel.2010.09.032 [access: 28.06.2017]

Hoang, V.-N., & Coelli, T., 2011, *Measurement of agricultural total factor productivity growth incorporating environmental factors: A nutrients balance approach*, Journal of Environmental Economics and Management, Vol. 62, pp. 462–474, https://doi.org/10.1016/j.jeem.2011.05.009.

Inge, M., T. (ed.), 1969, *Agrarianism in American Literature*, The Odyssey Press, New York.

Johnston, B., F., Mellor, J., W., 1961, *The role of agriculture in economic development*, The American Economic Review, vol. 51 (4), pp. 566-593. http://www.jstor.org/stable/1812786 [access: 28.04.2017]

Jorgenson, D., W., 1961, *The Development of a Dual Economy*, The Economic Journal, Vol. 71, (282), pp. 309-334. http://www.jstor.org/stable/2228770 [access: 28.04.2017]

Kautsky, K., 1911, *Finance Capital and Crises*, https://www.marxists.org/archive/kautsky /1911/xx/finance.htm [access: 21.05.2015].

Krzywicki, L., 1967, *Dzieła. Tom 8: Kwestia rolna*, Wydawnictwo PWN, Warszawa.

Kula, W., 1983, *Teoria ekonomiczna ustroju feudalnego*, Wydawnictwo Książka i Wiedza, Warszawa.

Kulawik, J. (red.), 2008, *Analiza efektywności ekonomicznej i finansowej przedsiębiorstw rolnych powstałych na bazie majątku WRSP*, IERiGŻ, Warszawa. https://www.ierigz.waw.pl/download/2883-analiza_kulawik_2009_do_internetu.pdf [access: 21.05.2015].

Landreth, H., Colander D. C., 2005, *Historia myśli ekonomicznej*, Wydawnictwo Naukowe PWN, Warszawa.

Linquist, B., Van Groenigen, K. J., Adviento-Borbe, M. A., Pittelkow, C., Van Kessel, C., 2012, *An agronomic assessment of greenhouse gas emissions from major cereal crops*, Global Change Biology, Vol. 18(1), pp. 194–209. https://doi.org/10.1111/j.1365-2486.2011.02502.x [access: 28.04.2017]

Luxemburg, R., 1913, *The Accumulation of Capital*, https://www.marxists.org/archive /luxemburg/1913/accumulation-capital/accumulation.pdf [access: 21.05.2015].

Mackie, A., B., 1964, *The role of agriculture in economic growth and development*, Illinois Agricultural Economics, vol. 4, nr 3, pp.1-10. http://www.jstor.org/stable/1349016 [access: 28.04.2017]

Maddison, A., 2005, *Measuring And Interpreting World Economic Performance 1500–2001*, Review of Income and Wealth, nr 51/1, pp. 1-35. https://doi.org/10.1111/j.1475-4991.2005.00143.x [access: 28.04.2017]

Marshall, A., 1936, *Principles of Economics* (8th Edition), Macmillan, London.

Martin, L., R., 1991, *A Survey of Agricultural Economics Literature Vol. 4. Agriculture in Economic Development 1940s to 1990s*, University of Minnesota Press, Minneapolis.

Maslow, A., H., 1943, *A theory of human motivation*, Psychological review, 50 (4), 370.

Mill, J.S., 1920, *Principles of Political Economy*, Longman S. Green, Londyn.

ONZ, 2016, *GDP and its breakdown at current prices in National currency*, http://unstats.un.org/unsd/snaama/dnltransfer.asp?fID=1 [access: 27.12.2016]

Overton, M., 1996, *Agricultural Revolution in England: The transformation of the agrarian economy 1500-1850*. Cambridge University Press, Cambridge.

Pajestka, J., 1981, *Czynniki i współzależności rozwoju społeczno-gospodarczego. Determinanty postępu I*, Państwowe Wydawnictwo Ekonomiczne, Warszawa.

Paszkowski, S., 2001, *Ewolucja idei rolnictwa zrównoważonego i rozwoju terenów wiejskich (SARD)*, Wieś i Rolnictwo, Vol. 1, pp. 45-63.

Poczta-Wajda, A., 2009, *Zjawisko paradoksu rozwojowego w polityce rolnej*, Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, Vol. 11 (2), pp. 200-205. http://rn.seria.com.pl/rn/category/51-11-2.html?download=2571:11-2-poczta [access: 28.04.2017]

Prebisch, P., 1959, *Commercial policy in the underdeveloped countries*, American Economic Review, Vol. 49, pp. 251-273. http://www.jstor.org/stable/1816120 [access: 28.04.2017]

Rickard, S., 2015, *Food security and climate change: The role of sustainable intensification, the importance of scale and the CAP*, EuroChoices, Vol. 14 (1), pp. 48–53. https://doi.org/10.1111/1746-692X.12082 [access: 28.04.2017]

Rostow, W., W., 1960, *The Stages of Economic Growth. A Non-Communist Manifesto*, Cambridge University Press, Cambridge.

Ruttan, V., W., 1972, *Review: The Role of Agriculture in Economic Development by Erik Thorbecke*, Economic Development and Cultural Change, Vol. 20 (3), pp. 590-594. http://www.jstor.org/stable/1152749 [access: 28.04.2017]

Singh, R., B., 2000, *Environmental consequences of agricultural development: a case study from the Green Revolution state of Haryana, India*, Agriculture, Ecosystems and Environment, Vol. 82 (1-3), pp. 97–103. https://doi.org/10.1016/S0167-8809(00)00219-X [access: 28.04.2017]

Smędzik, K., Stepień, S., 2011, *Zastosowanie metody DEA w badaniu efektywności ekonomicznej indywidualnych gospodarstw rolnych*, [in:] Grzelak A., Pająk K. (ed.), *Nowe trendy w metodologii nauk ekonomicznych*, Tom II, Wydawnictwo UEP, Poznań, pp. 327-342.

Stoate C., Baldi, A., Beja, P., Boatman, N.D., Herzon, I., van Doorn A., de Snoo, G.R., Rakosy, L., Ramwell, C., 2009, *Ecological impacts of early 21st century agricultural change in Europe – a review*, Journal of environmental management, Vol. 91, pp. 22-46. http://www.sciencedirect.com/science/article/pii/S0301479709002448 [access: 28.04.2017]

Timmer, C., P., 2002, *Agriculture and economic development*, Handbook of agricultural economics, vol. 2A., pp. 1487-1546. http://www.sciencedirect.com/science/article/pii/S1574007202100119 [access: 28.06.2017]

The Treaty of Rome, 1957, https://ec.europa.eu/romania/sites/romania/files/tratatul_de_la_roma.pdf [access: 28.06.2017]

Van Huylenbroeck, G., Vandermeulen, V., Mettepenningen, E., Verspecht, A., 2007, *Multifunctionality of agriculture: a review of definitions, evidence and instruments*, Living reviews in landscape research, 1 (3), pp. 1-43. http://lrlr.landscapeonline.de/Articles/lrlr-2007-3/download/lrlr-2007-3Color.pdf [access: 28.06.2017]

World Bank 2016, *Updated National and Global Estimates of Distortions to Agricultural Incentives*, 1955 to 2011, http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/Note_summarizing_core_updated_database_0613.pdf [access: 27.12.2016]

Woś, A., 1984, *Produkcyjność czynników wytwórczych*, [in:] *Encyklopedia Ekonomiczno-Rolnicza*, WRiL, Warszawa, pp. 579-580.

Woś, A., 1992, *Rolnictwo zrównoważone*, Zagadnienia ekonomiki rolnej, Vol. 1-3, pp. 9-21.

Zientara, B., 2006, *Historia powszechna średniowiecza*, Wydawnictwo TRIO, Warszawa.

Ziółkowski, A., 2009, *Historia Powszechna. Starożytność*, Wydawnictwo Naukowe PWN, Warszawa.

doi: 10.18559/ref.2017.1.2

RESEARCH PAPERS
IN ECONOMICS AND FINANCE

JOURNAL HOMEPAGE: www.ref.ue.poznan.pl

Income inequality in Israel between 2003 and 2014

Beny Tzarfati[1]

[1] PhD student, Poznań University of Economics and Business, Poland

ABSTRACT

Inequality in the distribution of income in the population is an important economic indicator. Today, economic inequality receives considerable attention due to the book of Thomas Piketty Capital in the 21st Century. The tremendous media coverage of the topic also attracted the attention of the world leaders. In many countries, the topic of inequality in income distribution was defined as a national challenge and was found at the top of the priorities of many important organizations, such as the International Monetary Fund (IMF) and the Organization for Economic Co-operation and Development (OECD). These organizations treat income distribution as the top priority because they see the problem to be a threat to the continuation of the existence of the global economic system [Piketty and Qian 2009]. This paper aims to describe the distribution of income in Israel and provide solutions for a more equal distribution of income.

Keywords: income inequality, distribution of income, Gini index, Israel.

1. Introduction

Measuring the inequality in the distribution of income in Israel, as well as in most countries of the world, relies only on data concerning current financial income. There is no agreed-upon measure that reflects economic inequality in all its aspects, such as the level of possession of property, residential conditions, level of education, public services, level of consumption, level of health services, security services, social isolation, level of risk, exposure to violence, and so on. In Israel, full and comprehensive information does not exist about the distribution of property and capital. According to the findings, it is possible to estimate that the level of inequality in the distribution of capital is higher than the level of inequality in the distribution of income, which is for the most part income from paid work [Central Bureau of Statistics of Israel].

Income inequality in Israel has risen sharply over the last 30 years. The periods of steepest rises were the late 1980s to early 1990s and then since 2000. Since the early 1990s, the level of inequality is very similar to, and even slightly exceeding, that of the United States.

With the exception of income tax, there are additional macro-economic factors and parameters in the economic policy that directly or indirectly influence changes in economic inequality: inequality in the distribution of human capital. Salary gaps, rate of participation in the work force, investment in infrastructure, liberalization in trade and globalization, employment of foreign workers, labor savings as a result of technological progress, systems of transfer payments, long-term macro-economic policy, minimum wages, intervention in the distribution of ownership of physical assets, discrimination or differences on a geographic, social or national background, structural changes, burnout in the workforce, laws and regulations, and unequal growth [Atkinson 2015].

This paper aims to describe the distribution of income in Israel and provide solutions for a more equal distribution of income.

2. Research method and data

This article draws on the data from the years 2003 to 2014 of a survey of the Central Bureau of Statistics [CSB] titled Monthly Income in the Deciles of Households according to Net Financial Income for Household. In each of the years, the data are divided into deciles regarding the sum of income tax levied and the data regarding income. For each of the years, the Gini index, which shows the level of inequality between the years, is calculated.

There are a number of measures of inequality in the distribution of income, such as the Theil Index, the coefficient of change, variance, and the Atkinson Index for inequality. They are differentiated by the weight each economic unit receives (for instance, the family) in the index that summarizes the inequality. The present study uses the Gini index, in light of the frequency of the use of this index in international publications, in research studies conducted in Israel, and in publications of the National Insurance Institute of Israel [NII]. The Gini index is one of the main indexes for the measurement of gaps in the distribution of income. The value of the measure ranges from zero to one, where the value of zero indicates a completely equal distribution of all income, while the value of 1 indicates a completely unequal distribution of all income. The index only takes into consideration the position of families in the ranking of income and in the level of their income.

The measurement is performed as follows: data is collected regarding monthly income in the deciles of households according to the gross financial income per household until the year 2012 (the last year for which the author has found data). From the total mandatory payments, the author has separated income tax and performed an examination of whether inequality decreases as the tax rate on income increases [CBS].

The data on wages come from two different sources: the Central Bureau of Statistics of Israel [CBS] Income Survey, based on self-reporting of sample respondents and on the reports of employers national insurance contributions for payment tax payments.

3. International comparison of the Gini index for 2012

In an international comparison, the Israeli trend of widening gaps is higher than in other Western countries. Israel ranked 29th out of 32 places, whereas Denmark is in the first place (the most equal) and Mexico in the last place in 2012, according to the Gini index.

Table 1: The Gini index in selected countries in 2012

Ranking	LOCATION	Value
1	DNK	0.249
2	SVK	0.250
3	SVN	0.250
4	NOR	0.253
5	CZE	0.256
6	ISL	0.257
7	FIN	0.260
8	BEL	0.268
9	SWE	0.274
10	AUT	0.276
11	NLD	0.281
12	CHE	0.285
13	DEU	0.289
14	HUN	0.289
15	POL	0.298
16	LUX	0.302
17	IRL	0.304
18	FRA	0.306
19	KOR	0.307
20	AUS	0.326
21	ITA	0.327
22	NZL	0.333
23	ESP	0.335
24	PRT	0.338
25	EST	0.338
26	GRC	0.340
27	LVA	0.347
28	GBR	0.351
29	ISR	0.371
30	USA	0.390
31	TUR	0.402
32	MEX	0.457

Source: [OECD 2015].

The average Gini index of the surveyed countries is 0.309, while in Israel it was 0.37 in 2012, i.e. 19% higher than the average. The rate of inequality differs between Israel and Denmark (in the first place) greater by more than 48%. In Mexico, the most unequal country, the Gini index is 0.457. The relationship between Mexico and Denmark is 83%. That is, in relation to Denmark, Mexico has 83% less egalitarian income equality. Israel ranks second among industrialized countries in terms

of the level of inequality in the distribution of disposable income. During the economic crisis in 2008, there was an increase in inequality due to an increase in unemployment. Countries that suffered most during the crisis saw especially severe damage to the lower classes. The Israeli trend of widening gaps is higher than in other Western countries. Compared to the above-mentioned, Israel ranks 29th out of 32 countries, with Denmark being the most equal and Mexico the least equal countries. Many of these inequalities remain wide, and some have widened since the economic crisis. The legacy of the crisis has not fallen equally. The consequences of this will form the backdrop not just to the coming General Election, but also to the way the society and public policies evolve over the years and decades to come [Hills, Cunliffe, Obolenskaya and Karagiannaki, 2015].

4. The gaps trend in Israel

From 1979 to 2013, there was a consistent trend of expansion in gaps in gross income (before taxes and transfer payments). The phenomenon of widening social gaps in the last two decades is characteristic of many developed countries, and is not unique to Israel. This phenomenon is explained mainly by the accelerating process of globalization and the effects of technological and media revolutions.

For any given level of income in a country, high inequality has a direct, negative effect on welfare. There are good reasons to be interested in inequality and social welfare from the perspective of a comprehensive evaluation of public policies and social programs that go beyond their impact on poverty [Wodon and Yitzhaki 2004]

High taxation on labor creates a negative incentive to work, while a parallel non-taxation of capital gains and interest exacerbates the distortions. Compared to the sharp increase in economic income disparities, the disparities in disposable income have become more stable over time. In 2012, the Gini index for disparities in disposable income. The income after taxes and transfer payment was 0.37. In 1979, the Gini index of inequality in disposable income amounted to approximately 0.32, and in 2013 it increased by 17%. An analysis conducted by the OECD suggests that the most negative impact on the growth associated with inequality is a large gap between low-income earners and the rest of the population. It is emphasized that it does not just concern the lowest decile, but it is a range which includes many low-income families – the four lowest deciles which also include the lower middle class. A gross income household in the upper decile was 50,741 NIS, i.e. 20.6 times higher than the income in the lowest decile (2,458 NIS). The Gini index for inequality in the gross income of households whose heads

Table 2: Gini index of inequality in income distribution among households in 1998 – 2014

Year	The Gini index, before payment transfer and direct taxes	The Gini index after payment transfer and direct taxes	The rate of increase in the Gini index (before and after taxes)
2014	0.4771	0.3706	29%
2013	0.4755	0.3634	31%
2012	0.4891	0.3770	30%
2011	0.4973	0.3794	31%
2010	0.5045	0.3841	31%
2009	0.5099	0.3892	31%
2008	0.5118	0.3853	33%
2007	0.5134	0.3831	34%
2006	0.5237	0.3923	33%
2005	0.5225	0.3878	35%
2004	0.5234	0.3799	38%
2003	0.5265	0.3685	43%
2002	0.5372	0.3679	46%
1999	0.5167	0.3593	44%
1998	0.5230	0.3556	47%

Source: National Insurance Report 2014.

are salaried employees was 0.37.

The Gini index measuring inequality between households by net money income per standard amounted to 0.363 points in 2013. In 2014, the index was 0.3706 points, i.e. 1.9% increase from the previous year. The analysis carried out by the author has decreased by 3.7% in the Gini index (after payment transfer and direct taxes) in 2013 compared to 2012, which means that the income distribution is more equitable economy. There is reduction in inequality in each year under analysis. An average percentage gap in 1998-2014 was 36%. The Gini index after payment transfer and direct taxes increased by 4%, whereas before payment transfer and direct taxes the Gini index dropped by 9% between 1998-2014.

In 2012, gross revenue household in the upper decile was 20.6 times greater than that of households in the lowest decile. In 2012 the net disposable income of households in the upper decile was 16.4 times higher than household in the lowest decile.

Table 3: Average monthly income deciles of households by net income per standard Israel in 2012

Total	1	2	3	4	5	6	7	8	9	10	NIS, unless otherwise stated
-	3,975	5,991	7,984	10,102	12,466	15,347	18,882	24,027	33,664	-	Upper limit (NIS)
8,742	905	896	849	852	865	877	866	859	884	889	Households in sample
2,270.0	227.1	227.2	227.0	226.8	227.0	227.1	227.0	227.4	226.6	226.8	Households in population (thousands)
2.71	1.85	2.39	2.55	2.67	2.75	2.87	2.89	2.97	3.11	3.09	Average standard persons in a household
1.40	0.29	0.64	0.89	1.16	1.39	1.62	1.75	1.95	2.17	2.18	Average earners in a household
47.2	55.9	51.6	46.9	46.3	44.5	44.3	45.4	44.4	44.9	48.1	Average age of the head of a household
13,829	2,260	4,733	6,532	8,428	10,344	12,522	15,013	18,348	23,097	37,051	Net money income per household
4,199	1,169	1,703	2,135	2,613	3,097	3,535	4,223	4,984	5,880	9,524	Net money income per person
10,751	4,247	5,730	7,244	8,331	9,732	10,842	12,125	13,477	15,489	20,304	Money expenditure per household
3,264	2,197	2,062	2,368	2,583	2,914	3,061	3,411	3,661	3,943	5,219	Money expenditure per person
12,466	2,696	5,050	6,955	9,080	11,201	13,800	16,967	21,304	27,871	43,135	Median of gross money income per household
16,577	2,458	4,998	6,956	9,065	11,232	13,844	17,005	21,336	28,180	50,741	Gross money income - tota

Source: The survey was based on a sample of 8,742 households, representing about 2,700,000 households in the population.

The analysis carried out by the author for the Central Bureau of Statistics in 2012 shows that:

• In 2012, average financial income (gross) for households in Israel was 16,577 NIS, and after compulsory payments the average income (net) was 13,829 NIS

• Net income per household in the upper decile was 16.4 times the income in the lowest decile (37,051 NIS in the highest decile compared with 2,260 NIS in the lowest decile)

• The average gross money income per household a month in 2012 came to 16,577 NIS. Net income of the household in Israel at the end of 2012 was 13,829 NIS. Net standard income per person was 4,199 NIS a month.

5. The solutions for more equal distribution of income

The present study aimed to describe the distribution of income in Israel and provide solutions for a more equal distribution of income. Here are the author's suggestions for solutions. Taxes and other payments reduce the gap between income deciles. Size differences between the highest and lowest deciles in various areas (sorted by size): According to table no. 3, gross disposable income, before taxes and transfer payments (2012) was 20.6. Disposable income, after taxes and transfer payments (2012) was 16.4. The changes in the Gini index before taxes and transfer payments between 1998 – 2014 show that the Gini index decreased from 0.523 in 1999 to 0.4771 in 2014. This means a total decrease of 1%. In other words, there was a small decrease in inequality. The changes in the Gini index after taxes and transfer payments between 1998 – 2014 show that the Gini index increased from 0.3556 in 1998 to 0.3706 in 2014. This means a total increase of 4%. In other words, there was an increase in inequality.

6. Recommendations

There was increased activity in improving access to and the quality of social services: schools, higher education, health and housing, as well as improving the situation of low-income families in the four lowest deciles. Enabling policy in the field of reducing inequality and promoting equal opportunities will also reduce inequality and encourage growth. Employment growth can contribute significantly to improving income equality, where employment conditions are in jobs that offer opportunities for career advancement. In addition, the increase in non-standard employment (non-permanent, part-time, contractor freelance, etc.) creates employment opportunities, but contributes to the growth in inequality. According to the OECD, high levels of inequality in the population hamper economic growth and weaken those on low incomes. Inequality has a significant negative impact on growth. The struggle to reduce inequality in disposable incomes, measures of redistribution, has no negative impact on growth.

Empirical studies show the fact that the increase in inequality measured by the share of the highest income is positively related to the economic growth. While in the case of the overall dispersion of income (measured by the Gini coefficient), the results of empirical studies are inconclusive. There is a positive correlation between the economic growth and the top income seems to be clearly indicated in subject literature. First, Frank (2009) document a positive long-term relationship between the economic growth and the share of income earners for most American states. The current belief is that income inequality has a negative relationship with the economic growth. Results suggest that in the short and medium term, an increase in the country's level of income inequality has a significant positive relationship with the subsequent economic growth. This relationship is highly robust across the samples, variable definitions, and model specifications. Moreover, several recent papers have developed models that predict a positive relationship between inequality and growth. Acemoglu and Robinson (2015) present the results of studies, showing a positive relationship between the inequalities measured by the participation of people with the highest income in the total income and economic development. Piketty (2015) shows that when growth is lower, the capital share of national income will be higher.

Banerjee and Duflo (2003) show that changes in inequality in any direction (measured by the Gini coefficient) are associated with reduced growth in the next period and that its non-linearity is sufficient to explain why previous estimates of the relationship between the level of inequality and growth are so different from one another.

While the results obtained by Forbes (2000) suggest that, in the short and medium term, an increase in the country's level of income inequality has a significant positive relationship with subsequent economic growth. Wodon and Yitzhaki (2004) show that the negative impact of inequality on growth may result from various factors. For example, access to credit and other resources may be concentrated in the hands of privileged groups, thereby preventing the poor from investing. High-income individuals today have a greater ability to pay taxes than before. Therefore, the governments of Israel have been considering a re-examination of the tax system to ensure that residents increase their share of the tax burden. In addition, work has begun to improve the collection of taxes, closing tax loopholes, eliminating or reducing tax preferences given to relatively high-income earners, and reassessment of the tax burden on all types of assets and income, as well as re-examination of the amount of tax on income from capital.

Despite the high level of inequality in Israel, the tax system is already characterized by a high degree of progressiveness. However, as has been already mentioned, this has declined in the past decade because of the reduction of direct tax rates so that there would not be any

'escape' by the top percentile. The income tax system can provide part of the solution, in the guise of higher taxation on people with this income and better balance between taxation of capital and taxation on work. The tax system must be sensitive to the groups of population upon whom the economic burden is especially heavy. The reduction of tax rates harms the progressiveness of the tax system and is expected to increase the social gaps (relative to the situation before the reduction). However, it is reasonable to suggest that the reduction of tax in the past positively influenced growth, but this influence steadily weakens as the tax rate decreases. The tax rates in Israel at the average and high levels are no higher than what is accepted in the OECD, and therefore, the competitive logic that is behind their reduction is lessened. Moreover, competitiveness is not just summed up by low tax rates. A competitive economy is also measured by the nature of the educational system, the level of civilian infrastructure, the support of research and development, quality medicine, and so on. The continuation of the implementation of tax cuts in the present situation will cause significant harm to public expenditure in the near future, which is already at low levels today compared to other developed countries. The continuation of this burnout will harm the government's ability to provide these services at an appropriate level. Aside from the most severe social implications that entail the increase in inequality and economic polarization, this burnout will sooner or later harm the growth potential of the economy. Every solution to this problem will necessitate the use of budgetary funds, which is not commensurate with the additional reduction in taxation. These funds can also come from an increase in indirect taxes (primarily VAT). However, as mentioned earlier, the weight of these obligations in the overall tax system is already high. Therefore, regarding the cancellation of the expected reductions, which focus on direct taxes, if and when the Israeli economy embarks on the path of accelerated fiscal growth, it will be possible to re-examine the policy of the reduction in taxes. It is suggested that this may be done by balancing the goals of the process and the manner of its implementation on the one hand, and the influences on the distribution of income in the economy and the need to increase the weight of public expenditure on the other.

The increase in income tax on high income (the increase of the income tax rate at the highest tax level) should return to a more progressive rate for income tax, with increases in the margins of tax rates up to a top rate of 65%, accompanied by broadening of the tax base. The income tax system should be progressive and it should reduce inequality [Atkinson 2015]. As a rule, the present tax levels are correct in terms of the level of progressiveness of the tax system and in terms of their influence on incentives to work. However, an adjustment in the top tax level should be made, so that effectively, another tax level will be created, commencing from an income of 40,231 shekels a month. This taxation adjustment will be a compromise between the desire to increase the degree of progressiveness of the direct tax system and the fear of the creation of tax distortions and negative financial incentives, which can derive from the determination of high marginal tax, especially on those with high incomes. The increase in the income of the state from the increase of the high tax level is estimated at about 0.8 billion shekels a year. Tax evasion influences financial efficiency and equality in the distribution of income. The tax regime in the United States evaluates that the rate of tax evasion amounts to 15% of the population obliged to pay tax. In 1993, the marginal tax rate in the United States was raised to 36% for income ranging $140,000-250,000 and to 39.6% for income above $250,000 a year.

Feldstein and Feenberg have examined the impact of this step on a number of factors, including the scope of the taxable income, the volume of tax revenues, and economic efficiency. The findings indicate that without the increase in tax rates, those with high incomes would report taxable income in 1993 with a sum higher by 7.8% than the sum reported in actuality. Therefore, it was found that the social loss from the increase of the marginal tax rate is double the sum of tax charged, i.e. 8 billion dollars [Slemrod 1989].

References

Abhijit V. Esther D., 2003, *Inequality and Growth: What Can the Data Say? Department of Economics*, MIT.

Assaf R and Efraim S., 1995, *Disinflation and Taxation: the Case of Israel Eitan Berglas School of Economics*, Tel Aviv University, Tel Aviv 69978 Israel.

Atkinson, A., 1973, *How progressive should income tax be?*, in: Parkin, M. and Nobay, A. R. (eds.) *Essays in Modern Economics*, Longman, London, pp. 90–109.

Atkinson, B., Piketty, T., Saez, E., 2015, *Top Incomes in the Long Run of History*, Publishing House, city (f. ex. New York).

Bargain, O., Dolls, M., Immervoll, H., Neumann, D., Peichl, A., Pestel, N., Siegloch, S., 2011, *Tax Policy and Income Inequality in the US, 1978–2009: A Decomposition Approach*. IZA Discussion Paper Series No. 5910, Germany.

Bird, R.M., Zolt, E. M., 2005, *The Limited Role of the Personal Income Tax in Developing Countries*, Journal of Asian Economics, 16, pp. 928–46.

Bucheli, M., Lustig, N., Rossi, M., Ambile, F., 2014, *Social Spending, Taxes, and Income Redistribution in Uruguay*, Public Finance Review, 42 (3), pp. 413–433.

Central Bureau of Statistics, Israel.

Dahan, M., Strawczynski, M., 2012, *The Optimal Asymptotic Income Tax Rate*, Journal of Public Economic Theory vol. 14,. pp. 737–55.

Daron A. James A. Robinson A. J., 2015, *The Rise and Decline of General Laws of Capitalism*, National Bureau Of Economic Research Cambridge.

Forbes J. K., 2000, *A Reassessment of The Relationship Between Inequality and Growth*.

Hills, J., Cunliffe, J., Obolenskaya, P.,Karagiannaki, E., 2015, *The Changing Structure of Inequality in the UK, 2007–2013*, CASE Social Policy in a Cold Climate Report 5, London School of Economics.

Kakwani, N., 1984, *On the Measurement of Tax Progressivity and Redistribution Effect of Taxes with Applications to Horizontal and Vertical Equity*, Advances in Econometrics, 3, pp. 149–168.

Kenway, P., Aldridge, H., Born, 2015, *What happened to poverty under the Coalition?* New Policy Institute

Kesselman, J. R., Cheung, R., 2004, *Tax Incidence, Progressivity, and Inequality in Canada*, Canadian Tax Journal, 52 (3), pp. 2709–2732.

Ma, G., Xu,J., Li,S., 2014, *The Income Redistribution Effect of China's Personal Income Tax: What the Micro-Data Say*. Contemporary Economic Policy, 33 (3), July, pp.488–498.

Ministry of Finance, Israel.

National Insurance Institute of Israel.

Organization for Economic Cooperation and Development (OECD), 2011, *Divided We Stand: Why Inequality Keeps Rising*, OECD Publishing.

Piketty, T., Qian, N., 2009, *Income Inequality and Progressive Income Taxation in China and India 1986–2015*, American Economic Journal: Applied Economics, 1 (2), pp.53–63.

Schröder, C., Bönke, T., 2012, *Country Inequality Rankings and Conversion Scheme*.

Slemrod, J. B., 1989, *Are Estimated Tax Elasticities Really Just Tax Evasion Elasticities? The Case of Charitable Contributions*, NBER Working Paper No. 2733, October 1988, and Review of Economics and Statistics, 71 (3) (August), pp. 517–22.

The American Economic Review, pp. 869 - 887

Tinbergen J., 1975, *Income distribution*, North-Holland

Turley G., 2005, *Transition, Taxation and the State*, Ashgate Publishing, Ltd.

Vito T., 1969, *The Individual Income Tax and Economic Growth*. Johns Hopkins University Press

Wodon, Q.,Yitzhaki, S., 2004, *Inequality and Social Welfare*, from PRSP Sourcebook.

Yitzhaki, S., 1994, *On the Progressivity of Commodity Taxation*.

doi: 10.18559/ref.2017.1.3

RESEARCH PAPERS
IN ECONOMICS AND FINANCE

JOURNAL HOMEPAGE: www.ref.ue.poznan.pl

Ukrainian perspectives of using world experience in investing energy innovations

Dmitry Lazarenko[1,2] Iaroslav Krutogorskyi[3]

[1] Academician of the Academy of Economic Sciences of Ukraine, Ukraine;
[2] Donbas State Pedagogical University, Ukraine;
[3] PhD student, Donbass State Pedagogical University, Ukraine.

ABSTRACT

The article presents the world economic trends of alternative energy. An analysis of international programs and innovative projects that are implemented and used in the energy sector is introduced. Conceptual proposals and innovative research in the field of alternative energy are represented. The author also suggests ways of formation of effective energy management and rational energy policy.

Keywords: alternative energy, resources, renewable sources, energy generation, innovations, investments, energy efficiency, energy policy, green tariff.

1. Introduction

More than one hundred countries around the world, including Ukraine, have proclaimed alternative energy as a priority of their policy. Most of them provide benefits to the producers of the "green" energy, realizing that its development is in line with the country's strategic goals: energy independence, cheap energy, jobs, and environmental care.

The achievement of certain scientific results and scientific and practical achievements in this area are facilitated by quite a large number of scientific events at the international level in order to promote the establishment and development of high-quality scientific and technological cooperation between scientists from European countries. Among them there are: symposia in June 2016 and February 2017 on the basis of the University of Banking (Kyiv, Ukraine), the National Academy of Public Prosecutor of Ukraine, Slovyansk State Pedagogical University, Poltava University of Economics and Trade, and the conferences in Poznan and Suwalki (Poland), Poltava, Lviv, Slavyansk (Ukraine) and others.

The role of the energy industry cannot be overestimated in the era of global energy consumption. At present, no industry can do without the use of electric and thermal energy. Energy is the basic part of the engine of world progress. Recently, humanity began to think about the limited use of raw materials for the production of electric and thermal energy from traditional energy resources: coal, oil, gas. This concern is not unfounded.

2. Literature review and problem statement

Scientific works of the Ukrainian and foreign scientists are devoted to the analysis of the energy potential of all types of non-traditional energy. Among them there are H. Pivnyak [Pivnyak 2013], O. Sokhatska [Sokhatska 2011], N. Konokhov [Konokhov 2011], V. Lyashenko, O. Kvilinskyy, A. Tolmacheva [Lyashenko, Tolmachova, Kvilinskyi 2016], K. Pająk, S. Zwierzchlewski, [Pająk, Zwierzchlewski, Kvilinskyi 2016], B. Kamińska, O. Kvilinskyi, O. [Pająk, Kamińska, Kvilinskyi, 2016], V. Lyashenko, N. Osadcha, O. Galyasovskaya, O.Knyshek [Lyashenko, Osadcha, Galyasovskaya, Knyshek 2017].

The article uses international experience with elements of energy efficiency programs [Price 2010], C. Forbes [Forbes 2011], N. Stern [Stern 2007].

As a result of conducted research, the works of the leading Ukrainian scientists dealing with problems of the use of alternative energy have been analyzed, namely, S. Kudra, I. Bondarenko, H. Varlamov, I. Volchin, A. Shindlovskyy, V. Shynkarenko and others. Furthermore, the author has examined articles in periodicals and electronic publications devoted to the issues of renewable energy in Europe.

The aim of the article is to highlight world innovations and international cooperation in the field of alternative energy, as well as to outline possible prospects for its development and means for increasing the efficient use of alternative energy.

3. Research results

Renewable or regenerative energy (the "Green energy") is energy which comes from the sources that, on a human scale, are inexhaustible (which are replenished naturally).

The basic principles of the use of renewable energy appear out of its nature and are as follows: firstly, in its infinite presence in the environment, secondly, in the possibility of maximum approximation of the sources to the objects of consumption, and thirdly, in the reduced level of unproductive losses at transmission and consumption [Lazarenko 2016].

All of the above mentioned is an economic advantage that persuades investors towards alternative energy. Renewable energy is generated from natural resources, such as: sunlight, water streams, air streams (wind), geothermal heat, biological assets (products of vital activity). The world practice of the 21st century shows rapid growth in investments in innovative energy.

The positive dynamics of the development of alternative energy is confirmed by the forecast of the International Energy Agency, which predicts growth in world demand for the use of alternative sources of energy for heating by 7% in 2030. Investments in renewable energy sources will amount to 5.5 trillion dollars by 2030, which is almost 50% of all investments in the energy industry [Renewable energy country attractiveness indices: February 2013].

"More for less money" – so it is possible to characterize the dynamics of investments in alternative energy. The volume of the investments in the RES has decreased in comparison with 2015 and 2014, but the objects of the RES have been built on a larger scale. As much as 241.6 billion dollars was invested in new renewable energy objects (excluding large hydroelectric power plants), 23% less than in the record-breaking 2015 [UN environment, Bloomberg New Energy Finance]. However, However, it was built more - 138.5 HW (for comparison in 2014 - 127.5 HW). We emphasize that investments into the RES have been about twice the rate of generating fossil raw materials for five consecutive years. That is, it can be assumed that this is no longer an alternative, but the most common type of energy sources. The forecast of the potential financial and capital investments has made it possible to make a perspective analysis of the absolute indicators (HW) of energy generation using renewable sources in Europe. Global trends in the use of the renewable energy sources indicate that it is possible to successfully increase the use of the renewable energy sources, and the amount of useful energy generated by this way to increase to 95% at final consumption. However, this requires creating a favorable energy efficiency policy and a rational energy management system.

In Ukraine, there has been an increase in installed capacities of alternative energy for the last 4 years. By the end of 2016, 1117 MW of renewable energy was installed, which produced about 1% of electricity in Ukraine. The largest share is occupied by the wind and solar power plants (925 HW and 492 HW of electricity produced, respectively). In the Donetsk region, following the results of 2012, implementation of energy saving measures allowed to save 361.18 million kWh of electricity, 1191.49 million m3 of natural gas, 248.100 tons of coal, 111520 Gcal of heat energy. The cost of the saved resources amounted to UAH 5819.36 million. The greatest savings in fuel and energy resources were achieved through the use of alternative (non-traditional, renewable) energy sources – 1.398.850 tons with a total value of UAH 5.22 billion [NISD].

According to the experts' estimates, the economically feasible potential of introducing the alternative energy sources in Ukraine by 2030 is estimated at 16 – 22 HW, compared to 1.1 HW, which were practically set at the end of 2016. In comparison with Europe, according to the Economic Discussion Club, the share of the renewable sources in the gross final consumption of energy was 16.7%, or over the past decade, has increased by 2 times.

In the European Union, the state of development of renewable energy in general is close to the global indicators. The RES's contribution to the final energy consumption is 15% (Table 1), including biomasses – about 9%. The share of the RES in electricity production is 25.4%, with biomasses being about 5%.

In order to comply with the 2DS climate change scenario, in 2011, the European Union

reaffirmed its official goal of reducing greenhouse gas emissions (decarbonisation) by 2050 to 80-95% compared to the levels of 1990. Since the energy sector is one of the main sources of human greenhouse gas emissions, the main reserves for reducing these emissions should be found and implemented in it.

The share of renewable energy from the renewable sources in the European Union in 2015 is 16.7% of the total volume, and is closer to the EU's target which will have been 20% by 2020 [Eurostat]. Sweden is the leader according to this indicator – more than half (53.9%) of its energy comes from the renewable sources. Next are Finland (39.3%), Latvia (37.6%), Austria (33.0%) and Denmark (30.8%). Eleven of the 28 EU member states have already reached 20%: Bulgaria, Czech Republic, Denmark, Estonia, Croatia, Italy, Lithuania, Hungary, Romania, Finland and Sweden. In addition, Austria and Slovakia lack only 1 % to the target set for 2020.

In 2014, the share of the energy from the renewable sources made up 16.1%, and in 2004, when Eurostat first published such statistics, this figure was only 8.5%. Solar power plants use solar energy directly (photovoltaic SES operate on the principle of the internal photoelectric effect), and indirectly – using the kinetic energy of steam. In 2016, 75 HW of photovoltaic solar power plants were invested and built in the world, 50% more than a year earlier. Due to this, the total installed power of photovoltaic solar power exceeded 300 HW. In the countries consequently: China – 34 HW, the USA – 13 HW, Japan – 8.6 HW, Europe – 6.5 HW. The world's largest photovoltaic solar power plant, Topaz Solar Farm, with the capacity of 550 MW, is located in California, the USA. There have already been installed 9 million solar panels. The solar power plant in Mohawk has become the largest in the world, with its area being 14.24 square kilometers, and it is called Ivanpah Solar Electric Generating System and is related to the type of thermal solar power plants. Its power reaches 392 MW. The station has 3 towers of 140 meters high (which are essentially plants that generate energy), surrounded by 300 thousand mirrors. The mirrors focus sunlight on the collector located at the top of the tower. There is also a water reservoir, where the heat energy is directed and collected by the mirrors. After the mirrors direct the sunrays to the collectors, steam is created at high pressure and a temperature of about 500 degrees Celsius, which is transmitted to a turbine and generator. In addition, the technology of dry cooling, which reduces water consumption to 90%, is used. As a result, the water circulates through the system several times, and then it is used to clear the station's mirrors.

Modern solar panels still have a rather low coefficient of efficiency. Therefore, to get high production figures from them one has to cover sufficiently large spaces with panels. A conceptual technology called Betaray allows to increase the coefficient of efficiency at about three times. Betaray is a small sized installation that can be located in the courtyard of a private house or on the roof of a multistory building. Its construction is based on a transparent glass sphere with a diameter of just under one meter. It accumulates the sunlight and focuses it on a fairly small photovoltaic panel. The installation itself is dynamic. It automatically adjusts itself to the sun's position in the sky, so that at any moment it works at the maximum possible [Designboom 2017].

Table 1: Achieved and planned targets for the share of the RES in the gross final consumption of energy in the European Union (%)

Countries of the EU	2013	2020
the EU	15.0	20
Belgium	7.9	13
Bulgaria	19.0	16
Czech Republic	12.4	13
Denmark	27.2	30
Germany	12.4	18
Estonia	25.6	25
Ireland	7.8	16
Greece	15.0	18
Spain	15.4	20
France	14.2	23
Croatia	18.0	20
Italy	16.7	17
Cyprus	8.1	13
Latvia	37.1	40
Luxemburg	3.6	11
Hungary	9.8	13
Malta	3.8	10
Netherlands	4.5	14
Austria	32.6	34
Poland	11.3	15
Portugal	25.7	31
Rumania	23.9	24
Slovenia	21.5	25
Slovakia	9.8	14
Finland	36.8	38
Sweden	52.1	49
Great Britain	5.1	15
Lithuania	23.0	23

Source: http:/energefficiency.in.ua/stati/vozobnovlyaemaya-energiya.

Wind power engineering is an industry specializing in the transformation of the kinetic energy of the air masses in the atmosphere into electric, thermal and any other form of energy to use in the national economy. The conversion is carried out by way of using a wind turbine (for getting electricity), wind turbines (for getting mechanical energy) and many other types of aggregates. By the beginning of 2016, the total installed capacity of all wind turbines was 432 HW.

The Enercon E-126 is a model of a wind turbine produced by the German company Enercon. With a mast height of 135 meters, a rotor diameter of 126 meters and a total height of 198 meters, this large model can generate up to 7.58 megawatts of power per turbine. The basement mass of the turbine tower is about 2500 tons, the tower itself is 2,800 tons, the car body is 128 tons, the generator – 220 tons, the rotor (including shovels) – 364 tons. The total weight is about 6000 tons [Enercon E-126].

The new environmentally safe energy source in the field of nanobiology is called osmotic energy. Energy is generated by contacting fresh and salt water through a membrane with a thickness of three atoms. The potential of such a system is enormous. According to the calculations, a membrane with an area of 1 m2, 30% of which is covered by nanopores, is able to produce 1 MW of electricity. Investing in the development of this technology of energy generation is highly profitable, because all the materials are often found in nature, and the whole model may easily be increased to the industrial scale.

Investing in conceptual innovations for electricity production has become an incentive for the introduction of interesting projects and the development of a number of concepts for generating energy. Among such technologies there is air generation with the help of Power Tree wind turbines. The municipalities of some French cities are already investing in this technology.

The international cooperation in the field of energy allows to direct investment resources to global projects. The Netherlands, Denmark and Germany reached an agreement signed in Brussels on March 23, 2017, on investing in a joint construction of a large wind power hub in the North Sea. A new artificial island with an area of 6 square kilometers will be created on the largest sandy shrimp in the North Sea, which is called Dogger Bank. This powerful hub will be the base for transmitting wind energy to the Netherlands, Denmark, Germany, the UK, Norway and Belgium. It is planned that more than 10,000 wind turbines will produce this type of energy. The location of a power hub (island) must meet a number of requirements: optimal wind conditions, central location and relatively small depth.

Delivery, conversion and energy consumption implies unproductive losses. According to the expediency (productivity), the final energy consumption is logically divided into two parts:

1) useful energy (energy consumption), which directly performs work;

2) unproductive energy (energy losses), lost in the conversion of heat generators, motors, and others.

In Europe, the problem of non-productive energy losses exists at all the stages of the transformation of energy and reaches an extraordinary size. Specific proportion of unproductive losses exceeds 62%. This is according to the International Energy Agency.

Considering the advantages of investing into alternative energy, it should be emphasized that the share of unproductive losses in the use of the RES is almost absent.

Thermal energy costs are determined by the results of an energy audit using a thermal imager. On the display of the thermal imager you can observe the temperature distribution of the object studied. In building structures and elements of the engineering infrastructure of the building, the warmer the colour of the site, the higher the temperature on the real object. This allows at first sight to determine the zones of the energy costs.

An example of reducing energy consumption in transport is the use of electric motors. If a standard car engine spends only 15% of its energy from fuel combustion that merges into a fuel tank and the rest is lost in the form of heat, then the electric vehicle uses a target of 80% of the resource.

A model of the world energy system, which operates on the basis of 100% of the RES, has already been developed. This new and unique development demonstrates how a power system, in which the main energy sources are renewable energy sources, can work [Internet of Energy Model].

The model shows how electricity production can be organized to cover the demand every hour of the calendar year. This development involves finding the most economical solution for the RES-electric power system. The optimal combination of generation, storage and logistics network economy provides electricity costs in the area of approximately 55 – 70 euros per megawatt-hour in all the major regions of the world.

The European Union under the program

"Energy Europe" has supported another Repowermap conceptual project since 2012. Until nowadays, more than 55,000 objects of the RES have been mapped available in 10 languages.

Similar information on the location of renewable energy systems stimulates investments. The support and development of such projects contributes to the creation of a positive investment climate in the regions, and investors, in their turn, have additional motivation.

4. Conclusions

The energy crisis once again proves the dependence of Ukraine on imported gas, nuclear fuel, and now coal, which has to be bought. The difficult situation requires new approaches to the industry reform, the search for the most energy-efficient ways. Aspiring to Europe, it is worth paying attention to the experience of the developed countries that reorient their energy to the alternative energy sources that are not dependent on the exhaustive resources.

The European integration processes should bring the national system of energy generation and energy consumption to the European standards. The construction of efficient energy management and rational energy policy requires a systematic approach, both at the microeconomic level and in the public sector.

One of the most promising incentives for the development of alternative energy is the "green" tariff – a mechanism for encouraging energy production, which gives state guarantees to producers that the energy produced by them will be purchased at higher prices than the energy from traditional producers.

Finally, the most important fact is that the introduction of energy saving technologies can reduce the import of energy resources and reduce the political pressure on the country from the exporters of oil and gas. In addition, reducing the energy component of the cost of production allows Ukraine to become competitive on foreign markets.

References

Betaray. Available from http://www.designboom.com/technology/betaray-spherical-glass-solar-energy-generator-by-rawlemon.

Cooperation European Transmission System Operators to develop North Sea Wind Power Hub. Available from https://www.tennet.eu/news/detail/cooperation-european-transmission-system-operators-to-develop-north-sea-wind-power-hub/

Designboom, 2017 Available from http://www.designboom.com/technology/betaray-spherical-glass-solar-energy-generator-by-rawlemon.

Enercon E-126. Available from http://www.windpowermonthly.com/article/1138562/close---e126-worlds-biggest-turbine

Eurostat. Available from http://ec.europa.eu/eurostat.

Eurostat43/2017 from: http://ec.europa.eu/eurostat/documents/2995521

Forbes, C. (2011). Summary of Country Reports Submitted to the Energy Efficiency Working Party. Period from March 2011 to September. IEA/OECD, P.12.

International Energy Agency, 2016, Retrieved from: https://www.iea.org/training/ieaonlinesummerschool2016/#d.en.156514.

Internet of Energy Model. Available from http://www.neocarbonenergy.fi/

Konokhov, N., 2011, *Kompleksnoe razvytye vetrotnerhetyky y uholnoy promyshlennosty v Donbasse* / N.N. Konokhov, S.Y. Tsykhmystro // Enerhosberezhenye. –

Lazarenko D., 2014, *Enerhozberežennja jak odyn iz naprjamkiv ekolohičnoji stratehiji Ukrajiny*. Naukovyj visnyk Xersons'koho deržavnoho universytetu. Serija «Ekonomični nauky», № 9. XDU, – pp.138-142.

Lazarenko D., 2016, *Al'ternatyvna enerhetyka yak zasib vyrishennya sotsial'no-ekonomichnykh problem enerhospozhyvannya*. Materialy mizhnarodnoyi naukovo-praktychnoyi konferentsiyi «Sotsial'na vidpovidal'nist': suchasni vyklyky» 21–22 kvitnya 2016 Kramators'k, DDMA. pp. 269-272.

Lazarenko D., 2016, *Socioeconomic indicators of energy-efficient development of the region*. European cooperation. Vol. 8(15) -2016 Collection of scientific proceedings is registered in District Court in Warsaw. C. 88-94.

Lazarenko D., 2017, *Economic approach to global energy trends. Economic transformation in ukraine: comparative analysis and european experience*. Composite scientific work edited by Piotr Głowski & Oleksii Kvilinskyi. Warsaw 2017. C.91-100.

Lyashenko, V., Osadcha, N., Galyasovskaya, O., Knyshek, O., 2017, *Marketing prospects of small developed African countries assessment for traditional Ukrainian exports*. Economic Annals-XXI, 166 (7-8), 20-25, http://soskin.info/userfiles/file/Economic-Annals-pdf/DOI/ea-V166-04.pdf

Lyashenko, V., Tolmachova, A., Kvilinskyi, O., 2016,. *Państwowa polityka rozwoju przedsiębiorczości w kontekście stabilności społecznoekonomicznej (na przykładzie Ukrainy)*. Zeszyty Naukowe Polskiego Towarzystwa Ekonomicznego w Zielonej Górze, 4, pp.155-164.

Meshkov, A. Bondaryeva, I., Kvilinskyi, O., 2016, *Factors of the region's investment climate formation under modern socio-economic conditions*. Perm University Herald. Economy, 2(29), 120–134.

NISD. *Shchodo perspektyv vykorystannia alternatyvnykh dzherel enerhii na Skhodi Ukrainy* / Natsionalnyi instytut stratehichnykh doslidzhen. Available from: http://www.niss.gov.ua/articles/1174/

Pająk, K., Kamińska, B., Kvilinskyi, O., 2016, *Modern trends of financial sector development under the virtual regionalization conditions*. Financial and credit activity: problems of theory and practice, 2(21), 204-217, http://fkd.org.ua/article/view/91052/92128

Pająk, K., Zwierzchlewski, S., Kvilinskyi, O., 2016, *Franchising transfer of renewable energy technologies in the context of sustainable development of regions*. International Scientific-Practical Conference Modern Transformation of Economics and Management in the Era of Globalization: Conference Proceedings, Klaipeda: Baltia Publishing, pp. 27-30.

Pivnyak, H., 2013, *Al'ternatyvna enerhetyka v Ukrayini: monohrafiya* / H.H. Pivnyak, F.P. Shkrabets'; Nats. hirn. un-t. D.: NHU, – pp.56-57.

Price, L., 2010, *International experience with key program elements of industrial energy efficiency of greenhouse gas emissions reduction target-setting programs* / Price. L., Galitsky C., Kramer K.J. // Ernst Orlando Lawrence Berkeley Laboratory. Environmental Energy Technologies Division. February. P.49.

Renewable energy country attractiveness indices: February 2013. Available from: http://www.ey.com/GL/en/Industries/Cleantech/Renewable-energy-country-attractiveness-indices_February-2013.

Report of the IEA «World Energy Outlook», 2012. URL. Retrieved from: http://www.iea.org.

Sokhatska, O., 2011, S*uchasni tendentsiyi na svitovomu rynku netradytsiynykh ta vidnovlyuvanykh dzherel enerhiyi* / O.M. Sokhats'ka, N.Ye. Strel'bits'ka // Enerhosberezhenye. Enerhetyka. Enerhoaudyt – № 11(93). – pp. 38 – 52.

Stern, N. (2007). *The Economics of Climate Change: the Stern review*, Cambridge, UK: Cambridge University Press, P. 662.

*UN environmen*t, Bloomberg New Energy Finance from: https://www.carbonbrief.org/seven-charts-show-how-renewable-investment-broke-records-in-2015.

UN-backed report: Record new renewable power capacity added worldwide at lower cost / from https://www.eurekalert.org/pub_releases/2017-04/tca-mbf032817.php