Features of the Entrepreneurship Development in Digital Economy

Irina Gontareva 1, Maryna Chorna 2, Dariusz Pawlischczy 3, Marta Barna 4, Oleksandr Dorokhov 1, Oksana Osinska 3

1 Kharkiv National University of Economics, Kharkiv, Ukraine
2 Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
3 Municipal Office Gromadka, Mayor Gromadka, Gromadka, Poland
4 Lviv University of Trade and Economics, Lviv, Ukraine

Abstract – The broad introduction of digital technologies makes changes in the structure of socio-economic relations between labor and capital in the market, affecting its informational efficiency.

The purpose of the article is a systems analysis of the structure of the cause and effect relationships between the informational efficiency of exchange prices, which affect the desired rate of return for investors; characteristics of the digital economy, methods used by entrepreneurs to evaluate specific assets.

The analysis of the informational efficiency of markets based on the Fama-Samuelson criterion and conducted with the use of likelihood functions showed the down trend in the informativeness of exchange prices.

According to the authors, this is due to a significant discrepancy in the price of transactions with real goods and futures operations, which are based on a variety of rational and irrational expectations.

At the same time, the disproportionate growth of the derivative capital strengthens the influence of irrational expectations and contributes to the growth of the number of speculative transactions while the uncertainty of the external business environment is growing.

Under these conditions, it is proposed to use the real options theory to evaluate specific tangible assets of entrepreneurial projects.

Furthermore, the authors outlined the main characteristics of the digital economy in terms of entrepreneurship; carried out an analysis of market-based business opportunities resulting from the characteristics of the digital economy. On this basis, two causal chains are specified.

For entrepreneurs in traditional spheres of activity, which has the following form: cause: excess labor — effect: a chance for development — market conditions: entrepreneurial activity, public-private partnership.

And for entrepreneurs in the field of information and communication technologies, which is as follows: cause: poor structuring of information — effect: a chance for development — implementation conditions: availability of ideas for structuring of information flows.

Keywords – Informativeness of Market Prices, Entrepreneurship, Market Based Business Opportunities, Structuring of Information, Information Society, Real Options Theory.

1. Introduction

The World Bank Report 2016 “Digital dividends” [31] shows three main negative trends in the current stage of the world economy: the fall in the growth rate of labor productivity; the increasing inequality in the distribution of income both within countries and between developed and developing countries; the high level of monopolization in the field of innovative information and communication technologies (ICTs) despite the high speed of their spread in the world. Thus, during the last thirty years, the provision of the world population with mobile phones has grown from almost 0 % to 90 %. At the same time, the food supply has deteriorated in many regions of the world, and the level of income inequality in the developed countries is growing even faster than in the developing countries, and has reached its maximum for more than a hundred years.
Without removing these trends, the challenges of achieving sustainable development for individual countries and for the world economy as a whole are becoming more complicated.

In this regard, there arise two questions: how effective the market in the digital economy is and what are the features of the perception of signals of the modern market among entrepreneurs, who ultimately ensure the overall efficiency of social production.

It can be assumed that all three noted trends are interrelated. As shown by statistical studies, in particular, those presented by P. Aghion et al. [1], the redistribution of incomes occurs in favor of the financial structures and management of large oligopolistic companies.

The main way of income redistribution is the deviation of equivalence in the exchange values arising from exchange transactions. One of the reasons for such deviations, Nobel laureate J. Stiglitz [28] calls derivatives operations.

The theory of financial derivatives using the example of options was proposed by Nobel laureates F. Black and M. Scholes [5]. It is based on a normal probability distribution, which causes difficulties in its application in the case of sharp fluctuations in exchange prices.

At the same time, entrepreneurs, in addition to exchange prices, require evaluations of specific tangible and intangible assets to carry out their activities.

To evaluate non-exchange assets, the real options method can be used. It is based on the Black-Scholes model, but includes a number of additional conditions proposed by Nobel laureate R. Merton [22]. His proposal broadens the scope of financial options while involving a reduction in the level of formalization of decision-making.

The valuation of intangible assets and the formation of an integral assessment of the comparative efficiency of spending and the probability of generating income are even less formalized and based on subjective assessments of probabilities.

To accept or not to accept all these risks depends on the characteristics of the external environment and how they are assessed and perceived by entrepreneurs. Thus, entrepreneurship as a form, way and process of personal participation in socioeconomic relations becomes the main means to achieve system efficiency of the development of the world, national and regional economies [6, 12].

Entrepreneurship is based on a personal initiative, accepting all the complexities and risks of doing business in order to obtain social, economic and moral benefits [7].

At the same time, the entrepreneur uses all available resources, including digital technologies for collecting and processing information. The mobile phone, computer, Internet and other benefits of digital economy are in demand, because they have real consumer value in the vast majority of spheres of the entrepreneur’s life.

Given that entrepreneurship is an important element of economic development, the problems of efficiency of use, by small and medium-sized enterprises, of the opportunities offered by the market digital economy require applying the systems approach to analyzing the structure of cause and effect relationships and patterns of development of both enterprises and their surrounding environment.

The term “digital economy” was first used in 1995. According to the author of this term, Nicholas Negroponte, the distinguishing feature of the digital economy is the transition from atom processing to bit processing [23]. The main work material for the digital economy is information, which is collected and processed with the use of digital technologies. As a result, either new information products appear — software, advertising, virtual games, etc.; or services for the organization of communication channels — trade, Internet banking, remote consulting, etc. As an expert in the field of computer science, N. Negroponte did not pay much attention to the consistency of the new term with general economic concepts and categories.

Further rapid dissemination of the term “digital economy” in diverse scientific, managerial and political circles significantly expanded the scope of its application and, accordingly, complicated its morphology, semantics and pragmatic significance.

To date, there are two basic approaches to understanding the digital economy [8, 19, 24, 32]. The first approach is more interconnected with the views of N. Negroponte.

According to it, the digital economy includes the industries involved in production and consumption, where digital processing of information plays a decisive role in creating consumer value. They are media content — cinema, television, computer games; telecommunications and related distance learning, consulting, commercial electronic operations; electronic financial and monetary systems.

The second approach states that the digital economy also includes all technologies, products and services, in which information and material processes and elements are combined in a coherent system.

In particular, these are computers, mobile phones, digital cameras, robotic installations and production, automatic and automated control systems for complex objects. In the future, the authors of the
article will proceed from the expanded understanding of the digital economy.

Statistical studies and theoretical evaluations confirm a wide impact of the digital economy on socio-economic development [12, 13, 20, 21, 31]. At the same time, the authors of the article agree with H. Matlay & M. Addis [20], who believe that there is a lack of connectivity in understanding the issues related to the use of information and communication technologies (ICTs) in business.

In the literature, problems and prospects for the entrepreneurship development in the digital economy are not adequately covered. In order to assess these prospects, it is necessary to understand what information the entrepreneur is looking for, how he evaluates and uses the emerging market-based options (business opportunities).

2. Aims of research

The purpose of this article is a systems analysis of the structure of cause and effect relationships between the informational efficiency of the market, characteristics of the digital economy, and opportunities for the development of entrepreneurship.

To achieve the goal it is supposed: to identify the reasons for the decrease in the informativeness of exchange prices; show the possibilities of using the real options theory to assess the prospects of an entrepreneurial idea; demonstrate the need for complementarity between traditional and digital economies; highlight the main — in terms of entrepreneurship — features of the digital economy; analyze the market-based business opportunities arising from the characteristics of the digital economy.

The systems approach implies that when analyzing an object of research, not only categories of economic science are used but a number of methods and patterns from sociology and business psychology as well.

3. Theoretical basis

According to hypotheses about the efficiency of the market suggested by Nobel laureates in economics E. Fama [10, 11] and P. Samuelson [26], exchange prices should reflect all the information available to market agents and their expectations about future returns from exchange transactions.

The term “exchange” is used based on its semantic meaning in economic theory, when money is the equivalent of goods, and the equivalence of exchange is ensured by the ratio of prices for goods with regard to exchange rates in the foreign trade.

The main objective of the exchange activity is to determine the parity prices for the main types of commodities (commodity exchanges), as well as for securities that determine the value of enterprises (stock exchanges) and the money itself (currency exchanges).

Given the asymmetry of information between buyers and sellers, the different degree of rationality, their expectations for the price change in a random, unpredictable way.

This is exacerbated by the variability of the market mechanisms for aggregation of the individual marginal utility of the average rate of return, which takes into account the composition and amount of additional risks assumed. In this case, market efficiency means not the maximization of revenues, but the speed of checking the initial information and expectations [10, 11, 26].

Despite the similarity of the hypotheses suggested by E. Fama and P. Samuelson, there are certain differences between them [9].

According to R. Thaler [30], the hypotheses have both a general thesis regarding the completeness of the reflecting in the market, exchange price of the available information, and two approaches to the mechanism for aggregating the expectations of market agents.

E. Fama proceeds from the theory of value and assumes that real prices fluctuate with respect to the intrinsic value. In later works, he equated the intrinsic value to the equilibrium price, which ensures the equivalence of exchange.

The fluctuations themselves are similar to the Brownian motion, and the ratio has Gaussian probability distribution. P. Samuelson suggested that the distribution may have a different form, which may change with time.

This allows taking into account the occurrence of various anomalies, including “financial bubbles”. Later the authors of the article use and develop the hypothesis advanced by P. Samuelson.

There are a lot of clarifications of and proposals for identifying and modeling the mechanism to form exchange prices. Their review is contained in works of a number of researchers [9, 14, 18, 30].

In particular, it is proposed to consider: except for rational expectations, adaptive and irrational ones; dividend policy of securities issuers; propensity to risk of sellers and buyers; availability of insider information for a narrow circle of agents; marginal efficiency of the market as an institution.

The authors of the article additionally suggest to take into account the correlation between prices for the same goods or securities when carrying out various exchange transactions with them as well as the functional roles of market agents — producers, consumers, intermediaries, investors. The difference
in operational objectives causes differences in the parameters of the criteria for assessing the price, income, and cash turnover ratio.

There are three main components, three factors of the formation of exchange prices: transactions with goods that have a real consumer value; agreements with a capital derived from the principal value (derivative), which, in addition to futures and options, also contains bonds, bills of exchange and other borrowed funds; speculative operations, which are weakly related to the consumer value and unpredictably affect their market-based valuation.

Each component has its own specific mechanism to achieve a balance between supply and demand. At the same time, the demand and supply for each component are not strictly interconnected.

They have time periods in which the magnitude of the demand or supply fluctuates, a wide range of degrees of freedom are subject to any abrupt changes in the conditions of interaction and shocks.

It is difficult to determine which of the three components is currently the main one using the usual methods of correlation and regression analysis.

The complexity lies in the fact that the speculative component obviously does not have a normal probability distribution and cannot be attributed to white noise.

Nobel laureate in economics T. Sargent proposed to analyze such systems using the maximum likelihood method [3, 27]. The likelihood function for a system is the total distribution density equal to the product of the individual densities of the variables.

The maximum likelihood method assumes the choice of such a combination of unknown distribution parameters, which maximizes the likelihood function.

In the simplest case, the search for an extremum can be carried out by finding the first and second derivatives of the likelihood function. In vector form, the basic model of a country’s economy in this approach is as follows:

\[ x_t = A x_{t-1} + G z_t, \]

where \( x_t = (y_t, \delta_t, i_t) \) — the vector of endogenous variables, respectively, volume of production, rate of inflation, nominal interest rate, these variables are directly or indirectly related to exchange prices;

\[ z_t = (\epsilon_t, \mu_t, \varphi_t) \] — the vector of random exogenous shocks, respectively, shock of demand, costs, monetary policy. These shocks are unpredictable and do not depend on each other.

Here the authors of the article suggest taking into account the shocks from speculative operations;

\[ A = \{a_{ij}\}i,j = 1,2,3; G = \{g_{ij}\}i,j = 1,2,3 \]

the matrix of unknown parameters.

At the same time, this model does not show the relationship between the growth of income from derivatives and the growth in prices for real assets.

Nevertheless, financial capital, as shown by crises, cannot be completely divorced from the actually produced value.

The fact of existence of such dependence is demonstrated, in particular, by the growth in prices for real estate and oil after 2000, which was followed by a sharp shock drop to almost the level of production costs.

Many experts, including Nobel laureate in economics J. Stiglitz [28], believe that the rapid growth of derivative capital has complicated the behavior of the financial system more than 12 times over the past 25 years and the economy as a whole insomuch that market agents are not able to rationally assess the current risks.

Accordingly, for investors it results in the necessity of increasing the risk premium, for producers — in worsening credit conditions, and for consumers — in accelerating inflation.

The redistribution of incomes is carried out in favor of the structures providing financial services.

But financial services, like most other services, do not accumulate in the form of physical capital (materialized labor).

Accordingly, they do not contribute to the growth of productivity of living labor and violate the sustainability of economic development.

The solution of the task of controllability and management of market efficiency should include the search for the possibility to balance the three main components of exchange prices, including through entrepreneurship development, which will contribute to accumulating human and social capital as well as increasing the demand for real goods.

The method of maximum likelihood was used by Nobel laureates in economics F. Black and M. Scholes to assess the premium of European call options [5]. Shares are interconnected with the total market value of tangible and intangible assets of entrepreneurial activity. Simultaneously, stock options are part of the derivative capital.

In this case, the study of the premium for stock options can increase the informativeness of exchange prices.

Later on, the Black-Scholes model was extended to the so-called real options, which found application in the methodology of hedging risks not only of securities portfolios but also portfolios of capital investments in production, stocks of raw materials and finished products, innovations, etc.

The option category itself in this case is regarded more broadly, with only the most important thing
being considered — acquisition of rights and opportunities to generate income, depending on the occurrence of certain probabilistic events.

Real Option Analysis (ROA) can be useful under following conditions: a significant uncertainty of the situation development; initial investment is high enough; a high probability of the appearing of additional information, which will necessitate changing the strategy; most of the economic effect of investment will be received with a time lag.

The prerequisites for using real options largely coincide with the characteristics of the process of creating entrepreneurial structures.

Typically, the following types of real options are used: options to abandon, which provide for reservation of opportunities to exit the project by selling the invested assets under conditions when achieving the project’s objectives is impossible or ineffective; options to delay, which reserve the opportunity to restore the project after the conservation of the production and trading facilities created for it; options to contract, which are reduced to reserving opportunities to attract subcontractors upon stipulated terms; options to switch, which make it possible to use assets, if necessary, that were created for other purposes and / or tasks; options to expand, which provide for the consistent fulfillment of responsibilities for the project stages, in particular, if a new type of product is developed, if the technology of its production is worked out, if sales channels are created, etc.

When constructing a model, it is necessary to take into account a number of limitations: short-term interest rates are known and constant throughout the term of the option; short-term loan and deposit interest rates are the same; the price varies randomly with a constant dispersion over the option period; the transaction costs for the purchase or sale of the option, as well as taxes, are not taken into account.

Verification of these assumptions, as well as the possibility of applying the Bayes formula, requires additional research and detailing.

This means that it is necessary to form an information and analytical basis, justify the scenario of the value change in the process of creating an entrepreneurial structure, and monitor the implementation of the strategy.

The scenario in the systems approach is understood as the logical sequence of probabilistic events or possible solutions to the problem, as a rule, distributed over time.

Forms of presentation of the script can be different, including the form of schematic diagrams. The script introduces the available quantitative parameters and establishes systemic interdependencies.

In this context, the scenario is a preliminary analysis of the problem, the preparation of relevant information for model and planned calculations, with further interpretation of the results obtained and recommendations for their practical application.

The real options theory is also largely based on the scenario approach. It examines various strategies for managing the risk of an entrepreneurial project, depending on the expected levels and trends in changing prices for basic investment instruments.

For this purpose, the level of diversification of the investment portfolio is compared by introducing into it options, which decrease the risk related to the cost of its acquisition, as well as variations in the average expected income from a hryvnia of investment.

The efficiency of an option is determined by the occurrence of certain events, and its value is a derivative of the probabilistic value of other assets. These specific characteristics of options create conditions for building possible scenarios of events and decision-making.

The main differences between scenarios built using options from a standard decision tree are as follows.

In the decision tree for the whole evaluation process, the cost of capital for a particular project is used as the discount rate.

In the approach based on the evaluation of options, not one project is used but the entire possible range of solutions.

The discount rate is determined by comparing the cost of different investment options. If other solutions are unknown, then, according to the proposal of F. Black and M. Scholes, a simulated portfolio is used.

This portfolio consists of a basic asset and a risk-free asset that creates the same cash flows as those valued using the option method.

This concept is called a no-arbitrage condition or the law of one price: assets that bring equal return must have the same value in the absence of arbitrage, i.e., speculative income. In the future, the internally reasonable option price is compared with the market price and is the basis for a possible investor to make a decision regarding the conditions for investing capital into a project or rejecting it.

The decisions themselves can be made not only within specific terms both in the decision tree and analogically in the European option but also according to the rules of the American option — at any time before the option is completed.

This increases the flexibility of the decisions made, including the introduction of intermediate options and options to option. One of the advantages of the option method for managing costs of an entrepreneurial project is that the value of some options, in particular, options to expand, can be directly included in the valuation of the investment.
The broadened understanding of options allows using the approved Black-Scholes model to find business opportunities among entrepreneurs. To do this, it is supplemented by the principle of bounded rationality suggested by Nobel laureate H. Simon. He formulates this principle in the following way: “Reasonable men” reach “reasonable” conclusions in circumstances where they have no prospect of applying classical models of substantive rationality” [33].

With regard to the real options theory, the principle of bounded rationality can be formulated as follows: if it is necessary to make decisions under conditions of low information availability and high uncertainty, with the improvement of the selection efficiency being related to the subject’s intellectual abilities to identify cause and effect relationships and assess the conditions for their actualization.

4. Results and discussion


The main factors singled out were the willingness of the entrepreneur to perceive the possibility — the personality traits, available knowledge and previous experience; social orientation and social relations; the ability to receive, process and use relevant information; the type of the opportunity itself — the prospects, resources required for the implementation, the degree of risk, institutional constraints.

K. Hockerts [15] believes that under modern conditions, it is the social value that should prevail when evaluating the identified market-based business opportunities. In the opinion of the authors of this article, the results and conclusions obtained in the papers discussed above [4, 15] can be adapted to the characteristics of the digital economy.

Let us start the comparative analysis of features of entrepreneurship under conditions of the digital economy with obvious historical analogies. The industrial revolution and further scientific and technological progress did not abolish agriculture. Industrial technologies significantly increased the coefficients of extensive and intensive use of natural resources in food production. Simultaneously, they contributed to the deterioration of the natural environment of man and, to a certain extent, reduced the quality of food.

In the same way, the digital economy will not cancel either agriculture or industry. Rephrasing N. Negroponte [23] we can say that the main tool for the processing of bits — the digital microprocessor — is based on the processing of atoms.

At the same time, the negative effects associated with the digital economy — the growing uneven distribution of income and the promotion of rapid spread of radical views — are already manifesting themselves [21, 29, 31]. According to the laws of dialectics, there is unity and struggle of opposite characteristics and factors interacting in a single process.

Figure 1. shows how the income share of the richest 10% in the total gross product of the United States grew with the simultaneous growth of the number of personal computers possessed by the population. With the growth of availability of computers from 30% in 1980 to 92% in 2008, the income share of 80% of households increased from 35% to 50%.

![Figure 1. Diffusion of PCs and income growth of the top 10% of the richest population in the US for the period 1980-2008 [based on 17].](image-url)
Traditionally, innovative development and increasing inequality are associated with the Kuznets curve [16]. Nobel Prize winner S. Kuznets put forward the hypothesis that at the early stages of Kondratyev-Schumpeter’s long economic cycle increases the unevenness in income distribution, which disappears at later stages.

The authors of the article also link the growth of inequality in the recent decades with the evolutionary feature of the digital economy associated with the beginning of diffusion of information and communication technologies (ICTs).

In the broadest sense, the economy is understood as production, distribution, exchange and consumption of material and non-material goods.

In economic processes productive forces are used and production-exchange relations are formed. Economic activity is part of social relations and is linked to them by needs, expectations, social interests and values.

Earlier, the development of the agrarian and industrial society began with the improvement of the productive forces. This increased the number and range of goods produced, expanded the exchange and public consumption.

On this basis, economic and social relations were changing and, according to O. Yun [34], the logical abilities of man rose to a new level.

In the information society, according to the authors of the article, a reverse process is taking place. The digital economy affects primarily social communications, the speed of distribution and exchange, and only then the productive forces.

A selective survey of entrepreneurs in Kharkiv region showed that almost 100% of them use ICTs for document management, accounting, personnel and material accounting, and formation and sorting of databases.

Up to 70% of respondents use ICTs for advertising, searching for customers and suppliers, and conducting marketing research.

About 45% of entrepreneurs apply ICTs to organize Internet trading and financial transactions. And less than 25% of entrepreneurs use ICTs as a means of production, with most of them working in the field of ICT programming, telecommunications, entertainment.

A certain fixing of the digital economy on its own, with the constant improvement of only technical characteristics, without assessing its socio-economic efficiency, is one of the factors reducing the growth rate of overall labor productivity (Figure 2.).

Today an automated truck without a driver transports the same amount of cargo as the one with a driver, with the expenses being the same. But it costs many times more. One numerical control machine can replace about ten skilled machine operators.

These machine operators, drivers, accountants should find work with other entrepreneurs, or ways of self-employment.

In any case, entrepreneurs need to see additional market-based business opportunities in the causal
field [25], i.e., to show the relationship between the cause — public and personal needs, the conditions for their satisfaction — resources and results.

At the same time, S. Alvarez & J. Barney single out the processes of discovery and creation as two alternative theories of how entrepreneurial opportunities are formed [2].

Discovery is understood as searching for existing needs and ways to meet them; creation — as forming new needs and creating conditions for their market penetration.

The concept of market-based business opportunities has a fairly complex structure. It includes a number of elements: intentions, chances and / or ideas, assessment of prospects, methods for realizing the idea, assessment of the availability of means of implementation, a plan for achieving the results.

Elements are united by two processes: purposeful cognitive processing of information and socio-psychological motivation for activity.

In this form, market-based business opportunities are a conceptual scenario for future entrepreneurial activities (Figure 3).

![Figure 3. Conceptual scenario for the formation of future business activities (developed by the authors).](image)

It is necessary to clarify the concepts “chance” and “idea” in the context of market-based business opportunities.

A chance is understood as the probability of solving existing problems related to unmet needs, with underutilized resources or their properties, with the need to replace a scarce resource with a more accessible one. Unlike the chance, an idea assumes that the future prospects, new products and technologies will be realized.

In particular, the digital economy creates such needs, although at present it looks like an attempt to turn Maslow’s pyramid upside down.

According to the authors of the article, in the digital economy, entrepreneurs should combine a chance and an idea. The disappearance of a number of professions creates an underutilized labor resource and the rapid moral obsolescence of many types of technological equipment.

This should be seen as a compulsory but a chance. Creation of small enterprises to repair equipment in service, development of individual product samples, search for other market niches should be based on the idea of private-state partnership.

The state has a chance to become useful for society. The state of the environment and the volitional attitude

At the same time, ICT specialists should remember that according to the classical Shannon’s formula, the growth of the volume of information is associated with the growth of entropy, with chaos.
We need to look for ideas that are consistent with the principles of logistics: in the right place, in the right quantity and quality, at the right time.

Consequently, two causal chains are formed. For entrepreneurs in traditional spheres of activity, which has the following form: cause: excess labor — effect: a chance for development — market conditions: entrepreneurial activity, public-private partnership.

And for entrepreneurs in the field of information and communication technologies, which is as follows: cause: poor structuring of information — effect: a chance for development — implementation conditions: availability of ideas for the structuring of information flows.

5. Conclusion

The authors showed the need to additionally take into account the system dependence of prices on transactions on real goods, futures and financial options, as well as to consider the specific expectations of market participants — producers, investors, consumers, intermediaries, in assessing the information efficiency of markets.

The main feature of the digital economy, as the authors believe, is that its development begins with the exchange and distribution functions of economic relations. The authors specify two causal chains of the entrepreneurship development, characteristic to the digital economy.

The direction for further research is the detailing of the conceptual model for the structuring of information flows in multi-layered business networks.

References


[30]. Thaler, R. (2009). Markets can be wrong and the price is not always right. [Electronic resource]: https://www.ft.com/content/efc0e92e-8121-11


