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II. ARTICLES

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THE MAIN STRANDS AND DILEMMAS OF CONTEMPORARY ECONOMIC GROWTH THEORY

The aim of the article is to identify the main strands and some of the most important dilemmas of contemporary economic growth theory against the background of methodological dilemmas of the theory of economics. Several threads are taken up with reference to comprehensive professional literature. The most important ones are: the vagueness of distinction between economic growth and economic development (and its influence on the way of understanding and measuring of economic growth), the role of time and space in economic growth theory, the types of language describing economic growth, distinguishing marks of economic growth theory, the separateness of economic growth theory and fluctuations theory, the frontiers of quantitative and qualitative economic growth analysis, the belonging of economics to the group of nomothetic or idiographic sciences, the significance of inductive and deductive methods in economic theory, the existence of economic laws. The main thread of the article is an attempt to justify that the frontiers of economic growth sources and mechanisms recognition are defined by different types of language that constitutes their identification, description and quantification. The vital conclusion derived from the article is the postulate of the unity of sciences, leading to the necessity of creating new systems theory which would be the metalanguage or metatheory of economics.

Keywords: economic growth, economic development, economic growth theory, economics and economic growth dilemmas

JEL Classification Codes: A10, C10, O10, O40

INTRODUCTION

In this paper we try to identify the main strands and dilemmas of contemporary economic growth theory against the background of more general methodological dilemmas of the theory of economics. In Section 1 we deal with the key issues related to the interpretation and measurement of economic growth[1]. In Section 2 we take up the subject of the role of time and

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[1] The dilemmas that are related to this are, in our opinion, due to the vague distinction between economic growth and development. The discussed measures of economic growth (GDP and related measures, GGDP, ISEW, GPI) show that the discussion on the choice of the right

space in economic growth theory[2]. In Section 3 we consider the type of language used to describe economic growth[3]. In Section 4 we present some of the fundamental features of contemporary economic growth theory[4]. In Section 5 we discuss other distinguishing features of contemporary economic growth theory[5]. In Section 6 we turn our attention to the limited usefulness of and, at the same time, the need to employ mathematics in economic growth theory[6]. Finally, in Section 7 we discuss in a synthetic way

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measures of economic growth is still ongoing, which is caused by the disadvantages of GDP and similar measures, as well as by changing economic conditions (globalization, technological progress, natural environment degradation and the need for its protection).

[2] Time can be a continuous or discrete variable and it serves to introduce the order with respect to the sources, mechanisms and processes of economic growth. It should not, however, remain the only dimension of analysis of economic growth. The role of space in economic growth theory is insignificant. In the context of the paradigms of spatial economic theory, economic growth theory and, more generally, theory of economics, are aspatial.

[3] The underlying problem of the analyzed dilemmas is the one of exact or inexact definiteness of the mechanisms of economic growth. The synonym of exact definiteness is the deterministic approach, which dominates in the contemporary economic growth theory. The synonym of inexact definiteness of the description of economic phenomena is, in turn, stochastics or fuzziness (in the sense of the theory of fuzzy sets), which are, in our opinion, on the margin of the deterministic approach.

[4] Our considerations start by stating that the contemporary economic growth theory mostly develops in the neoclassical strand. However, due to the global economic crisis, we should expect the emergence of a few Keynesian models. The dilemmas remain such as the exogeneity or endogeneity of economic growth. We think that endogenous models prove a higher craftsmanship in economic growth modeling techniques. This does not mean, however, that this sort of theoretical constructions is fully satisfactory. Next, we discuss the following dilemmas: the meaning of competitive or general equilibrium in the modeling of economic growth and the issue of stationarity or non-stationarity of economic growth processes. In this part of the paper, we also describe the dilemmas associated with searching for determinants (labour, physical capital, human capital, social capital, technological progress, technology diffusion, innovations, institutions) and the evaluation of their influence on economic growth. The subject of interest is also the long-lasting dichotomy between the analysis of economic growth and fluctuations. We also pay attention to the insufficient development of work on the influence of monetary policy, or more generally the influence of money and capital markets, on economic growth.

[5] Namely: the improvement of quality and availability of macroeconomic statistical data, the pursuit of a stricter link between empirical research and growth theory, the increasing role of "stylized facts" of growth for economic growth theory, the link between growth theory and economic history and the strive for more coherence between the acquisition of statistical data and the state of development of economic growth theory.

[6] To this end, we present the views of Walras (1874), Panek (2003) and Wojtyna (2009).

the most important dilemmas of the theory of economics which influence the development of economic growth theory[7].

In this context, we try to justify the view that the limits for exploring the sources and mechanisms of economic growth are determined by different types of language of their identification, description and quantification.

1. WHAT IS ECONOMIC GROWTH AND HOW SHOULD IT BE MEASURED?

Economic growth is a measurable economic category, defined usually in terms of growth of annual production of goods and services in a given country. Commonly used measure of economic growth is Gross Domestic Product (GDP). As an aggregate variable expressed in monetary units, it is sensitive to price changes. Therefore, one should distinguish between real and nominal GDP, or real and nominal GDP growth. The former should identify the growth of GDP which is not due to price growth (inflation)[8].

The most widely used measure of economic growth is the growth rate of GDP. One usually assumes that economic growth in the short-run depends mostly on domestic and foreign demand on consumer and investment goods, whereas long-term economic growth is determined by supply and the efficiency of production factors: land, labour, physical capital (within neoclassical approach) and more recently, human capital, social capital, intellectual capital, cultural capital, technological progress, technology diffusion[9] and institutions (political and legal system).

Economists try to distinguish between economic growth and development. When they define economic development, they emphasize that it has a broader meaning than economic growth. One of the most interesting

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[7] In particular, we assume the necessary conditions for economics to belong to the group of nomologic (nomothetic) sciences, and not the idiographic ones. To this end, the further development of mathematical economics is needed. To make this development real, the knowledge of the most important limitations of using deductional methods in economic theory is useful, as well as of other methodological limitations that make formulating theorems that could be regarded as scientific laws difficult.

[8] Economic growth is a real category, rarely a nominal one. In turn, the subject of economic growth theory is, to a higher extent, potential, rather than real, economic growth.

[9] Although technology diffusion is one of the aspects of technological progress, it is sometimes isolated as a very important factor of growth, because of its specific role and meaning (e.g. the Nelson-Phelps model).

works, and at the same time rather unknown in Poland, are the publications of the outstanding French economist François Perroux (1961, 1993), where the distinction between growth and development is given. A more up-to-date approach can be found in an excellent book by Daron Acemoglu (2009), one of the most influential contemporary economists.

The basis for the distinction of these two aggregate economic categories is the fact that economic development is believed to consist also of qualitative changes (changes in the political and legal system, unmeasurable changes that influence economic growth, but are principally related to the improvement in the quality of life in a society).

However, this distinction is not sharp enough, as indicated by many years of lively discussion on the choice of the right measure of economic growth. Although GDP or GDP *per capita* still remains the most often used measure, the discussion on how to construct a better measure is far from being over. An important context in this discussion is the increasing tendency for globalization[10]. Among the relatively new reservations with respect to GDP and GDP *p.c.* as the measures of economic growth, one pays attention to the fact that globalization, one of the manifestations of which are the activities of international companies, results in difficulties to localize the places where the output of a given country is produced. Moreover, one often mentions the fact that these measures do not take into account (or take into account inexactly): redistribution of income, negative influence of economic growth on natural environment or the functioning of the informal sector of economy. Therefore, propositions to use alternative measures of economic growth emerge[11].

One of them is the so-called GGDP (*Green Gross Domestic Product*), a measure of economic growth which by design takes into account its influence on the environment. The basis for such measure is the postulate to treat the good condition of the environment on an equal footing with positive aspects of market economy. Such an approach, however, leads to several difficulties with measurement units, terminology and the choice of the elements of ecosystem that should be taken into account in the measurement of Green GDP. Boyd (2006) suggests that these problems can be overcome if ecosystem services are taken as the measurement unit. Ecosystem services

[10] The discussion on whether GDP or similar measures are the best to quantify economic growth has a long tradition. The summary of this discussion would take too long, hence we concentrate here on the relatively new aspects.

[11] This issue was studied in detail e.g. in Sobczak (2008).

are these elements of the environment that are used by society and give them some benefits. We should emphasize that ecosystem services are treated as final goods and are thus valued by the choices of individuals and society.

Another example is the *Index of Sustainable Economic Welfare*[12] (ISEW), which tries to balance consumer goods against income distribution, pollution costs and other costs that are not directly perceptible. This indicator should measure the economic order in the context of environment protection. Its construction is based on individual consumption, weighted by social inequality coefficient and particularly taking into account the ecological aspects. Empirical research for countries like Austria, Germany, The Netherlands, Scotland, the United Kingdom and the United States suggests that the indications of ISEW are less positive than the ones which result from GDP *p.c.* analysis.

According to Borys and Fiedor (2008), for most of the above mentioned countries the rate of growth of ISEW was negative after 1970, especially in the 1980s. However, it is difficult to be satisfied with the results of this research, partly due to doubts about the quality of statistical data used in the analysis[13].

Another example of an alternative measure of economic growth is the *Genuine Progress Indicator* (GPI). This is based on data regarding private consumption used to determine the level of GDP. In addition, it takes into account also the distribution of income, the value of housework and volunteer work, as well as the costs of crime and pollution. In GPI, one can distinguish two parts: a measure of current economic welfare and a measure of sustained economic development. According to Sharpe (1999), the former contains: consumer expenses, government expenses, non-market production, leisure and external factors associated with unemployment and pollution. To estimate the latter, one takes into account: exhausting of natural resources (non-renewable energy and land), net capital investments, net foreign credits, long-term environmental (greenhouse effect, ozone depletion) and ecological problems (loss of swamps and forests in favour of agricultural use). Comparative research showed that it is possible that a growth in GDP is accompanied by a constant or decreasing GPI. For example, according to van der Bergh (2007), GPI was increasing in the USA in the 1950s and 1960s, but has decreased by 45% since 1970, while GDP has increased in this period.

[12] Also called the Daly-Cobb indicator of natural resources.
[13] A review of work on ISEW and GPI is given e.g. in Lawn (2003).

While the traditional measures are accused of not taking into account some important factors that are the carriers of economic growth – the synonyms of progress, at the same time one has to admit that the improved indicators described above also have their disadvantages. The methodological assumptions concerning the costs of exhausting non-renewable resources and environment degradation in the long-run are still arguable. Moreover, GGDP, ISEW or GPI still need better methods of valuing their components in monetary units. These disadvantages caused that these indicators have not been commonly approved. Therefore, GDP and GDP *p.c.* remain the commonly used measures of economic growth[14].

It is worth to bring one's attention to a pragmatic thread in this discussion, related to the existing international standards of statistical registration of economic growth, important from the point of view of international comparisons. This includes e.g. the standards of Eurostat, the OECD, the International Monetary Fund, the World Bank or the United Nations[15].

2. TIME AND SPACE IN ECONOMIC GROWTH THEORY

Economic growth is an economic category whose variability is expressed in time and space. Generally speaking, because of considerable accomplishments of sciences, especially physics and mathematics, economists took over some of the tools to analyze the time variability of fundamental economic variables. Time is treated as a variable that puts in order economic mechanisms and process and, as such, is a discrete or continuous variable. Whether some economic categories are discrete or continuous is associated to the frequency of measurements of these categories.

In the statistical registration of processes in a real economy, one usually measures some variables in time intervals, hence most of the real categories (including GDP) are treated as discrete variables. In the nominal (financial) sphere, however, the frequency of data is so high (stock exchange, financial

[14] In this paper, we do not discuss measures concerning (in our view) socio-economic development rather than economic growth, such as the commonly known and used Human Development Index.

[15] The discussion about the measures of economic growth shows that the way of apprehending and measuring economic growth has not been fixed. Hence, we should not exclude the case that in the future we will commonly use some other indicator of economic growth than GDP or similar measures (GDP *p.c.*, GDP per employed, GDP per effective unit of labour).

markets) that most of the categories are treated as continuous variables. While the languages of continuous and discrete mathematics are in principle equivalent (the former is an approximation of the latter, with some error margin), the more interesting results in economic growth theory are obtained within the continuous approach.

To describe economic growth in the long-run, one applies interchangeably the theory of difference and differential equations, theory of dynamic programming, variational calculus and optimal control theory. It is worth to emphasize that the more intuitive formulation (probably because of discrete statistical registration) for most of economic growth problems is with discrete mathematics. However, in the modeling of economic growth, one more widely uses continuous mathematics.

Space in economic growth theory is usually treated in a trivial way, with no reference to spatial economic theory[16]. The spatial aspect emerges implicitly in connection with the comparative analysis of growth and development processes in various countries or groups of countries: OECD, EU, Euro Zone, ASEAN, NAFTA, CARICON, MERCOSUR, Common Market of Western Africa, Common Market of Eastern Africa, APEC, SPARTECA, etc. It does not change the conclusion that from the point of view of spatial economic theory[17], economic growth and development theories have aspatial character and the mechanisms and processes of economic growth are not localized in space – even when we analyze the dynamics of aggregated economic variables (GDP, labour, physical capital, human capital etc.) in different countries.

Hence, economic growth is an aggregate economic category related to particular countries. Nonetheless, such superficial treatment of the spatial dimension seems to be oversimplified. It is commonly known that geographic localization influences the quality and intensity of economic processes. In the spatial economic theory one considers various forms of space (geographic, economic) and their analysis suggests the need for a kind of mathematical language different than the one used in economic growth theory[18].

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[16] The principles of spatial economic theory are discussed e.g. in Ponsard (1988).

[17] The paradigms of spatial economic theory were formed by: Thünen (1826-1863), Weber (1909), Hotelling (1929), Lösch (1940), Christaller (1933), Isard (1956), (1969).

[18] Claude Ponsard, the outstanding French economist, was looking for many years for more subtle tools of formal description of economic phenomena and processes in space. He obtained interesting results by using the notions of graph theory, topology and fuzzy sets theory.

The abstract notion of space, e.g. in the topological sense, is related to the notion of structure. This is important when we want to fully understand the essence of the underlying economic processes. Such notions as: system, space, or the structure of space, defined within abstract theory of systems, should be more fully applied in contemporary economic growth theory. Apart from geographic space, the idea of economic space should be developed with a special innovative role of: knowledge, knowledge transfers, advanced technology, technology diffusion, technological progress and the modules of electronic economy which can be distinguished from traditional economic modules by the extent to which advanced information technologies are used.

3. THE TYPES OF LANGUAGE USED TO DESCRIBE ECONOMIC GROWTH

The basic tools of the mathematical theory of growth are models of economic growth, defined by a set of parameters and variables and hypothetical relations between them. Most of these theoretical constructions describe the sources, mechanisms and processes of economic growth through deterministic functional dependences.

Much more rarely, we apply stochastic theoretical constructions. Of course, one can give examples of stochastic models of growth[19], but in real applications these more refined and elegant constructions are in general too trivial[20].

It is also worth mentioning the fuzzy sets theory, which was supposed to be an alternative tool (with respect to stochastics) of description of inexact determinacy of economic phenomena and processes. In practice, however, it was not seriously used in economics (apart from a few problems in regional analysis, e.g. the problem of delimitation of regions), including economic growth theory.

The triviality of stochastic models of growth and the seldomness of their use is to some extent compensated for by the use of econometric models in economic growth analysis. They are widely applied, which does not mean, however, that they are always justified and lead to interesting results. An

[19] For example, models described in Acemoglu (2009): Brock-Mirman, Bewley and Real Business Cycle Models.

[20] Stochastic models of economic growth are a very attractive direction of development of economic growth theory. However, their usefulness in empirical research is still limited.

example of this kind of analyses are the works of Barro and Sala-i-Martin (1995, 2003) on economic convergence. Another example are applications of the time series analysis, whose aim is, however, more to recognize long-run tendencies, rather than to develop theoretical constructions useful from the point of view of economic growth. Also worth mentioning is spatial econometrics, most widely used so far in regional analysis and with very limited applicability as an auxiliary tool in economic growth analysis.

4. THE FUNDAMENTAL FEATURES OF CONTEMPORARY ECONOMIC GROWTH THEORY

Contemporary economic growth theory uses the accomplishments of Keynesian economic growth theory to a very small extent[21], with notable examples of the growth models of Harrod (1939) and Domar (1946).

The models that form the basis of economic growth theory are: Ramsey (1929), Solow (1956), Swan (1956), Mankiw, Romer, Weil (1992), Phelps (1961), (1966), Diamond (1965), Shell (1966, 1967), Cass (1965, 1972), Koopmans (1965), Uzawa (1961, 1964), Dixit, Stiglitz (1977), Azariadis, Drazen (1990).

In contemporary economic growth theory one distinguishes between exogenous and endogenous models of growth. The principal criterion for this distinction is whether the long-run growth rate is determined by factors outside of the model (exogenous) or by parameters and variables of the model (endogenous). Although the first attempts to endogenize the mechanisms of economic growth are related to the works of Kaldor (1957, 1963), Arrow (1962), Kaldor, Mirlees (1962), the true development of this class of models is related to the *AK* growth models[22] and the models of growth of Romer (1986a, 1986b, 1987, 1990), Lucas (1981, 1987), (1988), Rebelo (1991), Grossman, Helpman (1991), Jones (1996), Aghion, Howitt (1998, 2009).

An important and distinct strand was started by the work of Aghion, Howitt (1992), which refer directly to the idea of creative destruction of

[21] This can be explained by the fact that contemporary economic theory refers mainly to the neoclassical strand. One can however suppose that the present global economic crisis may lead to some work based on the Keynesian approach.

[22] A model of endogenous economic growth of the first generation, with linear AK production function, which does not satisfy the Inada conditions and thus is not a neoclassical production function.

Schumpeter (1934, 1939, 1942) and is a very interesting attempt to describe the innovative processes[23].

Most of the considerations of economic growth in finite or infinite time horizon are related to the ideas of competitive or general equilibrium. In most of the neoclassical models of growth problems of identification of the balanced or optimal growth, which is equivalent to determining the conditions of existence, uniqueness and usually local or asymptotically global stability of equilibrium play the central role. In most cases attention is paid to steady states and the description of the economy as a non-stationary system is still beyond the mainstream mathematical theory of economic growth. An example of this kind of work is the monograph of Panek (2006), where an attempt at a generalization of the notion of stability is made, without reference to equilibrium. It was also proved that with much less restrictive assumptions than in the case of stationary models, it is possible to have a stable growth of economies even without equilibrium.

Another strand of research on economic growth is related to the sources of economic growth, whose essence is to identify and determine the meaning of production factors other than: land, labour and physical capital.

Among this class of research, one can distinguish the work on human capital models or growth models with human capital. From the former group of models it is worth to mention the models of Mincer (1958), Becker (1962), Becker, Barro (1988), Becker, Murphy, Tamura (1990), Ben-Porath (1967), Hendricks (2002), from the latter it is worth to turn to the models of: Lucas (1988), Jones (1996), Manuelli, Seshadri (2005)[24].

In yet another class of models, the focus is on technological progress or technology diffusion. Here, the most important work was by: Rebelo (1991), Romer, (1986), (1990), Nelson, Phelps (1996), Benhabib, Spiegel (2002).

An interesting work that presents results of research on the influence of human capital, technological progress and technology diffusion on economic growth is the monograph by Cichy (2008), which is a kind of synthesis and original extension of this kind of research[25].

An interesting strand of research on the sources of economic growth is represented by Sala-i-Martin (2002) and is based on econometric cross-

[23] This class of models are called the neo-Schumpeterian models of economic growth.

[24] For a broader outlook on this class of models, see: Cichy, Malaga (2007).

[25] Advanced calibration methods and techniques from theoretical physics, including Monte Carlo simulations, were used. Original simulational models of economic growth were proposed – they create an interesting research perspective with respect to traditional growth models that apply analytical or numerical methods.

sectional regression models. The analysis of the factors of economic growth based on regression equations was started by Barro (1991). A review of empirical work can be found e.g. in Temple (1999). The aim of this research was to quantify the influence on economic growth of: institutions (free market, law of property, legal system), socio-political systems (democracy), trade exchange, knowledge transfer. This was a pioneering research, however, because of simplified methods and research techniques, the results are vague and sometimes even contradict one another.

The principal reason for this was the insufficient precision in defining the notion of an institution and more generally – the unmeasurable character of most of the exogenous variables in regression models. Moreover, regression analysis is an elementary econometric method, which allows only to find the correlation between independent variables and the dependent variable in a given sample. This is not enough from the point of view of reconstruction of relationships between socio-economic categories described with variables whose choice does not result from any theoretical model.

A relatively new strand of research on the sources of economic growth is the analysis of the interdependence of social capital and economic growth. Similarly to human capital, social capital is also not uniquely defined. Some researchers identify it with such properties of social organization as: trust, norms, agreements, which contribute to the higher efficiency of a society. An example of such an approach can be found in: Putnam, Leonardi, Nanetti (1993). Other researchers, in turn, relate it to some particular set of informal principles and norms, which make it possible for the members of the group to cooperate (Fukuyama 1997) or to a certain system of interpersonal relations (Putnam 2000). Because of the difficulties in defining social capital, this strand of research mostly deals with empirical relationship between social capital[26] and economic growth[27], with the use of regression models with aggregated data[28].

A very interesting strand of research and a dynamically developing one is on the relationship between economic growth and ecology (environment). This is related to the idea of sustainable growth and development. An example of the results of such work is given in: Brock, Taylor (2005).

[26] An interesting attempt at the systematization of knowledge on social capital from the sociological viewpoint is given in: Bartkowski (2007).
[27] More in: Sobczak (2008).
[28] A fuller review can be found in: Durlauf, Fafchamps (2005).

In the theory of economics, the analysis of economic growth is split from the analysis of fluctuations[29]. In economic growth theory, the problem of coordination is usually ignored and optimal allocation of resources following rational expectations of economic agents (consumers, producers, households, firms etc.) is assumed.

Under such conditions, the focus is on the description of equilibrium paths, determination of existence, uniqueness and stability of equilibrium and finally it is concluded whether the equilibrium is socially optimal in the sense of Pareto[30]. However, a principal problem remains – whether a certain economy is really in the neighbourhood of equilibrium. This boils down to know how to interpret the situation of particular economies which show more or less regular growth. To be more precise, the important thing is to know whether endogenous market forces (as well as rational behaviour of economic agents) drive the economy towards equilibrium or in the opposite direction and the movement towards equilibrium is only possible with the help of exogenous regulatory forces.

One of the central issues for many years has been the influence of technical/technological progress on the functioning of economies. If technological progress results from economic factors, usually prices, then the natural state of an economy is equilibrium. However, if technological progress influences economies through impulses (shocks), then important fluctuations can occur and they can drive the economies away from equilibrium.

In the theory of economic growth, one considers two matters. What is the source of fluctuations? How to identify the (usually exogenous) factors which lead to the smoothening of this kind of fluctuations? Against this background, one distinguishes balanced economic growth (or growth in the neighbourhood of equilibrium) from out-of-equilibrium economic growth.

An equally important branch of research is on the influence of monetary policy, or more generally financial markets, on economic growth. It is worth to recall here the first works of Leijonhufvud, Wicksell, Lindahl, Hayek, Laidler, Lundberg, Hicks, Robertson. This topic is becoming very important, due to the current world financial crisis. Despite this fact, it remains out of the mainstream research on the sources and mechanisms of economic growth and development. Thereby, against natural expectations, the distinction between the real and nominal sphere of economy does not decrease, also in

[29] This kind of dichotomy has lasted for dozens of years.
[30] It is worth to emphasize the conservative character of Pareto-optimality.

the dynamical picture. This kind of research is at least as important as the subject of the influence of technological progress, knowledge, human capital, social capital, intellectual capital, culture capital, knowledge transfer, technology diffusion on economic growth and development in the global scale. These issues are strictly interconnected with the need to identify and create the conditions for efficient functioning of institutions, with special attention to who is or should be responsible for keeping the right balance between the real and nominal (financial) sphere of the contemporary world economy.

Speaking generally, the principal aim of economics is to look for the answer to the question of the nature and causes of the wealth of nations. To this aim, two opposing methodological approaches are in use. First, there is the general equilibrium theory, treated as a metatheory for economics. In the second approach the creation of wealth boils down to the allocation of resources. In such a case, an alternative analysis method is used – one that can be described as a sequential one. This consists of analyzing economic phenomena and processes in a strictly defined time and space, instead of an analysis from the beginning to the end.

In contemporary economic growth theory, inadequate methods of economic growth analysis dominate, which do not take into account permanent structural and qualitative changes that occur in real economies. Also, the way economic fluctuations that take the form of business cycles are treated is extremely inadequate. There are two opposing approaches. The first states that market economy is governed by general laws which ensure that it returns to equilibrium. Therefore, fluctuations and cycles may exist only because of more or less random disturbances that result from exogenous factors (economic policy or shocks that affect productivity or preferences). Deviations from equilibrium are analyzed within probability theory or more advanced stochastic methods. In the second approach, fluctuations and cycles are treated as the result of random shocks. As an effect, one looks for endogenous causes of business cycles, or in other words one tries to identify economic laws which invoke cycles in a steady but irregular way.

In this way, two opposing ways of analysis coexist. In the former, one allows such behaviour that boils down to search for intertemporal optimum and equilibrium remains in the frame of reference. In the latter, one allows for limited rationality of economic agents and the focus is on mechanisms and processes out of equilibrium.

The complexity of economic mechanisms and processes means that the market is not a sufficiently efficient regulatory tool, which results in

fluctuations and business cycles. Special attention should be paid to imperfections in financial markets, which are the source of serious economic fluctuations. Such issues are related to the works of Kalecki (1934, 1939), Frisch (1933), Tinbergen (1939), Schumpeter (1939), Lange (1941), Wicksell[31], Goodwin (1967, 1990), Long, Lucas (1981, 1985), Hicks (1982), Day (1982), Plosser (1983, 1989), Kydland, Prescott (1982), Baumol, Quandt (1985), Mankiw (1989), Baumol, Benhabib (1989) and others. These papers well summarize many years of discussion on the essence and the way to describe business cycles, also in the context of economic growth. From the point of view of this paper, it is worth to emphasize that in these papers one can find a distinction of exogenous and endogenous business cycles, as well as an explanation of the influence of nonlinearity on the description of economic fluctuations and the essential details of chaos theory and its application to analyze the complex dynamics of economic systems[32].

5. OTHER DISTINGUISHING FEATURES OF CONTEMPORARY ECONOMIC GROWTH THEORY

There is a strong emphasis on empirical research in contemporary economic growth theory. This kind of research is possible owing to access to increasingly reliable and extended statistical databases.

A special role has been played by the database of Summers and Heston (1991). We should also be reminded of the pioneering works by Madison (1991, 2001, 2003), which provided a wealth of statistical data on the world economy in the long-run. Equally important were the databases of Barro and Lee, which were key in international comparisons in the areas of education and human capital quality, as well as the databases of Knack, Keefer and Deninger, Squire, which addressed the issues of politics, institutions and social policy[33].

Another distinguishing feature of contemporary economic growth theory is the pursuit of a stricter link between the results of empirical research and

[31] See: Stern, Talberg (eds.) (1979).

[32] Facing the current world financial crisis, this strand of research, characterized by the summary of its key literature, should be seriously extended. It is also worth to mention that the most recent work in this area contains many examples of application of non-trivial stochastic tools.

[33] These are of course not all available statistical databases. For example, in the monograph Malaga (2004), the databases *EIU Country Data, OECD, European Commission,* and also Summers, Heston, Atten, Nuxoll were used.

economic growth theory. At the foundations of many neoclassical models of growth one can find the so-called Kaldor's stylized facts of growth. Gomułka (2009) recalls the stylized facts of growth of Easterly and Levine and confronts them with his own stylized facts, in the context of theoretical considerations of a generalized endogenous growth model of Phelps for developed countries[34].

Against this background, one should emphasize the need to identify and verify the stylized facts of economic growth in the context of development of new growth models, which take into account new sources of economic growth (human capital, social capital, technological progress, technology diffusion, institutions).

The third distinguishing feature of contemporary economic growth theory is an attempt at making use of the knowledge provided by economic history to build models of growth. This would be the basis for the development of new growth models which could be a theoretical reference for considerations on economic growth processes in the retrospective and the prospective. An example of this kind of work can be found in Parente, Prescott (2003) and Gomułka (2009). This type of research does not aim at predictions, rather it is an attempt at a general reflection about the mechanisms and sources of long-term economic growth.

The fourth distinguishing feature of contemporary research on economic growth is an attempt to achieve consistency between the registration of statistical data and the development of new growth models. A good example of this approach is the monograph edited by Sykes and prefaced by Cotis (2005), which presents the effects of broad empirical research under *OECD Growth Project*, whose aim was to identify the stimulants of economic growth in OECD countries in the last decades of the 20th century.

Finally, it is also worth remembering the very extended research on economic convergence at international and regional levels, started by the works of Barro and Sala-i-Martin (1995, 2003). They are examples of recursive relationships between theoretical and empirical research,

[34] In his considerations on the need to develop separate growth models for developing and developed countries, Gomułka presents the recommendations of Breton Woods (IMF, World Bank), sometimes termed the *Washington consensus* and also recalls of the meaning of nominal criteria of convergence from the Maastricht Treaty for the realization of macroeconomic policy in the European Union countries.

concerning various aspects of economic convergence or divergence[35] (mainly of incomes) in the contemporary world economy[36].

6. THE FRONTIERS OF QUANTITATIVE AND QUALITATIVE ANALYSIS OF ECONOMIC GROWTH

Ever since Léon Walras (1874) stated that: „*When it comes to the language, why should we insist on strenuously and very inaccurately expressing in colloquial language the problems (as David Ricardo did and John Stuart Mill does in 'Principles of political economy') that can be expressed more precisely and accurately in the language of mathematics, with a small number of words"* nobody claims that using mathematics as the right language to formulate and solve complex economic problems is pointless.

However, it does not change the fact that the expectations towards mathematics have not been completely fulfilled. The first reason is the lack of sufficient knowledge of mathematics among economists. The second is an insufficient level of mathematical knowledge adequate to the complexity of economic, or more generally, social problems.

The discussion on the limits of measurability of socio-economic phenomena and processes is usually summarized by distinguishing quantitative analysis (when measurements and quantification are possible) and qualitative analysis (when a satisfactory measure and quantification is not possible). There is nothing wrong about this, unless it results from the lack of competency in economics or mathematics, which obviously hinders the search for new and more efficient tools for the description and solution of economic problems.

It is worth to cite here two characteristic opinions about the limits and the need to use mathematical language, or more generally, formalization, to the description of economic phenomena and processes.

Panek (2003) presents the problem in this way: „*The axiomatics of most mathematical theories is in its essence a reflection of phenomena taking*

[35] See: Malaga (2009).

[36] One of the most important problems that have not been properly concluded is the issue of the relationships between real and nominal economic convergence. Our opinion is that there is no satisfactory theoretical justification for this kind of relationship between nominal convergence (whose synonym are the convergence criteria from the Maastricht Treaty, together with their reference values) and real convergence.

place in the real world. Under such conditions, the task of a mathematical economist is exceptionally difficult. Declaring his support for a certain mathematical theory as the way to solve some economic problem, he should resolve whether the assumptions of this theory do not oversimplify the problem, rendering it irrelevant. At the same time, however, for the problem to be effectively solvable within a mathematical theory, it should be formulated in a possibly simple form.

Mathematical theories without strong assumptions usually give uninteresting theorems. The question of practical usefulness of a mathematical theory boils down particularly to the issue whether such formulation of a problem is possible that despite strong assumptions it is also interesting from the point of view of non-mathematical reality".

This important opinion is also pertinent with respect to economic growth theory. Wojtyna (2009), in the search for „deeper" and „even deeper" causes of economic growth, points to limitations of a different kind, which indeed contribute to the discussion on the language and context adequate to the complexity of sources, mechanisms and processes of economic growth.

Diagnosing the state of current research on economic growth, Wojtyna states: „*Similarly as in the case of other complicated, multithreaded processes and phenomena, the research on economic growth is conducted according to a typical scheme; when on account of progress in theoretical and empirical work, one finally identifies the causes, the proposed explanation soon ceases to be satisfactory. Although the cause is often very useful in understanding the chain of phenomena that it leads to, equally often there is a doubt whether we can say something convincing about the deeper sources of this cause*".

Referring to the relatively new result of among others Knack and Keffer (1995), Hall and Jones (1999), Acemoglu, Johnson and Robinson (2001), Dollar and Kraay (2003), Levine (2005), Eicher and Garcia-Peñalos (2006), Aghion (2006), Wojtyna (2009), he states that: „*Despite controversies, one can assume that among the hypotheses on the „deeper" causes of growth, the belief of the dominating role of institutions prevails".* The „even deeper" causes of growth are according to him „*cultural and political predispositions"*. The author cites two important opinions by North and Thomas (1973), who emphasized the difficulties to define the notion of institutions and Rodrik (2006), who warn that: „*the boom in research that points to the superior role of institutions in economic growth is starting to be dangerous, since it threatens to substitute the earlier wave of „market*

fundamentalism" with „institutional fundamentalism" (instead of getting prices right, the mantra becomes getting institutions right)".

The diagnosis of the state of research on economic growth is pertinent. Without doubt, it points to very important and interesting areas of reflection on the causes of economic growth. Moreover, one can expect that this kind of research can lead to interesting results, more universal than the knowledge of economic history.

However, without a breakthrough in choosing a more appropriate language to describe the mechanisms and processes of economic growth than the language that is currently used, it is hard to believe that the conclusions can fully satisfy the researchers.

7. ECONOMIC GROWTH DILEMMAS AS AN EXEMPLIFICATION OF THE METHODOLOGICAL DILEMMAS OF ECONOMICS[37]

If it is true that there is no precise and commonly accepted definition of science and particular disciplines of science differ in analytical methods of the relevant phenomena and the ways of formulating and proving theorems of interest, it is worth to remind, following Tadeusz Kotarbiński, that "*the common feature of all sciences is only an honest pursuit of truth*".

Referring to the principal aim of science – to discover general truths, commonly called scientific laws – it is worth to look at the classification of sciences which distinguishes nomologic (nomothetic) sciences, which deal with discovering laws, and idiographic sciences, whose aim is to describe the facts.

Let us remind that the principal features of a scientific law are: universality, exactness, uniqueness and the state that there are no exceptions within the range of validity of a law. Let us also emphasize what makes economic laws, usually formulated as theorems, specific.

Universal theorems are usually trivial and are not strict, whereas strict theorems can be non-trivial, but they are not universal. Therefore, there exist true theorems, even general ones, but devoid of practical (predictive) features, as well as local truths and theorems that are not only factographic, but devoid of practical or cognitive meaning.

When economists formulate theorems, they use inductive or deductive methods. Inductive methods consist in generalizing observations about the

[37] A very large part of this section directly refers to the opinions of Czerwiński (1996), which are shared by the author.

real world. Deductive methods, in turn, boil down to deriving theorems from a set of assumptions (mathematical economics), unfortunately it is worth as much as the underlying set of assumptions, often too idealized or uncheckable.

One of the commonly accepted forms of writing sets of assumptions is their expression in the form of an economic model (e.g. economic growth models in our case of interest). However, it is observed that increasingly refined mathematical, statistical and econometric methods, backed by computer tools[38], using increasingly rich and reliable databases, do not lead in a simple way to better results – decisions and forecasts.

In order to expose the above thesis, it is worth to ask the following questions. Which of the undertaken economic decisions could have protected us from the world economic crisis? Why have so many factors accumulated to make such deep, global and long-lasting crisis possible? Which causes were responsible for the fact that the regulatory mechanisms that had been hitherto used proved to be inefficient? When and which of economists foresaw the possibility of the occurrence of the current world financial crisis?

As a result, one can think that the discovery of universal (globally valid), strict and non-trivial economic laws that could be used to resolve current economic issues, is an unachieved ideal – we do not even know if it is feasible.

Against this background, there emerge principal kinds of dilemmas for economists: formulation of true general theorems, without practical value; formulation of true theorems, but with a limited range of validity in time and space; formulation of theorems that are *ceteris paribus* true, but false if understood literally or formulation of formal theorems as rigorous deduction from assumptions that are usually only loosely related to economic reality.

[38] It is also worth to ask the question about the meaning of informatics for the description and solution of economic problems. Can it, and to what extent, provide economists with more effective techniques to describe and solve real economic problems? Can it be the subject that will give us an effective language for the analysis of the complexity of real economic phenomena? Despite impressive progress in computer sciences, one should remain skeptical and stoical, which is needed at least to separate informational noise related to these advanced techniques from cognitive value added provided by informatics and related branches.

CONCLUSION

The limits of cognition in economics are set by the kind and quality of language used in social sciences.

Economic growth theory still remains in the focus of the theory of economics, hence the question of the causes and nature of wealth, first asked by Adam Smith (1776), still remains one of the superior questions that should be answered by economists.

Encountering the above dilemmas, we should concentrate on the improvement of quality of the language of description and formulation of economic problems, including ones related to economic growth and development.

Among the superior imperatives of this kind of activity, the following ones will undoubtedly be valid: „honest strive for truth", pursuit to formulate economic laws and a stronger link of economics with sciences (physics, mathematics, informatics) and social sciences (sociology, psychology, law).

Contrary to numerous barriers that we encounter in all disciplines of science, usually ignoring the fact that they are more common also outside of the subject we are dealing with, we should remain faithful to the idea of the unity of science and take actions to create a new theory of systems, which should play the role of a metatheory with respect to economics.

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