

## INNOVATION DIFFUSION AS A CATALYST FOR INDUSTRIAL COMPANY'S ECONOMIC GROWTH

**Elena Efimova<sup>1</sup>, Natalia Kuznetsova<sup>2</sup>, Julius Ramanauskas<sup>3</sup>**

<sup>1</sup> Prof. Dr. St. Petersburg State University. Universitetskaja nabereznaja 7/9.  
199034. St. Petersburg. Russia. E-mail elenaef@mail.ru

<sup>2</sup> Prof. Dr. St. Petersburg State University. E-mail nataliakuz2010@yandex.ru

<sup>3</sup> Prof. habil. Dr. Klaipėda University. E-mail Julius.Ramanauskas@asu.lt

*Received 09 05 2014; accepted 10 06 2014*

The goal of the paper concerns essential issue of economic growth diffusion and innovation diffusion in the context of its spatial dissemination forming framework of the electro technical industry of Russia and the Netherlands main actors micro-level growth comparison. Comparison of two companies economic growth and innovation diffusion proves that Russian high-tech LOMO<sup>4</sup> having inormous innnovation portfolio but lack of financial capital could proceed only organic growth and hierarchical innovation diffusion compared to financial and innovational world giant Philips which shows growth scenario of organic and inorganic growth assimilation that implies hierarchical innovation diffusion priority and higher competitiveness than LOMO.

*Keywords: diffusion of economic growth, innovation diffusion, innovative development, organic/inorganic growth.*

*JEL codes: D22, L63, O00, O31.*

### 1. Introduction

The economic growth as a long-term tendency of changing cycles of reproduction is a multidimensional phenomenon and one of the most important results of economic development and economic policy effectiveness in the innovation - informational economy. The goal of the study is to figure out classification of the innovation diffusion and its characteristics, which determine different types of economic growth at the micro and macro levels. The classical theories of the spatial allocation of production, exogenous economic growth and innovative business practices of individual companies serve as the **theoretical and methodological background** of the study. The main results of the study could be observed as follows: 1) the diffusion of innovations classification and consideration of innovation diffusion characteristics pre-determines different types of economic growth at the micro and macro levels in the center and periphery of the national economy; 2) comparison of two companies economic growth and innovation diffusion proves that Russian high-tech LOMO having tremendous (former Soviet) military innnovation portfolio but lack of financial capital and international cooperation ties could proceed only organic growth and hierar-

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<sup>4</sup> LOMO – Leningrad Optic-Mechanics Company

chical innovation diffusion compared to financial and innovational world giant Philips which shows growth scenario of organic and inorganic growth assimilation that implies hierarchical innovation diffusion priority (compared to contangence innovation diffusion) and higher competitiveness than LOMO.

A. Granberg (Strategic management..., 2004) sees the national economy's economic growth diffusion as follows. On the background of the continuing depression the economic growth starts within a small number of regions, using tactical competitive advantages and acting as the core of innovation and the pole of positive economic dynamics. Gradually a number of such regions increases; they form wider areas of growth and, finally, the spatial dissemination (diffusion) is resulted in a positive growth rate of the national economy as a whole. Under this conditions any (even highly-developed) country can be characterized by the duality of the economy and, along with fast-growing regions there exist depressed regions which could not reach the pre-crisis level of development. Russian academics' economic growth studies analysed at least three problems: 1) the necessity of economic growth concern in the historical and institutional context; 2) the problem of development duality in the center and periphery of national economies; 3) the idea of energy-oriented to innovation-driven type of economic growth conversion (Kuznetsova, 2001; 2009; 2012).

We could observe a number of prominent Western scholars regionalists among geographical diffusion of innovations researchers. T. Hägerstrand (1962) developed three-dimensional model of this process. A. R. Pred (1981) linked national economic growth, commercial expansion, and technological innovation to forming communications networks across American cities. Former French Prime Minister R. Barr (1995) considered internal and external factors of economic growth. He believed that development of service sector should not always be seen as the result of technical progress. It is actually happens in the case of the progress resulting from emansipation of the labor force from industrial and agricultural production sectors.

The diffusion approach of J. Richardson (2001) and H. Perloff (2005) provided two basic types of territorial systems in which the diffusion of innovations happens:

- a system of countries and regions of different levels of hierarchy, in which there always co-exist more developed core (center), and the closely related peripheral areas;
- hierarchical system of cities - the main centers of innovations, including the more advanced centers (R&D generators) and the centers of lower rank dependent from main centers.

Accordingly in a diffusion approach two separate lines of relationship between central and peripheral structures study were formed: wider, regional, lying in the most recent concepts and theories, and more narrow urban direction, the basis of the growth poles concept. One or another direction priority is mainly determined by the stage of economic development features, dictating certain system of views on the society's territorial organization.

The theory of polarized development which is a node in the regional studies is usually associated with the studies of F. Perroux (1961, 1979) and is a further deve-

development of the G. K. Myrdal theory (1957) with his principle of cumulative causation. Proponents of these concepts have proven the benefits of production concentration, particularly in several centers of dynamically developing industries, that gives considerable economic effect provided the policy of entrepreneurship and formation of start-up new firms stimulation. Initially the F. Perroux concept was based primarily on an analysis of economic factors in the regional development – the restructuring and revitalization of industrial organization, infrastructure, establishing a system of intra-and inter-regional economic relations. At the same time social problems associated with social differentiation, polarization and stratification as well as the negative impact of growth poles on the environment, etc. remained in the shadow of the academic mainstream. The concept of growth poles formed the basis of many countries regional programs. Creating poles and development centers initially had the objectives of enhancing economic activity in peripheral areas (Gritsay, 1991).

The **problem** that was not discussed by the scholars staying outside the mainstream of the regional and economic growth studies considers the interaction of innovation and economic growth diffusion and the "center - periphery" model issues and hence the method of this interconnection analysis. The theoretical framework of this problem is clarified in part 1. Diffusion and the "center-periphery" model. The practical concern of this relationship and spatial diffusion characteristics deals with the microlevel innovation diffusion as a economic growth catalyst which could be implemented to large-scaled high-tech companies comparison of different countries. The latter issue is considered in part 2. discussing case-Study of „LOMO“ and „Phillips“.

## **1. Diffusion and the "center-periphery" model**

Classic concept of "center-periphery" was stated by J. Friedmann (1966; 1973) who attempted to integrate regional and urban areas in regional research and develop a general theory of regional development. J.Friedmann distinguishes two types of peripheral regions: upward transitional regions – those regions which could liquidate the traditional dependancy from the center, being in fact its part and downward transitional regions – those regions which are losing their key position and transforming into peripheral areas.

Modern geographical theories consider diffusion in a wide spectrum of issues, including the organization, architectural styles, and technological innovation. Geographical aspect of the diffusion analysis is constantly stable in the issue of joining at least one area or region which is the source of the diffusion process.

Spatial diffusion characteristics are often classified into 2 types:

- contangious diffusion means that the process of geographical spread is limited to the distance between the diffusion source and the receptor;
- hierarchical diffusion is exposed to the influence of economic and / or political links between the source and receptors in addition to and even as an alternative to the distance, considered as a determining factor of diffusion.

In practice the difference between these two types of diffusions often erases. Temporal and spatial characteristics of the diffusion can be divided for research purposes. The time characteristic is described by the following formula:

$$P = \frac{L}{1 + a \cdot e^{-bt}} \quad (1),$$

where  $P$  – the share of consumers receiving the scattered flux at time  $t$ ;  $L$  – marginal share;  $a$  – initial position ( $P$  at  $t = 0$ );  $b$  – statistically defined parameter.

Logistic growth processes occur first as weak, then amplified, and then weakening again. The dominant characteristics of spatial diffusion is "distance decay" which is defined by function:

$$I_{ij} = D_{ij}^{-k} \quad (2),$$

where  $I_{ij}$  – degree of spatial interaction between the  $i$ -th and  $j$ -th place;  $D_{ij}$  – distance between the  $i$ -th and  $j$ -th places;  $k$  – statistically defined parameter.

Spatial decay function has the form of a hyperbola. Points located close to each other have more interaction. Temporal and spatial characteristics of the diffusion can be described as a 4-staged process:

- establishment of the source of diffusion;
- diffusion rapidly activated in the immediate vicinity of the source;
- diffusion spread over longer distances;
- saturation stage where all the items under consideration reached the highest level of consumption, defined by logistic model.

Hierarchical diffusion was modeled by J. Hudson (1969). The distance decay function included an amendment about more probable interaction of larger items compared with smaller (gravity model). In the hierarchical model, the largest regional center is seen as a source of any innovation spread. First innovations are distributed in the vicinity of the source, then they are slowly removing. In this approach, the size of population and distance are equally important determinants of diffusion.

Innovations' diffusion of different types determines different types of economic growth at the micro and macro levels. Starting point of the exogenous economic growth study is the growth rate of the economy relationship with propensity to save or to invest. In a simple case a single reason for the per capita increasing is the accumulation of fixed capital. At the microeconomic level the firms' managers hires productive resources (labor, capital, technology) and uses them to produce goods for further sale to other firms or households. Volumes of demand and supply determine the relative prices for resources and goods produced. The production function takes a form:

$$Y(t) = F[K(t), L(t), T(t)] \quad (3),$$

where  $Y(t)$  – flow of commodity produced at time period  $t$ ;  $K(t)$  – capital resource;  $L(t)$  – labour resource;  $T(t)$  – knowledge and technologies used in production process at time period  $t$ .

The manufacturing process presupposes the inability to use the same resources of labor and capital, which, in turn, can use the same technology, knowledge and information. In post-industrial society information is transformed into information resource – a set of constantly updated fundamental and applied scientific, technical and socio-humanitarian knowledges, engineering, managerial and organizational decisions, social and professional experience of the population (the aggregate intellect), which are used as the subject of labor and determine sustainable economic growth and social development of society. Production of informational services that embody the specified resource is processed not only by special information sector, the share of which in GDP is growing rapidly, but by all citizens who have free access to Web. Recent studies of Western theoretical researches indicates that the conversion of information into the most important resource changes the production paradigm at the society's evolution, reduces the dependence of economic growth in the country from its endowment of natural resources, fixed capital, active population and other extensive factors that exhibit the highest entropy, ie chaotic scattering (Machlup, 1966). Thus, different manufacturers who wish to produce a certain volume of production, must use different number of machines and workers, but can use the same knowledge, information, and technology.

This is what predetermines different types of economic growth and different level of economic development achieved in the industrial economy, including a sector of knowledge based economy. In the new economy, according to J. Bradford DeLong (2003) three cornerstones of the market system disappear: 1) excludability – an ability of sellers-monopolies to dictate the terms of trade; 2) rivalry – large companies competitive advantages associated with relative costs decrease accompanied by the mass production of standard products increase; 3) transparency – certainty and obviousness of the demand for goods and services.

## **2. Case-Study of "LOMO" and "Phillips"**

To illustrate the classes of innovational and economic growth diffusions at the micro level it is suitable to proceed the comparison of the same sectoral market in Russia and Netherlands two companies – the production of high-tech goods of optical-electronic industry – products of Fine Mechanics and Optics: Russian manufacturer „LOMO“ (LOMO, 2012) and Dutch manufacturer „Philips“ (Delivering... 2013).

This case-study has certain limitations in statistics and informational data provision: LOMO's information is more descriptive than Philips', it doesn't provide a reader with annual precise balance sheets, data concerning employment, fixed and financial capital at use, etc., etc. due to the fact that this company is considered to be the bread and butter of the Russian Defense Industrial complex and hence an object of national security and top secrets of the government. This lack of data decreases a val-

ue of research and recommendations that could be done to LOMO and makes it unreasonable to imply statistics accessible from Philips but not accessible from LOMO. But generally in spite of different economic systems models, different stages and levels of development in Russia and the Netherlands the provided material could be used for the purposes of comparative economic study concerning innovational and economic growth diffusion on the micro-level of high-tech companies producing approximately the same range of goods and products.

Differences in innovational and economic growth diffusion models of two companies under consideration are explained by the scale of production, specifics of its allocation, characteristics of industrial organization and their market regulation, enterprises belonging to the sectors related to national security.

Simultaneously we could observe that the following scenarios of organic growth (the concentration of capital as a result of introduction of the technical-technological and scientific progress implementation) or inorganic growth (centralization of capital as a result of a merger or acquisition) may mean diffusions – contagious diffusion in the first case and the hierarchical diffusion – in the second.

Both companies were founded approximately in the same years: Philips in 1891, LOMO in 1914 during the last period of European industrialization known as electro-technical revolution. Both companies in the beginning of their existence started to provide the armies of the states involved in the II WW with military technique and equipment, but LOMO kept this industrial organization and military specialization via the 70 years of the Soviet period, Philips' productive divisions through the 93 years of its functioning were focused primarily in the field of Healthcare, Consumer Lifestyle and Lighting simultaneously fulfilling state orders in the area of military technique.

Historically compared to Philips Company LOMO for 70 years being natural monopoly and state owned enterprise never executed inorganic economic growth and couldn't experience M&A process. Overall state support in fundamental and applied R&D allowed LOMO to accumulate huge innovational portfolio that in the XX-c. 90-s was the basis for conversion from military to civilian national and international specialization during the painful period of overcoming from plan to market in spite of financial and managerial capital lack. Once and again LOMO has a chance to proceed with organic innovational growth and inside diffusion of innovations as well as highly qualified human capital implementation. New innovational development of the company and former Soviet and new Russian innovation portfolio implementation allows it to be at the highest international level in the optics, electronics and precise mechanics area.

Philips has a chance to combine both organic and inorganic growth due to the enormous financial potential, high competitive international position and well-known international brand of the company. We could observe both contagious technological diffusion between separate strategic business units (SBUs) and hierarchy diffu-

sion between Head Quarter Philips Group Innovation<sup>5</sup> и regional and local centers through over the world. Innovations are the primary factor of Philips' strategic development. It is the key aspect of how the company keeps leader position. As a result of the strategic development nowadays Philips is organized into three main divisions: Philips Consumer Lifestyle (formerly Philips Consumer Electronics and Philips Domestic Appliances and Personal Care), Philips Healthcare (formerly Philips Medical Systems) and Philips Lighting. Distance decays (see formula 2) for all SBUs have constantly large estimations. It allows to reach long distance aggressive diffusion of technologies that provide production activities (see formula 3).

Philips's hierarchical diffusion is supported by its international organizational structure (see Table). The data depicted in the table were taken from the company's Annual Report (Delivering... 2013). Phillips is characterized by the technical and technological diffusion between different departments of the company and between different national and transnational companies in electronic equipments industry allocating more than 50 R&D centers and 100 manufacturing sites all over the world employing 114000 people across more than 60 countries.

Table. Philips's international organizational structure

	Sales	Number of employees	R&D centers	Manufacturing sites	Assets
Asia & Pacific (Including Russia and CIS)	7439	40438	13	25	5357
EMEA (Europe, Middle East and Africa)	7410	41829	21	40	9735
Latin America (excluding Mexico)	1439	3189	3	6	947
North America (including Mexico)	7041	29233	22	40	10520

In 2013 R&D centers includes group and sector centers. The quantity of productive units is as twice as big compared to R&D centers which include sub-departments servicing overlapping sectors and separate product's groups. The main part of employees are occupied in production allocated "Asia & Pacific" region. Successful spatial location of SBUs allowed to proceed a policy of inorganic growth due to the use if large capital accumulation.

Inorganic growth of Philips (compared to its absence at LOMO) is provided by the process of M&A. For example, in 2013, there were four minor acquisitions. Acquisitions in 2013 and previous years led to post-merger integration charges totaling EUR 16 million in 2013: Healthcare EUR 6 million, Consumer Lifestyle EUR 4 million, and Lighting EUR 6 million.

<sup>5</sup> By adopting harnessing its relationships with institutes, academia and industrial partners, Philips Group Innovation leverages its company-wide synergies in technology, IP, research, design, shared competencies and laboratories to bring innovations to the market faster and more effectively. Philips Group innovation encompasses Philips Research, Philips Innovation Services, Intellectual Property & Standards (IP&S), the Philips Innovation Campus, Healthcare Incubators as well as Philips Design. Philips Group Innovation employs about 5 000 professionals around the world.

Nowadays LOMO started the process of inside innovational diffusion and organic economic growth in the condition of industrial organization of the market economy formation. LOMO as well as Philips preceded with the process of different specialized division creation approximately the same as at Philips: Medical, Telescopic, various Monitoring including lasers-scanners and night vision devices, special equipment for the Army, Air Force, Navy and space. However LOMO's specialization (defense-industrial complex) and lack of financial opportunities doesn't give an opportunity to large-scaled inorganic growth. Moreover, technological distance decays (see formula 2) for the industrial units are estimated as slow. The fixed capital in the production function (see formula 3) divided into three parts is allocated to technological resources. Therefore the scale of production is small. The company has not any international ranks.

Innovation is at the heart and soul of both LOMO and Philips – it is vital to the strategy of the entire LOMO and Philips organization and it is the key aspect of how Philips and LOMO have won in the past (in spite of different product lines, different market experience and models of industrial organization development), is winning today, and will win in the future in their own high-tech regional and international markets.

### 3. Conclusion

1. The classical theories of the spatial allocation of production, exogenous economic growth and innovative business practices of individual companies serve as the theoretical and methodological background of the interdisciplinary study.

2. The diffusion of innovations classification and consideration of diffusion of innovations characteristics predetermines different types of economic growth at the micro and macro levels in the center and periphery of the national economy.

3. The classification of the types of economic growth at the micro and macro levels gives an opportunity to point out two types of microlevel economic growth: organic and inorganic.

4. For the theory of spatial diffusion characteristics implementation to the micro level of large-scaled, high-tech companies of Russia (LOMO) and Netherland (Philips)

4.1 spatial diffusion is classified into 2 types: contagious diffusion and hierarchical diffusion;

4.2 choice of the diffusion type is defined by specialization, by the character and scale of the company's international activities.

5. Given historic and institutional limitations the same industrial organization market is observed in the case study in Russia and the Netherlands including two companies which specialize in the production of high-tech goods of optical-electronic industry: Russian manufacturer „LOMO“ and Dutch manufacturer „Philips“. This comparison led to the following summing –up conclusions:

5.1. both companies have almost the same economic historical background;

5.2. the Soviet economy isolation presupposes impossibility of full-scale implementation of “center-periphery” model for LOMO which demonstrates primarily contagious diffusion. Besides relatively modest scale of LOMO (it is not included in any significant international rating) is dictated by the fact that the company had (and still have) no need of extensive economic growth that predetermines to follow organic growth model.

5.3. LOMO via the 100-years history proceeds only with organic innovational growth and inside innovation diffusion, Philips figures out interaction of two types of growth: organic and inorganic accompanied by inside and outside innovation diffusion.

5.4. Technological distance decay affects deeply the company's scale of production. Philips increases its business activity in different regions and countries. Increasing scale of production leads to the world leadership in the industries that the company occupies.

5.5. LOMO which still is financially weak company keeps product-oriented military industrial organization of national security provision and demonstrates organic growth scenario that implies (in future as well) prior contagious diffusion. Philips as a world financial mightiest TNC having client-oriented sales strategy demonstrates growth scenario of organic and inorganic growth assimilation that implies hierarchical innovation diffusion priority compared to contagious diffusion and higher competitiveness than LOMO.

6. Results of micro-level international comparison of economic growth diffusion and innovation diffusion of the same high-tech industrial organization prove the higher competitive advantages that could be provided by the assimilation of organic and inorganic growth and convergence of contagious and hierarchical innovation diffusion.

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## **INOVACIJŲ SKLAIDA KAIP GAMYBINĖS ĮMONĖS EKONOMINIO AUGIMO KATALIZATORIUS**

**Elena Efimova<sup>1</sup>, Natalia Kuznetsova<sup>2</sup>, Julius Ramanauskas<sup>3</sup>**  
*<sup>1,2</sup> Sankt Peterburgo valstybinis universitetas, <sup>3</sup> Klaipėdos universitetas*

*Įteikta 2014 05 09; priimta 2014 06 10*

### **Santrauka**

Straipsnio tikslas – apibūdinti inovacijų sklaidos būdus ir jų ypatybes, lemiančias skirtingą ekonominį augimą mikro ir makro lygmenyse, nustatyti ryšius tarp inovacijų plėtros ir ekonominio augimo. Straipsnyje palyginamas organinis ir neorganinis ekonominis augimas kompanijų LOMO (Rusija) ir PHILLIPS (Nyderlandai) – pagrindinių homogeniškų elektros prietaisų rinkų dalyvių – pavyzdžiu. Klasikinės geografinio produkcijos paskirstymo, egzogeninio ekonominio augimo ir inovatyvios verslo praktikos teorijos sudaro teorinį ir metodologinį tyrimo pagrindą.

*Reikšminiai žodžiai: ekonominio augimo sklaida, inovacijų plėtra, organinis augimas.*

*JEL kodai: D22, L63, O00, O31.*