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PRINCIPLES OF CYBERNETICS IN THE INNOVATION AND INVESTMENT DEVELOPMENT OF UKRAINE

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A B S T R A C T

The relevance of the study consists in highlighting the principles of cybernetics in separating relatively self-sufficient whole economic systems from reality, considering their functioning and the relationship between them and the environment, and discovering analogies and general patterns of development and action in an innovative atmosphere. The purpose of this study is to identify and then apply in practice the general laws and principles governing economic processes in Ukraine, and the transformation of cybernetic information elements in innovative development. Cybernetics, which is an interdisciplinary science, studies the operation and functioning of particularly complex economic systems without regard to the material from which they are created. The cybernetic aspect represents the ability to perceive and capture the surrounding economic reality, to observe the changes occurring in it, their causes, and consequences comprehensively and dynamically. For this purpose, the article used the following methods: functional analysis, logical method, and scientific abstractions. The management principles and general laws of cybernetics look for analogies between all components of economic organisms and social systems, discovering common laws borrowed from various sciences. Cybernetics allows these laws to be transposed into a completely different field, providing a variety of practical applications. The findings indicated the potential for the development of an innovative national economy as a set of interrelated resources and opportunities for their realisation in the context of cybernetic individual, collective and societal systems. The categories of innovative development in the investment potential of Ukraine were considered. Its components are analysed predominantly from the perspective of an innovation management principle, which was implemented gradually according to the achievement of objectives at defined assessment points. The practical relevance lies in the analysis of the principles of cybernetics in the innovation segment, and the examination of the current state of the investment sphere and its policies from the perspective of the cybernetic component of the economic system.

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1. INTRODUCTION

Cybernetics as a "techno-science" about managing systems by controlling data and information flows represents a change of perspective on concepts, a real epistemological revolution, and a profound paradigm shift in relation to classical science. Cybernetics and its principles seek to mimic complex laws even more effectively by accurately emphasising the logic of cause-effect relationships, communication, and interactions between the various elements of a self-regulating system. The medium then becomes a "network of messages and signs" or an autonomisation of the entire universe of practices and forms as an operational and accounting sector (Ramazani, 2021). Unlike traditional science, which studies the structure of matter and energy transformation, cybernetics also studies the process of information transformation and control of a system that consists of three elements: material, energy, and information, where it considers material and energy only as necessary prerequisites for the operation of the system and does not investigate what material the system consists of or how it is transformed energy and focuses specifically on the information. Cybernetics relies on a real electronic, mechanical, neural, or economic machine as a prototype, studying the function of all dynamic systems of matter, and revealing their behaviour in terms of functionality (Zannetos & Wilcox, 1969).

Automatic control is an interdisciplinary discipline that has its origins in engineering, mathematics and has since been applied in various social sciences, including economics, sociology, psychology, criminology, and financial systems. Automatic control is also called control theory because of its emphasis on theory. The control system consists mainly of measurements, comparisons, calculations, and corrections (Seppanen et al., 2007). The basic principle of control theory is feedback. Initially, feedback was a biological concept related to a system that can influence the continuous operation of the system, and later became the basic concept of modern science and technology. Feedback in control theory refers to the process of returning the output of the system to the input and some change in the input, thereby affecting the output. The device performing the feedback function is called a controller, which can be a circuit, a machine, or a human brain receiving signals. The most basic characteristic and requirement of control theory is stability, where classical control theory is suitable only for linear systems with one input and one output. The control process in the control system is essentially the same as in engineering and biological structures: it uses information feedback to identify the difference between the indicators and the benchmark, taking corrective measures to stabilise the system in a given target state. Therefore, theoretically, methods suitable for engineering and biological cybernetics are also suitable for analysing and explaining management and control tasks in the aspect of the state of Ukraine (Harryson et al., 2008; Gilsing & Duysters, 2008).

In a modern management system, the combination of human, financial, material, and other elements is different, time and space change, the environment has a great influence, and the internal work and structure sometimes change greatly. In such a complex system, the process is inconceivable without controlling the attainment of the goal and development in the competition. It is based both on the development of technology and on an analysis of the various activities in which man can be assisted, controlled, or even replaced by a machine, to establish the laws of substitution that guide the programme of "technological evolution" (Thorgren et al., 2009). In this area, cybernetics can be thought of as building on the intersection of applied mathematics and automatic computation. Financial efforts and socio-economic integration are aged here, both in terms of equipment and services. Nevertheless, the sector is experiencing a renaissance driven by recent applications, the Internet, and the ubiquity of interoperable electronic components. Information sciences and technologies combine computing, electronics, automation, telecommunications, and robotics. In this respect, one of the main theses of economics is that a modern unification strategy is neither conceivable nor achievable without the prior and social development of a new worldview directly influenced by aspects derived from cybernetics (Van der Valk et al., 2011; Riemer & Klein, 2006).

The purpose of this study is to identify and then apply in practice the general laws and principles governing economic processes in Ukraine, and the transformation of cybernetic information elements in innovative development.

2. MATERIALS AND METHODS

The methodological basis of the study consisted of the following approaches to the study of this issue: the method of functional analysis, logical, and scientific abstractions. The method of functional analysis made it possible to explain economic phenomena in accordance with the analysis and study of the functions of cybernetic phenomena, where a function is understood as the role that the economic component plays in discourse and in its structural relations with other components. Theoretically, it underlines that cybernetics in this case is a continuum created to meet needs, and emphasises explaining dynamic economic or social phenomena from a functional point of view. In practice, the focus is on collaborative observation, which requires a deep immersion in reality, integrating all the principles of the control system. The structure of functionalism, according to which the function of

Ukraine's economic system depends, allows the system to be maintained, continued, and operated. Its elements allowed focusing on the integrated development process, investment trends and the influence of the international political system.

The logical approach reflects the full application of the methodology of system sciences in economics, highlighting the transformation of political science research from traditional static analysis to dynamic and interdisciplinary. Its essence lies in the decomposition of things into various parts, aspects, attributes, and their separate study. The synthesis of the methodology consists in organically combining all the parts, aspects, and properties of things into a coherent whole according to their intrinsic relations to perceive the essence and laws of things. The components of logic are interpenetrated, transformed, and analysed under comprehensive guidance. The causal inference approach helps to understand the scientific causes and ways in which cybernetic matters change. It can be seen as an open-source mindset designed to find a causal link between the laws of cybernetics and the principles of innovation management in Ukraine's economic system. Persuasive logical reasoning allows, in this case, to shed light on the subject under study, thereby enabling it to become sufficiently complete and affirmative, characterising the relevant evidence and explanations.

The method of scientific abstractions made it possible to reveal the process of studying political economy and analysing the capitalist mode of production, where objective matters appeared in diverse and complex phenomena, which were not limited to a simple description of phenomena but revealed their essence and laws through the form of cybernetic principles. By revealing the nature of the matter under consideration, the approach made it possible to understand and transform the objective mechanisms of the system more effectively. The existing connections were investigated to establish a scientific theoretical system. The methodology of scientific abstraction presented a process of investigation from the concrete to the abstract by means of the abstract reasoning ability, revealing the essential links and internal regularities underlying complex economic phenomena, thus forming a series of concepts and theoretical categories. The use of a number of abstract theories and concepts about the nature of cybernetic aspects for a clearer and deeper explanation of the process of economic and social evolution has led to concrete representations in the thought process, where the concrete is no longer just a perceptual thing, but a rational concreteness with a rich connotation, which is a synthesis of many rules and unity of diversity.

3. RESULTS AND DISCUSSION

Ukraine's informational model of economic subjectivity seeks to embed a determinism on a par with the machine in any theory dealing with the question of the subject, which boils down to the simple status of a thing whose behaviour can be predicted because it is represented informationally. Here, other key concepts of cybernetics, such as "feedback" and "entropy", are interpreted, after a brief evocation of their genealogy, as the tools by which the "new science" was able to embrace all economic products. Cybernetic concepts induce a communicative representation of society. Having become a huge communication system, the latter exists only through the exchange of information between its participants. However, the validity of these theses about the relationship between the epistemic content of cybernetic science and the status of the subject in it will become possible only from the moment when the economic component of management integrates cybernetic formalism, its language, and its tasks. Accelerating the construction of an autonomous, managed, secure, and reliable digital infrastructure is an inevitable choice to increase the country's core competitiveness. To further expand the possibilities of technical support for digital infrastructure, it is necessary to accelerate the joint investigation of basic and applied technologies (Olsson, 2010). At the same time, it is important to strengthen the protection of intellectual property rights in digital infrastructure, accelerate the development of key common standards and key technical standards, facilitate the establishment of a standard management system and the promotion of advanced technologies and the interconnection and sharing of facilities.

The practice of innovation management applied by Ukraine has changed radically over the past two decades. The progress recorded in information and communication technologies, along with increased competitive pressure, have prompted the economic system to deploy strategies that are increasingly based on a combination of their internal capabilities with various external resources. The functionality of strategies is characterised by an increased degree of openness in research aspects, in particular, the paradigms of open innovation popularised by H.W. Chesbrough (2006), a theory of user innovation introduced by E. von Hippel (2016), or even the ecosystem and business model approach initiated by J.F. Moore (1993; 1997). All of them consider innovations as a result of interaction and cooperation between economic organisations of the state. They involve the search, selection, combination, and integration of a wide variety of tangible and intangible resources embodied in various organisational and technological contexts distributed within the system. These interactive approaches to innovation are accompanied by a violation of the processes and methods of knowledge management applied by innovative components (Freel & de Jong, 2009). Thus, the dissemination of knowledge associated with the performance of tasks related to the invention and commercialisation of innovations leads to a change in the ways of their creation, application, and use. They involve the

adaptation of codification and integration practices, sharing and transfer, protection, and enhancement of knowledge. In addition, a knowledge that has been created at least in part externally should be exploitable to supplement the system's internal knowledge. Finally, the transformation of innovation models is changing the way the economy manages the knowledge involved in the commercialisation of innovations.

Strategic innovation indicators refer to measures used to quantify the facts related to the development of an innovation strategy and to identify, evaluate and select ideas in the innovation process. Strategic innovation indicators can be structured according to the phases of the innovation process. Innovation management and the innovation process are at the heart of the competitiveness and growth of the state. Therefore, it is the basis of the future viability of the economy and determines its success or failure. Thus, key performance indicators are central variables for monitoring Ukraine's future success. Innovation management encompasses the overall structure, including innovation strategy and business operations. In other words, it is about integrating innovation into everyday activities. Different operations go through concepts such as teams, responsibilities, resources and equipment, risk management, processes, cooperation, exchanges between different functional areas, control, and optimisation. The innovation process is a kind of performer arising from the general framework of innovation management. This innovation process should not be limited to one economic aspect but should be applied wherever it is useful and possible. Above all, the process allows for achieving perfection and provides an innovative environment for development. Therefore, financial interventions alone are not sufficient, they need to be complemented by strategic and operational key performance indicators so that early indicators allow for timely intervention if it is found that objectives cannot be achieved (Rampersad et al., 2010; Abidian & Martin, 2009).

One of the inherent advantages of Ukraine's planned economy is the value of a long-term investment in infrastructure and strategic technology, as it can exist without fear of falling market demand or loss of confidence, which usually leads to project cancellations. This means that consumer demand can be restrained in favour of further capital investments for the economic development of a specifically desired model. For example, the state of Ukraine can start building heavy industry without waiting for many years to accumulate investment capital or necessarily choosing financial debt. British cyberneticist S. Beer (1995), believed deeply in the basic principle of cybernetic engineering, where the regulation of system variability is through planning and constant adjustment. The principle exported to the economic planning environment of Ukraine, as a process of artificial immunisation with constant feedback, is a kind of bet on regulatory intervention in the form of an attenuated aspect. Today, advanced computing developments would make it possible to create a single, global, and accurate production plan, eliminating the problem of economic calculation and mitigating sudden imbalances resulting from speculative market fluctuations. Within this conceptual framework, it is possible to formulate a political and technological germ for managing an effective and coherent European digital socialism, based on the central role of the common good of the European Union (EU) (Francois, 2004). In fact, although this label sounds difficult to implement, the preliminary plans for the so-called digital model have a planning component. It is not just a question of a way of investing in new technological infrastructure, but also of managing consumption rationally rather than excessively, and encouraging the allocation of public resources to the sectors concerned.

It is necessary to develop various applications aimed at integrating technological and theoretical systems, creating data streams that will be supplied with information in real time for various users, which may be ministers, the presidential cabinet, companies, and various organisations. It is also important to integrate citizen participation from home into public decision-making. This is one of the first e-government initiatives and an extension of the concept of creating and encouraging action groups and development in a collaborative working environment using truly effective information management tools. Modern science and electronic computing offer the government new opportunities to tackle today's complex issues of the Ukrainian economy. Investments in the construction of digital infrastructure are huge. At the initial stage, it is worth focusing on application scenarios and engineering construction with a better foundation, wider application, and faster effect, and implementing a new application infrastructure, concentrating on sectors such as intelligent manufacturing, social management, online medicine, online education, digital life services, focused on the needs and concerns of the state (Heims, 1993). It is also important to compile and issue a list of needs for building digital infrastructure application scenarios, organise application innovation competitions and other events, and use the market mechanism of "list disclosure and team acceptance" to select excellent solutions.

In 2017, the investment attractiveness index of Ukraine reached its highest level in the last 6 years – 3.15 points on a five-point scale. This assessment was given by the European Business Association (EVA) after conducting a survey among 142 major international and Ukrainian companies. The fact is that Ukraine has managed to improve its investment attractiveness and this growth is confirmed by the good situation in the commodity market, where the country is an active player, leading in the trade of grain, agricultural products, metals, and ore. The Ukrainian market is undoubtedly attractive to Western entrepreneurs. Its openness attracts investors,

which augurs for its further imminent growth in the future. To improve the investment climate in Ukraine, a series of reforms need to be undertaken. Policy, not efficiency, is the dominant factor influencing the trend of the investment market. In the medium and long term, the direction encouraged by the policy is of greater importance, where investment opportunities, which are mainly concentrated in semiconductors, are the creation of a system of high-tech equipment, the promotion of new infrastructure, the emergence of new applications controlled by artificial intelligence and the modernisation of manufacturing industries with accelerated advancement. Facing the current market, anticipating future developments, and looking ahead to the next one or two years, the likelihood of the market making a relatively good profit is quite high. While the economy is gradually stabilising and supporting healthy development, the innovative viability of Ukraine is becoming stronger, new industries continue to appear and mark high growth rates, and traditional industries will continue to be rebuilt and updated. According to the Ministry of Finance of Ukraine (2020) for the 1st quarter of 2019, the total amount of capital foreign investment increased to $600 million. The economy offers a fertile ground for a large number of investment opportunities, which will continue to bring investment opportunities to the stock market (Table 1).

Table 1. Capital Investments in Ukraine by Asset Type, for 2019

	January-March	January-June	January-September	January-December
In actual prices, UAH million				
Total	108298.0	233995.5	379203.1	584448.6
Investments in tangible assets	102653.6	223986.0	364774.5	563573.1
Housing stock	11664.0	24457.2	38404.2	55623.6
Non-residential facilities	13503.1	31181.7	54628.2	89717.7
Engineering structures	20159.8	46295.6	79879.0	131910.5
Machinery, equipment, inventory	37712.5	82715.0	131531.3	198709.5
Vehicles	14994.1	29127.9	44156.4	63319.1
Land	311.7	840.5	1207.3	1866.0
Long-term livestock and crop production assets	929.9	1921.1	2886.3	4101.2
Other tangible assets	3378.5	7447.0	12081.8	18325.5
Investments in intangible assets	5644.4	10009.5	14428.6	20875.5
Software	2076.7	4377.9	6619.7	9886.6
Patents, licenses, concessions	2656.4	4070.8	5622.3	7525.3

Source: formed based on data from the Ministry of Finance of Ukraine [20]

However, investments in equity of cross-border investors in Ukraine have recently decreased by $868 million, which is the first decrease in inflows since 2015. This was stated by the President of the National Bank of Ukraine (2021), pointing out that the key reasons for the low interest of foreign investors in the Ukrainian economy are the underdevelopment of the domestic market, the ongoing armed conflict with the Russian Federation and the low level of the legal protection of investments. Ukraine is still perceived by investors as an unfriendly place to invest capital in the ranking of the Global Index of Attractiveness of Countries for Foreign Direct Investment. Other challenges are also pointed out by the Ukrainian finance minister, as he acknowledges that the COVID-19 pandemic and the situation in the world economy do not encourage investors to commit capital. He believes that Ukraine still has a solid foundation in the form of domestic private investors, government investment activity and support from international institutions. This allows for gradual improvement of the investment climate. In the regional context, a significant decrease in capital investments in April – June occurred in Volyn (by 64.1%). Kirovograd (by 17.1%). Mykolaiv (by 13.3%) Oblasts. The main source of funding for capital investment remains the equity of enterprises and organisations, which accounted for 75.2% of total investment. In 2019, the volume of capital investments in Ukraine increased, but only by 8% – up to UAH 624 billion. There has been a decline in contributions from businesses and organisations and from the public for the construction of housing. At the same time, foreign investment increased by 159% to UAH 4.7 billion (Ashby, 2015). Investments in agriculture, trade, transport, information, and communication have decreased (Table 2).

The prognostic assessment of Ukraine's investment sphere development, given the principle of emergence, refers not to a specific, finite time, but to a permanent process of change. Economic emergence causes a gap, a historical and identifiable sequence of getting out of the backwardness trap. Growth causes structural, nonlinear, and unbalanced changes. The resulting concentration of activity and income causes social tension, which increases as a result of globalisation. In this context, economic emergence should be analysed as an indefinite, nonlinear and heterogeneous process that generates gaps and hides blockages, the scale of which is specific to socio-political and geographical space, but the general mechanisms of which can be identified.

Table 2. Capital investment indices by economic activity for 2019 in Ukraine (in %)

	January-March	January-June	January-September	January-December
Total	117.8	112.3	112.4	115.5
Agriculture, forestry and fisheries	102.1	91.4	88.7	90.0
Hunting and related services	102.8	91.8	89.1	90.4
Logging	57.3	63.0	60.9	60.7
Industry	132.0	130.8	128.1	134.7
Construction	103.4	105.0	105.6	109.8
Wholesale and retail	118.9	106.3	112.4	100.3
Transport, postal and courier services	120.8	104.7	99.8	96.6
Temporary accommodation and meals	257.2	199.3	167.5	148.7
Information and telecommunications	57.7	62.7	76.6	83.4
Publishing, cinema, radio, television, programmes	142.5	134.7	137.4	124.8
Computer programming	147.1	126.7	127.8	140.5
Financial and insurance activities	75.4	82.5	92.8	102.8
Scientific and technical activities	188.7	164.5	143.8	131.4
Public administration and defence	186.7	145.8	134.1	129.9
Education	124.6	122.6	122.7	131.6
Healthcare	135.9	127.3	132.4	146.6
Art, sports, recreation	244.3	152.1	118.0	117.1

Source: formed using the data State Statistics Service of Ukraine (2022) data.

Consequently, this may seem to contrast with other countries where earlier economic changes have taken place in a different context. The increasing external returns of the country, associated with the concentration of certain additional activities, can cause an acceleration of growth, and spread to the rest of the economy when there is an overflow of knowledge or sufficiently dense intersectoral relations. The dynamics of industry growth is likely to cause a movement towards convergence, first sectoral, and then more global if the sector in question maintains close relations with other sectors. Economies of scale and training, sanctioned by the size of the global market, as well as technological, logistics and marketing transfers caused by investment ties, will allow competitive sectors of activity to quickly approach the levels of productivity of the technological front, which has implications for the entire national production system. According to the State Statistics Service of Ukraine (2022), capital investments in Ukraine have collapsed by 38.2% by the end of 2020 (Table 3).

Table 3. Capital investment by economic activity asset type in 2020, in UAH thousands

	The volume of capital investments	Investments in tangible assets	Investments in intangible assets
Agriculture, forestry and fisheries	50679695	49781904	897791
Industry	180537373	177399868	3137505
Construction	39614886	39534816	80070
Wholesale and retail	41684741	38864968	2819773
Transport, storage facilities, postal and courier services	34884633	34491549	393084
Temporary accommodation and catering	1951234	1713769	237465
Information and telecommunications	22381603	13223155	9158448
Financial and insurance activities	11979335	7664411	4314924
Real estate transactions	19940118	19779661	160457
Public administration and defence	62303585	62043447	260138
Education	3740151	3722658	17493
Healthcare	14835634	14096141	739493
Art, sports, recreation	2772823	1633922	1138901
Administrative services	8623796	8333580	290216
Professional, technical and scientific activities	11823599	10613869	1209730

Source: formed using the data State Statistics Service of Ukraine(2022) data.

In terms of emergence, Ukraine is undergoing profound structural changes that accompany high and sustained growth phases, but the cause-effect relationship between the two has not been clearly established. Economic success, first of all, is based on the often random synchronisation of national political strategies and a favourable configuration of the global economy. It is likely that, in the future, the growth of globalisation will

not allow the state to be constrained by the narrowness of convergence conditions after successful integration into the world economy at the expense of investment components. This raises a more fundamental question about the emergence of production systems capable of both meeting the requirements of international competitiveness and ensuring sufficient activity for workers of all skill levels. The study of the conditions for the possibility of a harmonious increase in the standard of living involves going beyond the purely quantitative characteristics of economic changes and diving into the core of new political regimes emerging in a globalised environment. The scientific and technical base is formed spontaneously as knowledge is acquired. Although this model seems attractive from the point of view of the principle of emergence, it assumes the fulfilment of certain conditions and therefore is not suitable for all situations. It essentially requires a minimum of skills, a sufficiently developed scientific apparatus and a skilled labour force. For an economy with a low level of scientific and technical potential, it is often unattainable and can lead to a waste of resources if the technologies transferred at great cost are not mastered within the country. On the other hand, it may represent a relay model after reaching a certain skill level. Thus, if the investment model is regarded by regions, Kirovograd (by 33.5%), Odesa (by 29.4%) and Volyn Oblast (by 26.5%) suffered the most in 2021, similar to the period of 2020. Capital investments in 2021 increased the most in Luhansk (81.5%), Zaporizhzhia (60.1%) and Ivano-Frankivsk Oblast (47.5%). Capital investment in Ukraine in 2021 fell by 9.5% y-o-y, according to the National Bank of Ukraine (2021) (Table 4).

Table 4. Capital investment by asset type by region for 2021 in UAH thousands

	Volume of capital investments	Investments in tangible assets	Investments in intangible assets
Vinnytsia Oblast	14013094	13854948	158146
Volyn Oblast	8263244	8181409	81835
Dnipropetrovsk Oblast	65469771	64848238	621533
Donetsk Oblast	30072847	26159814	3913033
Zhytomyr Oblast	9484439	9397856	86583
Zakarpattia Oblast	5126333	5046060	80273
Zaporizhzhia Oblast	18270778	18058827	211951
Ivano-Frankivsk Oblast	8408234	8215085	193149
Kyiv Oblast	35927395	35073524	853871
Kirovograd Oblast	6540378	6482354	58024
Luhansk Oblast	3291761	3281992	9769
Lviv Oblast	24041905	23256837	785068
Mykolaiv Oblast	8272664	8212564	60100
Odesa Oblast	18853678	18477148	376530
Poltava Oblast	23808239	23585824	222415
Rivne Oblast	6076296	6032460	43836
Sumy Oblast	7465009	7366575	98434
Ternopil Oblast	8536591	8519684	16907
Kharkiv Oblast	19438622	19087320	351302
Kherson Oblast	5157946	5117786	40160
Khmelnytskyi Oblast	10874810	10772730	102080
Cherkasy Oblast	9590276	9452174	138102
Chernivtsi Oblast	3397187	3376722	20465
Chernihiv Oblast	8367139	8268683	98456
Kyiv	170053375	155119685	14933690

Source: formed based on data from the National Bank of Ukraine (2021)

However, Ukraine, as a country with a rather immature system, is a candidate for emergence. Its ability to achieve the status of a developing state depends both on their initial position and on the actions taken to develop and structure the national innovation system. The nature of immature systems makes it impossible to describe a single trajectory that allows creating conditions for emergence. Nevertheless, it has a certain number of common features that open many avenues for reflection, where one of the contributions of the concept of the national innovation system is the possibility of a synthetic vision of dysfunctions. All of them are characterised by both the weakness of knowledge production activities and a very low level of network density between aspects of the system. Important areas for the appropriation of innovation and know-how to enter international markets, such as quality and standardisation in its various variations, are usually ignored. They should concentrate most of their scientific and technical activities in the least developed areas related to the policy of monitoring and technology selection. The strengthening of the national innovation system is accompanied by a sharp increase in gaps between regions and between industries. There is every reason to believe that to achieve a sufficient level of attractiveness it is reasonable to concentrate funds on a reduced number of centres of excellence, which will be

able to benefit from very substantial funds in terms of financial resources. This concentration will be used to attract foreign investment, which would find the conditions there favourable and thus cooperate and function. Such a process can be seen in the statistics of capital investments in Ukraine, where since 2015 the level of investment of Ukrainian enterprises has increased markedly. However, in 2020 it decreased by 38.2%, while in 2018-2019 it increased by 16.4% and 15.5%, respectively, as stated in the data of the State Statistics Service of Ukraine (2022) (Table 5).

Table 5. Capital investment by asset type for 2015-2020 in Ukraine (UAH million)

	2015	2016	2017	2018	2019	2020
Investments in tangible assets	254730.9	347390.5	432039.5	542335.1	600568.1	483324
Residential premises	45609.8	44864.9	53371.8	57395.9	58014.9	34885.7
Non-residential premises	43330.9	59398.3	65605.2	88846.1	100468	78920.1
Engineering structures	50948.7	67517.1	78563.5	111314.8	149153.5	127995.4
Machinery, equipment	84423.2	123133.3	154721.7	187650.4	198455.3	161636.6
Vehicles	19650	36685.7	60123.9	73926.2	65870.8	50074.6
Land	1441.8	1915.8	1994	1673.1	2230	2298.5
Long-term biological assets	2762.6	3162.7	3727.9	4528.3	5999.8	5247.4
Other tangible assets	6563.9	10712.7	13931.5	17000.3	20375.8	22265.7
Investments in intangible assets	18385.5	11825.6	16422	36391.3	23410.8	24893
Commercial property rights	12653.9	4435.8	6228.1	24381.6	8389.5	8389.1
Software and databases	4908.4	6315.5	8196.4	9476.4	10215.3	12411.1

According to Ukraine's parliamentary ombudsman for business, Algirdas Šemeta, per capita investment in Ukraine is five times lower than in Poland and ten times lower than in Estonia. The main reason for this is corruption and distrust of Ukrainian judiciary, which are the biggest obstacles to foreign investment. However, the investment market of Ukraine is characterised by dynamic development, high demand for investment resources and a fairly high level of interest from foreign investors, along with investment attractiveness, which is confirmed by statistical data on foreign direct investment. The current state of the investment sphere and its policy in Ukraine characterizes the process of integration of the state into the globalised economy and world capitalism through strong economic growth for several years. Supporting multipolarity, emergentism has a geopolitical dimension in that it legitimises the country's representation in international institutions and is economic rather than social in nature. It is possible to expand the functionality of the principle only if it is integrated into the global capitalist system. Developing states share common characteristics, found in more or less pronounced form and with variations depending on the situation: a large population, but completed its demographic transition; a stable but often authoritarian political regime; the emergence of a middle class able to consume and hold intermediate positions in services and administration; rapid metropolisation and often a growing wealth gap, leading to the coexistence of a rapidly enriching oligarchy with masses of people living in poverty, often in peripheral, rural or landlocked regions (Holland, 1996). Due to sufficient liquidity and constant inflow of foreign capital, the overall liquidity of the stock market is at a historically low level, which provides a good basis for creating medium- and long-term investment returns. The stock market will continue to improve with the gradual decline in corporate profits, and structural opportunities will arise.

Modern Control Theory, developed in the 1960s, is a new theory based on the concept of state variables, using modern mathematical methods and computers to analyse and synthesise complex control systems and suitable for multi-input, multi-output, time-varying and non-linear cybernetic systems of the Ukrainian economy. The application of modern control theory for analysis and synthesis can bring the effectiveness of the control system to a new level. The current reality of global capitalism increasingly reveals on a global scale the essential contradiction of an economic system which, while promoting continuous scientific and technological development with the robotisation of production, artificial intelligence, and big data, unfolds regressive social dynamics, generating unemployment and job insecurity, social polarisation and ever more serious crises. To address the basic challenges facing humanity, given the inability to manage or reform the blind logic of capital, which subordinates the entire society to the ever-increasing demands of profitability and accumulation, global alternatives to the capitalist order must be created that make possible the modern ideal of civil self-government with social and rational control over the economic process and the only possibility to direct the development of society towards democratically chosen goals. In this perspective, the principles of cybernetics assess the possibilities of socialism and economic planning in the light of current scientific and technological possibilities ininformation technology(IT), telecommunications, and artificial intelligence, and propose a model for a democratically planned, viable and efficient socialist economy for discussion. In the planned economy of Ukraine, without market processes and competitive pricing, rational economic calculation is impossible, which inevitably condemns to inefficiency (Richardson, 1999).

The subject matter contained in modern control theory is very broad in the understanding of cybernetics and is characterized by the basic principles: linear systems, nonlinear systems, optimal control, stochastic control and applied control theory. The theory of linear systems is the most basic and relatively mature branch of modern control theory. It focuses on the management and observation of economic conditions in linear systems. The main method of analysis and synthesis is the state space method. According to the mathematical apparatus used, linear systems theory is usually divided into three schools: geometric theory, based on geometric concepts and methods; algebraic theory, based on abstract algebraic methods; and complex frequency theory. The nonlinear system theory is not yet perfect. The areas of investigation are mainly limited to the stability of system motion, the control and observation of a bilinear system, and the problem of non-linear feedback. A more general nonlinear systems theory has not yet been created. Since the mid-1970s, some methods derived from differential geometry theory have provided powerful theoretical tools for the analysis of certain types of non-linear systems. From the cybernetic interpretation of the Ukrainian economy, the principles of equifinality and multifinality are derived, very far from the deterministic postulate of R. Descartes (Descartes, 1938) on linear direct communication, where the cause precedes the effect (Umpleby & Dent, 1999).

In 1948, the American mathematician N. Wiener (1985) published his book "Cybernetics or control and communication in the animal and the machine" in English and French, which discusses the general method of control theory, further specifies the concepts of feedback and the mathematical definition of the regulator and gives a new meaning to the subject of control theory. At the same time, four basic principles are distinguished, namely universality, rationality, non-determinism and black box testing methods. With the assimilation of cybernetic theories systems came the understanding of the regulation mechanisms of economic structures as negative feedback processes aimed at preventing deviations (Meystel, 1996). Cybernetic systems strive to maintain a viable stable state of interactions in changing conditions through a process of trial and error. In France, Dr J. de Rosnay (1975) was one of the first to popularise the main concepts of cybernetics and to apply them to a systems approach to management: cell, body, city, economy, and ecosystem. The management of the system, in this case, is to link it to another system, the role of which will be to maintain as little variety of results as possible. The purpose of stochastic control theory is to solve stochastic control systems, analysis, and synthesis. The N. Wiener (1985) filter theory and the Kalman-Bucy filter (Kalman, 1960) are one of the foundations of stochastic control theories. A major component of stochastic control theory is stochastic optimal control, and the solution to such stochastic control problems depends on dynamic programming concepts and techniques (Varela & Maturana, 1992). Adaptive control theory is a type of control system that can automatically adjust its own characteristics based on the idea of imitating biological adaptability. The study of an adaptive control system can often be attributed to the following three main tasks: identifying the dynamic characteristics of the managed object;choosing a solution based on the recognised object; producing a reaction or action based on a recognised object.

One of the pillars of modern management theory is the principle of optimal management. This principle has been applied in practice since the early 1960s (Klir, 2001). This process changes the design method of classical control theory, which focuses on stability and dynamic quality, and looks at system performance over the whole period of operation, selecting the optimum control law that can significantly improve the performance of the Ukrainian economic system. The theory of optimal control studies the control laws and complex methods of a controlled system at optimal specified performance indicators. In the theory of optimal control, the main methods of synthesis of optimal control systems are the maximum principle and dynamic programming. The scope of studies in optimal control theory, such as optimal control of large systems and optimal control of systems with distributed parameters, is expanding. Another core of modern management theory is the principle of optimal estimation. It provides a powerful mathematical tool for solving stochastic elements and stochastic control problems, overcoming the limitations of the filter of linear, stationary, or non-stationary random processes.

4. CONCLUSIONS

Thus, the last decades of the 20th century have been characterised by the explosive development of the Internet and the processes associated with globalisation. The concepts of cybernetics include a system of interdependencies between markets in which they are internally balanced. The economy resulting from this paradigm is looking for optimal and sustainable solutions in static and dynamic senses. A condition for sustainability in Ukraine's innovative development is that there are alternative approaches to explaining economic shocks and phenomena, where the cybernetic aspect represents an interesting alternative to an equilibrium economy. The structure of economic governance has changed over time: it has been amended in response to new economic challenges. The mechanisms and legal framework of the economic architecture in the cybernetic aspect are designed to show that the model of economic management was burdened with structural flaws from the very beginning. Ukraine's economic management principles are excessively rigid, opaque, and ineffective, often in the form of non-compliance with accepted rules and policy recommendations, a lack of adequate room for

manoeuvre, and the absence of emergency management mechanisms in situations of economic shock or crisis.

Innovation is an important factor in the competitiveness of Ukraine, since it contributes to economic growth, improves living standards, and enhances the country's image in the international arena. The study diagnoses both favourable and weaker conditions for the development of innovation and investment principles in Ukraine. Particular emphasis was placed on the country's investment opportunities, given the principle of emergence. They are based on multivariate theoretical approaches with an analysis of the strengths and weaknesses of each. Living in a time of information revolution, the economic factors in a cybernetic perspective are overwhelmed by an incredible amount of content and back information. This science provides extremely effective solutions to issues which interact with the environment through feedback. Innovative controls prioritise spending on existing infrastructure to free up the resources needed for further innovation. The principles of cybernetics are not questioned but are fiercely debated, as they are deemed totally unsuitable for an economy as weak as Ukraine's, and this series of tactical errors could lead to the deindustrialisation of the country, accompanied by massive system failures.

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