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THE REGULATION MODEL OF DATA-DRIVEN ECONOMIC POLICY MAKING

Manaf BAGIRZADE¹

¹Department of Digital Economy and Innovations, Economic Scientific
Research Institute under the Ministry of Economy,
Baku, Azerbaijan

ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received:2025-05-27 Received in revised form:2025-06-20 Accepted:2025-12-05 Available online:2025-12-25</p> <hr/> <p><i>Keywords:</i> Data-driven policy; Regulation approach; Digital economy; Cyber Fordism JEL: D58, G18, L51, N01</p>	<p><i>The emergence of the new economy and the conditions brought about by digitalisation require implementing new approaches and forms of regulation in economic policymaking. Although the accumulation of big data of social activities due to digitalisation enables data-driven economic policymaking, there are significant uncertainties in its practical application and conceptual framework. In particular, there is a research gap in determining the conceptual and economic regulation model of data-driven policymaking. Therefore, the purpose of this paper is to conceptualise the regulation model of data-driven policymaking in the process of digital economy formation. In the study, data-driven policymaking is evaluated from the perspective of the digital economy, which summarises all new economic trends, and the digital and cybernetic aspects of the problem of economic calculation are reconsidered on a theoretical basis. The regulation approach used in the research makes it possible to understand the current situation in terms of accumulation at the stage of economic development and to prepare appropriate policy proposals for the provision of new economic relations. As a result, a model of digital cybernetic regulation scales has been developed that can explain new forms of accumulation and regulation, including the green economy, and help in policymaking.</i></p>

1. Introduction

The wide diffusion of information and communication technologies in social life has led to the emergence of innovations that increase the importance of information, such as cloud technology, big data, artificial intelligence, the Internet of Things (IoT) and data analytics. Thanks to new digital technologies, the amount of data produced has increased significantly and has become an important source for decision making in many areas. Data-Driven Decision Making (DDDM), which has been widely used especially in management, marketing, production and finance, is raising awareness that it can be an effective tool in economic policy-making (EU Commission, 2014) (Joseph, 2014). New economic relations shaped on the basis of technological innovation have led to the formation of the digital economy and the renewal of factors of production (Xu et al., 2009), Digital transformation has turned data into the most fundamental new factor of production and the main source of economic regulation.

New data-driven economic decisions are required for economic policymaking under the conditions of the digital economy's development process. The article explores the conceptual

rationale of the regulation model for data-driven policy-making in the new economy. For this reason, within the framework of conceptualisation research, a comprehensive literature review, clarification of abstract ideas, and definition of variables were carried out in this article. The article aims to analyse the essential devices of the digital economy ecosystem and the implementation strategy for economic policy-making. The realization of data-driven policy-making requires the management of informational processes involving the accumulation, classification, processing, and calculation of data arising from a multitude of economic relationships. For example, the Internet of Things (IoT) is increasingly covering all areas of economic sectors, enabling the influx and accumulation of data from vast areas (Hristov, 2017). Artificial intelligence (AI) deep learning techniques are used to make use of the vast amount of information accumulated in big data, which was previously considered useless. The calculation of big data by artificial intelligence is performed by supercomputers. In other words, data-driven decision-making requires multi-layered governance for economic decision-making. This requires a new role for the state in the digital age and a different form of economic regulation. Current technological conditions have made it possible to reassess more than a century of economic regulation problems and to create new forms of economic regulation. At the top of the list of economic regulation problems is the 'economic calculation problem. Therefore, this article examines the digital aspects of the economic calculation problem, which covers almost a century of debates, and conceptualises a digital cybernetic model of regulation. The study used abstract logical methods that examine the relationships and validity between concepts using logical rules.

2. The Role of Digital Economy in Data-Driven Policy Making

The social transformation that has taken place with digitalisation has led to the discussion of relations that characterise new conditions under different names such as digital economy, information economy, data economy, internet economy, and network economy. The digital economy can be considered as the common name of the new situation that is handled in different frameworks. The term 'digital economy' was first proposed by Don Tapscott in 1996 in his study 'The Digital Economy: Promise and Peril in the Age of Networked Intelligence' when he tried to explain how digitalisation was transforming the economy (Don, 1996). Although the initial definition of new economic relations focused on technological infrastructure, over time this focus shifted towards processes and regulations (Lane, 1999; Mesenbourg, 2001). When we look at the literature analysis, we see that the framework of the digital economy has been determined in terms of policy making and regulation since 2013 (House of Commons, 2016; OECD, 2013) (Van Gorp & Batura, 2015). Today, the digital economy has become a global economic model as a stage of social development in which information and communication technologies are widely used in different areas of the economy (Gumah & Jamaluddin, 2006). The realisation of economic activities in computer networks has increased the economic value of digital information processes and has become a tool for policymaking. Whether it is consumers comparing prices, searching for new goods and services, providing feedback and reviews, or businesses determining demand, supply, production, marketing, etc., these processes take place in digital networks.

Over the past 20 years, the digital economy has been defined from many different perspectives. Without dwelling on these definitions, we can briefly summarise the digital economy as "the realisation of economic activities in the digital environment". When characterising the digital economy, we encounter two basic choices. The first is to consider the digital economy as a sector of the economy. In our view, this is completely wrong. The second is to think of the digital

economy as characterising the economy as a whole. The correct identification of the digital economy allows the selection of the right analyses in policymaking and the timely determination of the processes of data-driven decisions.

Data-driven policymaking is only possible if the digital economy is fully realised. This is because the digital economy enables the transformation of economic activity into data through digital means and the collection of data. Data-driven economic policy-making starts with the collection of data arising from economic activities through the provision of information channels. In fact, the problem of collecting and calculating information on economic activity predates Internet technologies. This problem is based on the feasibility of economic planning, known in history as the "economic calculation debate." Today, the rise of the digital economy has enabled us to look at the economic calculation debate from the perspective of data-driven economics.

3. Digital Solution of Economic Calculation

As we have seen, the practical history of the idea of subjecting the economy to quantitative calculation is not new. It goes back to the 'socialist calculation debate' of the 1920s. The socialist calculation debate began with the problem of how to implement economic calculation (regulation) to implement planning in a socialist economy where capital and the market did not drive regulation and there was no private ownership of the means of production. Ludwig Mises argued that the planned economy has the problem of rational allocation of resources, citing the market economy as an example where supply and demand play a regulating and determining role. In a market economy, the price of the product provides information about the demand for the product. Without this information, it is not possible for the planned economy to make proper use of the means of production (Adler, 1990). The efforts of the planners (managers) of the socialist economy, who do not have accurate information about value, to correct the inaccuracies in value-price determination lead to economic costs, reallocation of resources, and social injustice. According to Friedrich Hayek, the economics of central planning, which determines the allocation of resources, often leads to the emergence of managers who take resources and impose penalties for the effective implementation of the plan (Hayek et al., 2005). Bryan Caplan argues that the source of the economic failings of socialism is not the lack of economic rationality that the Austrian school claims, but the weak incentives that result from the system of party rule (Caplan, 2004). In fact, by denying economic rationality in this way, Bryan is, on the other hand, defending Hayek's view. We believe that in this case it is unnecessary to question the egg or the dwarf. Unsuccessful economic planning by the party power is also a failure of the Soviet rulers.

Otto Neurath claims that it is possible to make economic calculations on the basis of natural products instead of financial calculations, citing the example of the military economy in wartime, which is based on natural products. According to him, it is not enough to use only one currency or energy unit in economic evaluation. All information about social life, including population groups, consumption preferences, education, disease, mortality, family life, and the workplace, allows for economic calculation (Cockshott, 2008). It was thought that by using information about available resources and consumer preferences, it would be possible to determine the required amount of production and price. Of course, the information processes and the technological situation at that time did not allow the processing of the large amounts of information that we now define as big data. This approach is central to the viability of the digital economy and the green economy.

The rise of cybernetic science, which is reflected in all areas of social life, has led to the idea that the problem of economic calculation can be solved by considering the economy as a management system. The use of today's digital technologies and powerful computers as important tools in the cybernetic planning and calculation of the economy offers new alternative solutions in the economy. In 1972-1973, Chile gained experience in computerised planning and control of the economy. Normally, statistics for the government's economic policy are delayed by 4-5 months due to conventional methods. The SYBERSEN project, led by Stafford Beer, a decentralised interactive system of social economic regulation, eliminated the problem of delays and enabled the government to provide immediate information for policymaking (Beer, 1994). The computer network set up as part of the project enabled the then Allende government to mobilise transport resources to move products (Brewster, 2004).

The information age, which became more widespread in the early 2000s with the third industrial revolution, has allowed economic activities to be fully integrated into digital systems. The transformation of economic activities has given rise to trends such as the knowledge economy or the digital economy, in which information and digital products are valued. It is an era in which the value of the economic product is determined by completely different social preferences and dynamics and in which performance and marketing have become important in socio-economic relations. This revolution has been discussed as a new stage of capitalism or a post-capitalist formation (informationalism) in which society has undergone a new class stratification. This situation has made it possible to view the problem of economic calculation through a new prism (Jael, 2015). In his 1967 work 'The Computer and the Market,' Oskar Lange equates the market with a computer by likening it to a device that performs calculations (Oskar, 1967). We can conclude that digital networks have replaced the market and computers (algorithms) have replaced the function of the market, as the migration of social life to internet networks allows the accumulation of production and consumption information in large quantities.

The recent development of the economy, followed by the digital transformation of society, has brought about changes in the class structure of society, new ways of organising production and consumption, new functions of social institutions and new areas of responsibility. Digitalisation has had the effect of increasing the possibilities of accumulating and processing economically meaningful information, thus solving the problem of calculation. This situation has mainly affected the proponents of the socialist planned economy and the green economy (Burdack et al., 20-23; Cottrell & Cockshott, 1993; Duffy, 1989; Elson, 1992; Kennedy et al., 2008; Kiker et al., 1996; Mandel, 1986; Peng & Fan, 20-21; Yang et al., 2017). Economic calculation has always been of interest to socialists and neoclassicists for the feasibility of intervention, restriction and full control to ensure accumulation in economic life.

4. The Digital Cybernetic Regulation Scale Model

Although the beginning of negotiations on new economic regulations coincides with post-Fordism, the history of their social institutionalisation, implementation, and manifestation in regulations can be dated to the COVID-19 processes. The main reason for associating the beginning of the new digital cybernetic era with covid-19 is that the regulation model is realised through data-driven cybernetic methods. For example, cybernetic methods and digital calculations based on patient census data have enabled the implementation of socially restrictive and health care policies. This type of regulation can play the role of a tool for many types of accumulation and reproductive alternatives that may emerge after the post-Fordist period. From

the perspective of regulation theory, the accumulation regime encompasses norms relating to the organisation of production and labour, principles of income distribution, norms of demand and consumption in the market, rules governing the management of joint industry and trade, and patterns of exchange and relations between economic sectors. In cyber Fordism, economic regulation can be realised by including a large number of non-economic indicators such as health, environment, disasters, and social tensions. This feature is characterised by the concept of a smart economy.

The wide range of economic regulation factors is related to the multi-accumulation diversity of today's global economy. This is why, in addition to the green economy, concepts such as the environmental economy, smart economy, knowledge economy, digital economy, behavioural economy, Industry 4.0, and Industry 5.0 have become topical. Suntsova Olesia notes that the scientific basis of these economic concepts has not been sufficiently analysed and that they are only general ideas. Nevertheless, the common feature of all of them is that they are based on a technological infrastructure that enables the accumulation and processing of information, such as big data, cloud technology, artificial intelligence, the Internet of Things, etc (Suntsova, 2022). This technological infrastructure also enables the realisation of digital economic calculation to ensure a smart economy with smart production.

If the role of the state was clearly defined in the periods before the digital economy, the activation of sustainability has led to the need for a complex regulation that plays between the plan and the market (Bagirzade, 2023). The sustainability of the economy is possible with the realisation of the regulations imposed on the planned economy when intervention is required and on the market economy when freedom is required. A smart economy is the regulation situation in which a balance is achieved between the plan and the market.

With regard to the accumulation regime, the planned economy and the market economy differ in method, but not in substance. If the planned economy has the possibility of increasing accumulation by restricting consumption, the market economy has the possibility of increasing accumulation by expanding consumer spending (subsidies). The historical development process has led to the conclusion that the market economy is practically more efficient in terms of the accumulation regime. However, the conclusion of the previous part of the study is that the possibilities offered by information technologies today increase the potential of the planned economy. Therefore, the study does not focus on the antagonism of planned or marketisation of the digital economy but aims to learn about the digital and green accumulation regime. In order not to dwell on this antagonism, the study proposes to make an evaluation within the framework of the 'Balanced Cybernetic Regulation Model' (Fig. 1) which envisages the regulation of both the planned and the market economy at the same time. The main argument for proposing this model is that the new form of economic organisation that is emerging today has a specific and complex political-economic structure. On the one hand, the proposed decarbonisation of the economy suggests planned regulation, and on the other, the realisation of carbon markets (Newell & Paterson, 2010; UN, 1998).

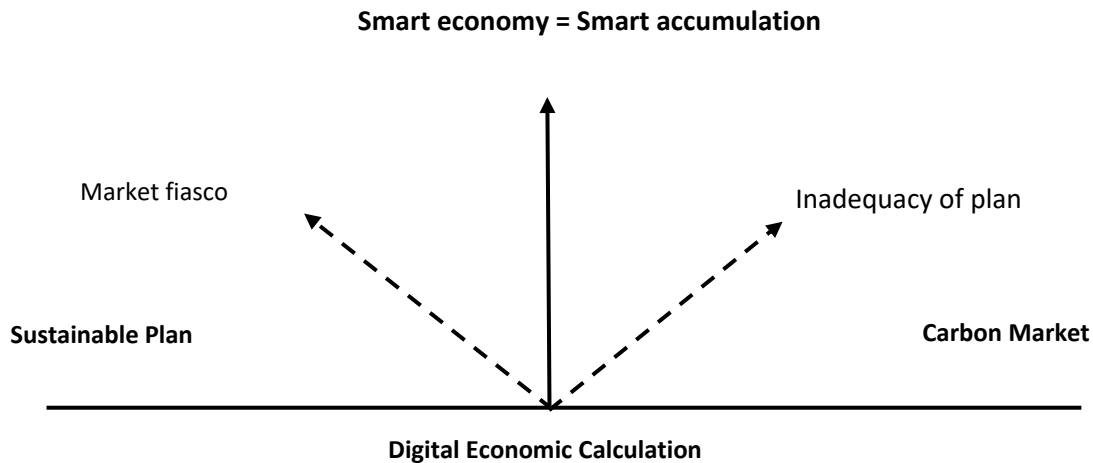


Fig. 1 Balanced Cybernetic Regulation Model

In many sources, the smart economy is referred to as Industry 4.0, which leads to confusion and uncertainty about its true nature (Galperina et al., 2016; Suntsova, 2022). The important feature of the smart economy is its form of regulation. From this point of view, we can define a smart economy as a form of economy in which digital cybernetic regulation is provided on the basis of information processes through digital technologies. The functionality of digital cybernetic regulation is realised through new data-orientated economic calculation tools. The importance of digital economic accounting can be illustrated by the following topics:

- Determination of ecology-based value,
- Determination of the entropy of economic activity,
- Market failure-resources are not allocated efficiently.
- Creation of green economic value,
- Determination of carrying capacity,
- Providing the basic argument in economic regulation,
- To determine the functional infrastructure of the accumulation regime (Bagirzade & Murshudli, 2025).

For the above reasons, the smart economy based on digital computing has an important role to play for the realisation of sustainable development and green accumulation. From the perspective of regulation theory, sustainable development strengthens the integrity and position of the emerging global economic order (Böhm et al., 2012). Digital cybernetic regulation utilises the smart economy to ensure balanced carbon markets and decarbonisation schemes. At the same time, it is criticised that digital cybernetic regulation, which functions to ensure green accumulation, serves to monetise and capture environmental goods and to create a new colonial dimension (Bachram, 2004; Mannat, 2023; Müller & Passadakis, 2015; Sullivan, 2011). Harvey associate's green accumulation with unequal development and dispossession processes. Examples of policies of dispossession include commodification, privatisation, deportation of the population, confiscation of assets, taxation, use of migrant labour, financialization, and expansion of the credit system (Harvey, 2005, 2006). His use of the understanding of 'space' in the evaluation of capital accumulation, together with the explanation of Fordist and post-Fordist

production organisation, has shown its importance in sustainable organisation. The possibility of uneven development of green accumulation, its different reflections on the economic situation of countries, and the global economy's inequality between North and South. The development of the digital economy is not only about economic development but also about ensuring the functionality of the environment-based green economy. The digitalisation of economic activity through the digital economy is key to the realisation of the tasks of the green economy, such as green consumption. At the same time, the green economy, which has the potential for the accumulation of large capital resources, can help to direct large investments in the digital economy.

The digital economy helps integrate the green economy into real economic activities and fulfils the demand for data for environmental calculations. This data helps to solve the problems of carbon footprint, green accounting and economic calculation, enabling a new accumulation regime. The digital economy also enables the governance of environmental and economic actors for sustainable development goals (Bagirzade, 2024, p. 38).

Despite the uncertainty of empirical data that maintain scientific objectivity and show the positive impact of the green economy on the environment, data that show the functionality of green accumulation are generating widespread debate. For example, the volume of the global carbon market in 2021 will be \$851 billion (Arcos-Vargas et al., 2023). According to the World Bank's Carbon Pricing Dashboard Status and Trends, the volume of government revenues from carbon pricing worldwide reached \$97 billion in 2022. Of this, \$32 billion will come from carbon taxes. The price range in carbon trading varies from \$0.7 to \$155.8 (World Bank, 2023). Green savings through carbon markets involve the purchase of carbon credits for emitters to comply with mandatory compliance plans. According to the report of the London Stock Exchange Group for 2023, the global carbon market increased by 2% and reached \$948.75 billion (Kozintseva & Wizman, 2024). All these result data of the carbon reduction regime can be considered as digital cybernetic regulation of green savings.

5. Conclusion

The study includes an assessment of the conceptual basis of the regulation model for data-driven policy-making from the perspective of the digital economy. Therefore, it focuses on the basic elements and their conceptualisation that ensure the functionality of the accumulation regime of the digital economy. The problem of economic calculation is the main obstacle to the social organisation of the digital and green economy. This is because the failure to correctly assess the economic value of environmental goods and services leads to uncertainty about the carrying capacity of the environment, the value-price relationship, the distribution of resources, economic regulation, and the functioning of the accumulation regime. In this framework, based on the regulation approach, the sustainable aspect of the reflection of economic calculation on the accumulation regime and the form of regulation is discussed. Especially in recent times, the beginning of a new era of information processes in society has led to the emergence of new solutions and approaches to the problem of economic calculation. The digital and cybernetic aspects of the problem of economic calculation have been evaluated, taking into account the new conditions that can be considered as the era of informationalism. As a result of the evaluation, the "Digital Cybernetic Regulation Scale" model is proposed by modelling the interaction of the elements of the digital and green economy. Considering that the green economy consists of mandatory practices and artificial markets for their realisation, the proposed model reflects the

balance of the dualism of plan and market. The model can also help to determine the political economy that will ensure balanced regulation in a sustainable economy.

According to Dan Ciuriak, the following factors explain the privileged importance of data-driven economic policy making:

- Lack of information may lead to market failure,
- Industrialisation of learning through artificial intelligence,
- Multiplication of superstar companies,
- Changes in the traditional economic accounting system,
- Risks arising from inadequacies in the information infrastructure (Ciuriak, 2018).

The asymmetric distribution of information can significantly hinder the achievement of equilibrium and competitiveness in the market. Market players who are able to use big data have more economic regulation tools than market players who treat data as a set of useless information. The proliferation of actors capable of making data-driven decisions leads to a proliferation of superstar firms. Contrary to Dan Ciuriak, we see a current trend towards individualisation rather than industrialisation of learning. The creation of data-driven policies makes it possible to generate information according to individual situations and new data analyses. This information leads to an increase in individual, additive learning compared to the current situation. The analysis of the Fordist and post-Fordist organisation of production shows that with the formation of new economic relations, specialisation and labour relations have changed. Thus, the formation of a data-driven economy creates the need to evaluate and conceptualise social relations in terms of the new organisation of production. For superstar companies, their good position in the data-driven economy neglects the principle of competition and the principle of the market, since they have the best access to economic big data. Only technological innovation can end monopoly in the market, what Schumpeter conceptualised as 'creative destruction' (Aghion & Howitt, 2023). Since the conceptualisation of the realisation of data-driven economic policies is of an overarching nature, the theory of regulation has been applied.

The study evaluates the digital economy within the framework of regulation theory and proposes a cyber Fordist form of organisation in addition to the Fordist, post-Fordist economic organisation. It is argued that the digital and green economy can be realised mainly under the cyber Fordist form of economic organisation, and it is concluded that green accumulation is the cybernetic digital regulation of the carbon reduction regime. This model emphasises the function of the smart economy in achieving green accumulation.

Thus, the article argues that the green economy is part of cyber Fordist economic organisation and that green accumulation, which can be seen as smart accumulation, is achieved through digital cybernetic regulation. The basis of digital cybernetic organisation is digital cybernetic economic calculation. Examples of measures of green economic calculation include green accounting, carbon footprints, ecological footprints and consumption-related footprints. Digital cybernetic regulation takes into account the factors that ensure flexibility of production in economic policymaking, as well as the provision of diversified savings through environmental, health, or other issues. For a more precise specification and conceptualisation of the digital cybernetic regulation of green accumulation, issues such as money and credit relations, the

remuneration of labour, the form of competition, international relations, and the new role of the state should be further explored. These issues encompass the institutional aspects of the form of organisation described by Boyer Robert and determine the institutionalisation of green accumulation (Boyer & Saillard, 2002). Thus, a deeper analysis and conceptualisation of the theoretical basis of cyber Fordism as a new form of economic organisation is proposed.

Despite the tendency of carbon taxes and emissions trading schemes to grow in volume and capital accumulation, no definitive conclusions can be drawn about the carrying capacity of the ecosystem, the limits to growth, the transformation of the environment into commercial goods and services, and the determination of its net value in monetary terms. The scientific methodology and results of studies on these issues have been subject to much criticism. In 1997, for example, a study involving a large number of researchers put a price on the economic value of the world. In this study, the economic valuation assigned to 17 ecosystem services was determined to be 16-54 trillion US dollars (33 trillion per year) (Costanza et al., 1997). This figure is twice the world's gross national product in the year under consideration.

The problem of economic calculation, which has been discussed for almost a century, is coming to a solution with the emergence of the digital economy. New ways of calculating, which we can define as digital economic calculation, can be a solution to problems such as determining the value of environmental products in the green economy and ensuring the relationship between consumption and environmental carrying capacity.

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