Innovation, Economic Growth and Inequality

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ABSTRACT

This article discusses the different types of growth (endogenous and exogenous; Schumpeterian and Smitiansky); analyzed their relationship with innovation and the territorial distribution of institutions of higher education (for example, the UK, USA and Ghana). Attempt rapprochement Schumpeterian and institutional approach to understanding the nature and economic growth. It emphasizes the influence of innovation activity on the basis of the ideas of Schumpeter of "creative destruction" on economic growth; held idea that the ability to build and practical use of innovations, due to the level of scientific and technological progress in some countries, it is essential to ensure quality of economic growth. It argues that cross-country differences in economic growth, level of education and innovation activities are also responsible for increased inequality in the distribution of income/wealth between countries and within countries, and one of the negative trends becomes decrease in the share of the middle class in developed and in developing countries.

Keywords: Economic Growth, Innovation, Inequality
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1. INTRODUCTION

For three decades, from the mid-1950s until the mid-1980s in the western economics is almost completely dominated by developed within the neoclassical theory of the concept of exogenous, i.e., brought into the economic system from the outside technological progress. It was proposed and substantiated in the works of Tinbergen, Solow, Harrod and several other well-known economists. Tinbergen, for example, believed that the slow increase in the impact of resources as a result of technological progress can be reflected by the inclusion of a neutral factor in the exponential technological progress multiplicative production function. The idea of a neutral technological progress (that at which it does not change the ratio of the values of certain parameters) was later developed by Hicks, Harrod and Solow (Kolemaev, 2005). However, Nelson and Winter, not without malice notice that the theory of Solow (innovation=shifts production function,

previously wrote about it, and Schumpeter) "does not explain literally nothing from the observed productivity growth" (Nelson and Winter, 2002). However, despite this, as well as the fact that in the opinion of many economists theory Solow cannot explain the difference in the richness of the different countries of the world (which is especially important for the purposes of this article), but this "failure" has stimulated the further development of the theory of endogenous growth (Mankiw et al., 1992).

Various studies carried out in the framework of the three-factor neoclassical growth model with a production function on an array of statistical indicators of the dynamics of the US economy, in different periods gave divergent, but always quite high estimates of the contribution of science and technology in economic growth.

In these studies, we are faced with the fact that technological progress has given the outside (exogenous) and is autonomous

in relation to the other two alternating three-factor neoclassical growth model-labor and capital. However, in most cases, technological innovation, "dissolved" in the factors of production (i.e., the set of endogenously). Then there is a situation in which capital and labor can, under certain technology becomes infinitely interchangeable (Kovalev, 1999).

From the neoclassical models implied that all countries have equal access to modern technologies, should be in the limit when entering the path of equilibrium growth, converging between a rate of change in labor productivity (of course, adjusted for differences in starting conditions, the rate of population growth, The savings rate of capital and factors beyond the simulated process). But, as Robert Solow admits talking about something similar to a convergence in the real economy can only be for the most industrialized countries and inappropriate when compared with the countries of Latin America, Africa and most of Asia.

An important theoretical breakthrough came in the mid-1980s. When Romer, Lucas, Aghion and Howitt, as well as several other researchers used a new approach to the construction of models of economic growth, providing the possibility of generating in the study of macroeconomic system inherent internal (endogenous) technological changes. As a result, the simulated system receives additional impetus to growth at the same ratio of the cost of traditional factors of production - Labor and capital. In the most general form, this is due to the accumulation of human capital, induces an increase in the effect of scale.

Of all the models we have mentioned the most useful for the purposes of our study has a model of Aghion and Howitt, because it is based on the ideas of Schumpeter on the role of creative destruction (partial bibliography of these researchers is given us in the list of references. See, for example, (Angus, 2010; Angus, 2013; Angus, https://www.press.princeton.edu/chapters/i10054.pdf; Richard et al., 2015; Elliott, http://www.theguardian.com/business/2015/jan/19/global-wealth-oxfam-inequality-davos-economic-summit-switzerland; Schumpeter et al.). In accordance with this model of economic growth driven by technological progress, which, in turn, is ensured by competition between firms, generating and implementing long-term product and technological innovation. Every innovation brings to market a new intermediate goods (product, technology), which can be used more effectively than ever before, the production of the final product.

2. LITERATURE REVIEW

The problem causes and sources of economic growth is one of the main areas of economics for decades; of the sources used is provided in the bibliography appended to this article.

2.1. Model of Aghion and Hewitt

On the relationship between education, science, innovation activity and economic growth, there is an extensive and ever-growing literature repeat that we are not - In the end, much of the innovation is created in universities and/or their affiliated organizations. We note only the following: In our view, the territorial distributions of scientific and educational institutions also have a significant impact on innovation and economic growth. For example, in the UK and the US to meet college or university in the countryside - are not uncommon. However, in developing countries the situation is different; there are universities - Almost exclusively urban phenomenon. For example, Kwame Nkrumah University of Science and Technology, one of the leading technological universities in West Africa, located in Kumasi, the second largest city of Ghana; in rural areas do not find anything similar (Richard et al., 2015; Kindle location 408). Example Ghana we still need, when we turn to the analysis of inequality in the distribution of income/wealth.

The main motivation for innovative companies is the prospect of monopoly rents in the case of the successful patenting innovations. Due to this rent covers costs associated with the development and implementation of innovations. However, the monopoly is automatically lost when the next innovation, which leads to the obsolescence of existing intermediate goods before him. The patent remains valid all the time to come, but its use is economically less profitable. The period between two consecutive successful innovations is a random variable due to the stochastic nature of the innovation process. The theory of endogenous growth based on innovation, argues that the way to increase the rate of economic growth is not the preservation of much of the production and transfer of the company's focus on research and development (R and D).

Model Aghion - Houita exploring the balance between three types available on the market include labor, final consumption goods and intermediate goods, which are necessary for the production of final consumption goods. For all markets except the market of intermediate goods, characterized by perfect competition.

In this regard, it must be remembered that different countries have very different access to scientific and technical progress and, more broadly, to innovate. However, as proof Acemoglu and Zilibotti even if all countries have equal access and so on, in which case there would be a difference in performance, which, in turn, would determine the difference in growth rates and the distribution of income (Daron, and Fabrizio, 2001).

As part of the analyzed model assumes that there are three categories of labor: Unskilled labor M, which can only be used for the production of final consumption goods; skilled labor force N, which can be used in the process of R and D and the production of intermediate goods; experts R, are engaged only in R and D.

Of final consumption goods are produced using intermediate goods constantly updated and fixed resources unskilled M. The corresponding production function is of the form:

$$y = AF(x)\ (F'>0,\ F''<0), \tag{1}$$

Where:

y - The volume of production of final consumption

x - The number of used intermediate products (technology)

A - Parameter characterizing the performance of intermediate goods.

Production of intermediate goods requires skilled labor costs. Appropriate human resources are allocated between the intermediate sector and the R and D. The total resources of skilled labor in the simulated system is to N.

The production process of the intermediate sector is linear:

$$x = L \qquad (2)$$

Where L - The outflow of skilled labor used in the intermediate sector.

The flow of innovations is randomly generated in the sector of R and D. The intensity of the flow of events is subject to a Poisson distribution, and is for any moment of the expression:

$$x = \lambda \varphi(n, R) \qquad (3)$$

Where:
n - Characterizes the part of skilled labor, which is occupied by R and D
λ - Constant parameter
φ - Concave production function for all n.

The values of λ and φ are determined by the peculiarities of the functioning of the R and D sector, including concentrated in this sector resource. It is assumed that all numerical values and rates between two adjacent events (appearance innovation) remain constant. Lags associated with the diffusion of new technologies available.

In the intermediate sector has always made the latest intermediate goods. The use of new intermediate goods leads to an increase in productivity parameter A in the sector of final products in time γ $(\gamma > 1)$:

$$A = A^0 \gamma^t \qquad (4)$$

Where:
A_0 - A value corresponding to the initial instant
t - In this case the sequence number innovations.

2.2. The Formalization of the Theory of Joseph Schumpeter of "Creative Destruction"

As part of the Schumpeterian theory (its genesis and further development was seen earlier [Dmitriev, 2011]) innovations create improved versions of older products, and aggregate output is played through a constant stream of intermediate products in accordance with the following formula:

$$Y = L^{1-\alpha} \int_0^1 A(i)^{1-\pm} x(i)^{\pm} di \qquad (5)$$

Where L - total labor costs, $x(i)$ - the amount of intermediate input i, A - parameter characterizing the performance of intermediate goods available for use.

Subsequently sector monopolized and held therein intermediates constant limit value.

Innovations in sector i consist of new versions whose grocery parameters $A(i)$ higher than previous versions due to the fixed factor $\gamma > 1$. Assume that the probability of innovation in the sector i is increased for a short time interval dt, which is equal to $\mu * dt$. Then the growth parameters $A(i)$ will be:

$$\frac{dA(i)}{A(i)} * \frac{1}{dt} = \begin{cases} (\gamma - 1) * \dfrac{1}{dt} \: with \: probability \: \propto * dt \\ 0 \: with \: probability \: 1 - \propto * dt \end{cases}$$

Accordingly, the expected growth in $A(i)$ is given by:

$$E(g) = \mu(\gamma - 1) \qquad (6)$$

The probability μ innovation in any sector is proportional to the flow of the performance adjusted for the cost of R and D:

$$\mu = \lambda R / A \qquad (7)$$

Where R - The final amount of R and D costs.

Thus, the theory of endogenous growth based on innovation, argues that the way to increase the rate of economic growth is not the preservation of much of the production and transfer of the company's focus on R and D (Peter, 2008).

2.3. The Use of "Cannibalization" Method in Innovation Management

Model Aghion - Howitt carries the idea of creative destruction Schumpeter: Every innovation is aimed at obtaining monopoly rents, but it also eliminates the monopoly rents previous innovations. The phenomenon of the supply of goods and services that compete with the previously manufactured by the same company line of products called cannibalization. When companies refuse to cannibalize their own products, they are under the influence of false representations, believing that if they did not withdraw into the market a new product, then that no one else will do. Therefore, they believe that prices will remain stable, and their incomes are protected. The Company will continue to adhere to this statement, referring to the strength of the performance of its share of the market and the high level of losses that consumers will suffer if they switch to the production of competitive goods.

Error that actually appear competitors; Moreover, the size of the market share it had previously appeared in the company actually is minimal, as the new product, if it is a worthy rival of the former, by definition, it has significant advantages. Customers can switch to the consumption of a new product, regardless of the future will soon change in prices. Consumer behavior of different groups of customers described us in the first section of this paper.

Thus, the refusal of cannibalization leading to a loss of market share and deterioration of economic indicators (Foster and Kaplan, 2005).

In more detail the use of "cannibalization" in innovation management discussed earlier in the relevant article (Dmitriev, 2013).

Value innovation is determined by the time of his life, which, in turn, depends on the number of specialists working in R and D sector following the implementation of innovations.

Every moment of time within the system being modeled society accepts only solution - How to allocate fixed resources of skilled labor between R and D and production.

Considering the conditions of stationary equilibrium of the system described, we, in the end, the expressions:

$$yt = AtF(N-n^*), \qquad (8)$$

$$AGP = \lambda\varphi(n^*)ln\gamma, \qquad (9)$$

$$VGR = \lambda\varphi(n^*)(ln\gamma)2, \qquad (10)$$

Where:
AGR - The average rate of economic growth
VGR -The dispersion of the average growth rate
n^* - The share of skilled labor associated with the production of intermediate goods.

Increasing the intensity of the flow of innovation, the scale of the impact of innovation on the economy and the share of skilled labor associated with the production of intermediate goods (ie the human capital in the field of R and D), leads to the equilibrium path to the increase in the average growth rate of the economy. However, the increase in interest rates has the opposite effect (Innovation Management: Concepts, multilevel strategies and mechanisms for innovative development, 2007). Financial aspects of the growth model based on the idea of creative destruction in detail in the article Morales (Morales, http://www.digital.csic.es/bitstream/10261/1911/1/48701.pdf).

2.4. Interrelation of Schumpeterian and Smitiansky Growth

Close enough to the position Howitt about Schumpeter model of endogenous growth is the point of view of Acemoglu. The difference is that Acemoglu emphasizes the role of international trade (Daron and Robinson, 2010), bringing together, thereby Schumpeterian and Smitiansky growth. (Read more about Schumpeterian, Smitiansky and other types of growth (Mokyr, 2014). Interestingly, Mokyr argues that business profits provided such innovations as railroads, "is a clear link between Schumpeterian and Smitiansky growth" (Mokyr, 2014), whereas Deaton writes that the construction of railways can reduce poverty, but they appear to be one of those "mechanisms that work in one context and do not work in another"(Angus, 2010).

2.5. Inequality of Income/Wealth as a Consequence of the Difference in the Rate of Economic Growth and Innovation Activity

The increase in revenue secured rates of economic growth are distributed very unevenly. As the results of the work carried out

by researchers from the National Bureau of Economic Research inequalities in the distribution of wealth in the US is close to its record level over the last 30 years, the share of household income, related to the 0.1% of the most affluent population, increased from 7 to 22%. (Emmanuel and Gabriel, http://www.nber.org/papers/w20625), almost reaching the figures recorded before World War I (Figure 1).
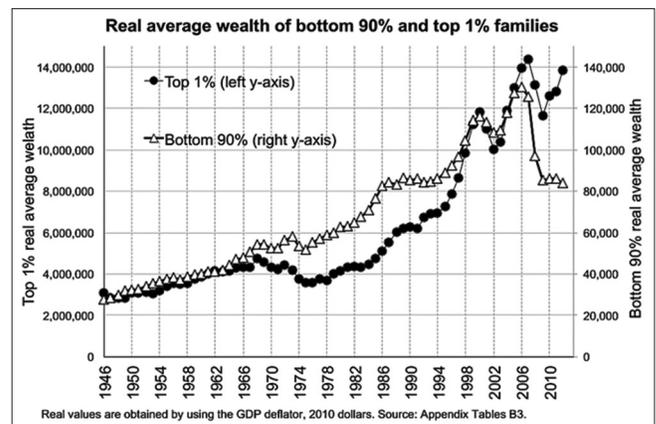
In turn, the income share of the poorest 90% of households has steadily declined as a result of the influence of a combination of rising debts, depreciation due to the global crisis of their financial assets, as well as low growth of real wages. The average level of income referred to 90% in 2012 was $80,000 - the same as in 1986, while the average income level of 1% of the wealthiest households from 1980 to 2012 increased more than 3 times (Monaghan, http://www.theguardian.com/business/2014/nov/13/us-wealth-inequality-top-01-worth-as-much-as-the-bottom-90).

This inequality is not unique to the United States, but also to other countries within the G20. For example, in Australia in 1980, the share of the richest 1% of households accounted for 4.8% of national income, while in 2010 this share was more than 9%; during the period when Australia chaired the "Big Twenty" (from 2013 to 2014.), the combined wealth of the G20 countries increased by 17 trillion dollars. USA; at the same time, the share of the richest 1% of households had 6.2 trillion dollars. USA, i.e., 36% of total growth (Monaghan, http://www.theguardian.com/business/2014/nov/13/us-wealth-inequality-top-01-worth-as-much-as-the-bottom-90).

At last year's Economic Forum in Davos, researchers from Oxfam International presented the report, which shows that the 85 wealthiest people on the planet have the same wealth as the 50% (i.e., 3.5 billion people) of the poorest; the comparison becomes even more impressive when you consider that in 2010 the number of the most wealthy people have the same wealth amounted to 388 people.

Scientists from Oxfam International concluded that the current trend will lead to the fact that by 2016 the richest 1% of households

Figure 1: The average values of 90% of the wealth of the poorest (right vertical axis) and 1% of the wealthiest households (left vertical axis)

will own more than 50% of global wealth (Elliott, http://www.theguardian.com/business/2015/jan/19/global-wealth-oxfam-inequality-davos-economic-summit-switzerland).

Figure 2 is a so-called "pyramid distribution of global wealth," according to a study compiled by Oxfam International:

With these resources, the richest part of the population has an enormous capacity to maintain the current status quo, using his success to change the "rules of the game" in their favor, for example, by using a tool such as lobbying. According to the Nobel laureate in economics in 2015 Angus Deaton, this is not the success that I should be proud of (Deaton, 2013). Deaton, incidentally, notes the paradox inherent inequality "inequality is often a consequence of progress. Can not all rich in the same time. In turn, the inequality can affect the progress" (Angus, https://press.princeton.edu/chapters/i10054.pdf). Here it is appropriate to recall the English proverb "necessity is the mother of invention" ("Necessity is the mother of invention").

In addition, negative symptoms are slow growth of incomes of the middle class, which hinders the growth of consumer demand, etc. This is evidenced by the data obtained by experts from Credit Suisse Research Institute (Elliott, http://www.theguardian.com/business/2015/jan/19/global-wealth-oxfam-inequality-davos-economic-summit-switzerland).

The above-mentioned tendency to property stratification inherent not only to developed countries. The proof of our thesis is an example of African countries (excluding South Africa). On the one hand, the skyscrapers of Accra, capital of Ghana, show a fairly high level of development of the construction industry and its financial center can be found throughout American businessmen, students over a cup of coffee stock quotes. (Urbanization and the above-noted concentration of educational institutions in the large cities of Africa, may serve as a confirmation of the thought of Marx that the bourgeoisie "... has created enormous cities, has greatly increased the urban population as compared with the rural, and has thus rescued a considerable part of the population from the idiocy of rural life" (Marx and Engels, 1955)). On the other hand, according to The Pew Research Centre, only 6% of Africans can be attributed to the middle

Figure 2: Pyramid of the distribution of global wealth

class (in Africa are people who earn from $10 to $20 a day, while 74% of the population lives only 74 cents per day), and it very small number is growing rapidly. Research conducted by the consulting company EIU Canback (partner of the influential British magazine "The Economist"), recorded only a slight increase in what are called "middle class") in the period from 2004 through 2014: From 4.4% to 6.2%; growth of the "upper middle class" (from $20 to $50 per day) in the same period was only 0.9% (from 1.4 to 2.3%).

Particularly noteworthy is the fact that the growth of the middle class, which is hardly spectacular, occurred against the background of annual economic growth of 5%, almost twice as fast as population growth (Few and far between, http://www.economist.com/news/middle-east-and-africa/21676774-africans-are-mainly-rich-or-poor-not-middle-class-should-worry?frsc=dg%7Cd).

3. DISCUSSION OF THE RESEARCH OUTCOMES

The reasons for these disparities are a low "initial conditions" of African States (there is no "free lunch" for which it is impossible to doubt), but, more importantly, revenue growth due to data growth is distributed very unevenly. And this inequality in recent years only increased. Confirmation of this hypothesis is the fact that the company Shoprite Holdings, the largest South African retailer, has opened in Nigeria 600 - 800 stores, closed most of them - now the number is only 12 - and with Cadbury and Coca-Cola shut down its plants in Kenya (Few and far between, http://www.economist.com/news/middle-east-and-africa/21676774-africans-are-mainly-rich-or-poor-not-middle-class-should-worry?frsc=dg%7Cd).

In turn, this inequality can be explained by the "vicious circle of political and economic institutions", as do Daron and Robinson (2010).

4. CONCLUSION

Against this backdrop, the concern of Pope Francis and IMF head Christine Lagarde aggravation property stratification, as well as the success of the book by Thomas Piketty "Capital in the XXI century" look quite reasonable, and fear Schumpeter, capitalism as "the civilization of inequality," "fast disappearing" (Schumpeter et al.) fairly realistic (to mention in this article about inequality, we have deliberately tried to avoid references to the book of Piketty, which became a bestseller economic past two years trying to preserve the independence of his own thought, formed, if not before the original "Capital in the Twenty-First Century", then at least before the publication of his Russian translation).

Strange as it may sound, but the innovation and strong economic growth did not reduce inequality in the growth of national income in different countries, on the other hand, this inequality is increasing.

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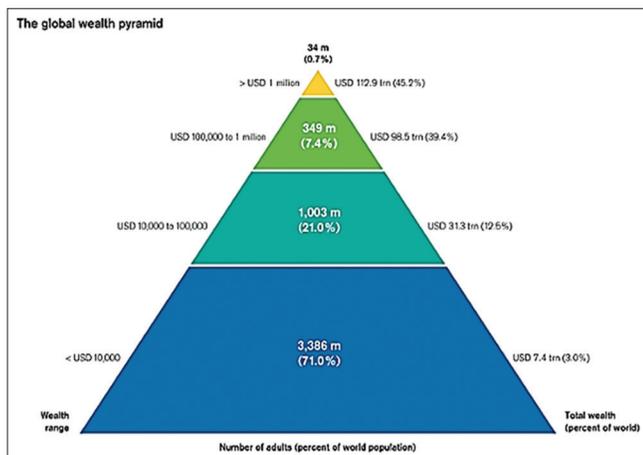
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