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Международна научно-практическа конференция

90 години дарителство, знание, иновации и устойчиво развитие в СА „Д. А. Ценов" – Свищов

Том II



5-7 ноември 2026 г.

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SHADOW DIGITAL ECONOMY AND SUSTAINABLE DEVELOPMENT

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Abstract: *This paper investigates the phenomenon of the shadow digital economy (SDE) as a latent yet intensifying form of digital conflict, operating at the intersection of informal economic activity and cybercrime. The analysis demonstrates that the SDE is not merely a collection of isolated cyber threats or illicit transactions; rather, it constitutes a distinct politico-economic formation embedded in global capitalism and reproducing its internal contradictions.*

The study outlines key practices of the SDE, ranging from cyberattacks and distortions of labor markets to transnational data trade, cyber extortion, money laundering, and tax evasion—all facilitated by anonymity and digital payment systems. These processes not only operate „outside the law" but also reshape institutional environments by exploiting vulnerabilities and constructing parallel value chains in which legal and illegal practices become mutually intertwined.

Particular attention is given to the implications of the SDE for sustainable development. Economically, it undermines fiscal regulation, widens socio-economic inequality, and erodes public trust in state institutions. Technologically, it fosters illicit digital ecosystems, proliferates Crime-as-a-Service models, and amplifies asymmetries in global digital flows. This dual impact renders the SDE both a symptom of institutional erosion and a driver of long-term risks to achieving the Sustainable Development Goals.

Keywords: *Shadow Digital Economy, Digital Sovereignty, Cybercrime, Digital Warfare, Sustainable Development, Political Economy.*

JEL: E25, K24, C51, D52

1. Introduction

The rapid digitalization of the global economy has brought significant benefits in terms of innovation, productivity, and cross-border interactions. However, it has also given rise to a shadow digital economy (SDE), which constitutes a latent form of digital warfare. Unlike the traditional informal sector, SDE is deeply transnational, scalable, and technologically enabled. Its practices – ranging

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from cyberattacks and extortion to platform-based informal labor – reflect and intensify the contradictions of deregulated digital markets.

Existing literature on informal economies and network society has highlighted the structural role of informal and illicit activities in capitalism. However, studies of cybercrime often remain confined to technical or criminological approaches, neglecting the systemic and political-economic nature of SDE. This paper builds on critical political economy and digital capitalism studies to conceptualize SDE as an adaptive subsystem of the global economy, co-evolving with formal markets.

The aim of this study is to develop a conceptual framework for the Shadow Digital Economy (SDE), examine its socio-economic and institutional implications, and identify strategic approaches to mitigating its adverse effects.

2. Literature review

The literature review can be structured along three main directions: political economy, ICT, and cybersecurity.

The starting point of this study lies in identifying the macro-trends that shape contemporary business. For instance, Stephen J. Andriole (Andriole, 2005) highlights two central tendencies:

- The first, or business trend, is collaboration. This refers to companies engaging with employees, customers, suppliers, and partners in new and ongoing ways.
- The second trend is technological integration. Systems once used for accounting, customer communication, or employee information management are now increasingly interconnected, exchanging data and building on each other's analyses to drive and expand collaboration.

According to the author, the intersection of these two trends produces a powerful business-technology synergy. The crucial point is that collaboration and technological integration are tightly intertwined. Collaboration is becoming ever more dependent on technology, while technologies themselves are increasingly integrated, thereby enabling and reinforcing collaborative business models. Such models require not only process integration but also data integration. Business technologies remain „tactical" and „operational" — computers and networks still need to function reliably—but they have also become highly „strategic". They now have the potential to make or break a company, particularly as the pace of collaborative and integrative trends accelerates. Organizations are discovering ways to enhance the efficiency of existing processes while simultaneously adding new, cooperative ones.

Heikki Patomäki's book offers a pioneering investigation into the future of wars, crises, and transformations within the global political economy. Bringing together economic theory, political economy, peace and conflict studies, philosophy, and historical analogy, the work explores alternative futures (Patomäki, 2007). Patomäki develops an original and thought-provoking political-economic

critique of neoliberalization and globalization at the end of the twentieth century, describing their real-world consequences as a twenty-first century form of imperialism. He argues that even a partial return to nineteenth-century ideals and practices would likely be profoundly counterproductive today, potentially setting the stage for a global catastrophe.

An important perspective is also presented in Christian Fuchs's „Digital Labor and Karl Marx" (Fuchs, 2014). The author draws on Marx's labor theory of value, where value is determined by the number of labor hours socially necessary for producing a commodity. Since the actual labor time for each item is difficult to measure, what matters economically is the average labor time required during a given period (for example, one year). This average can be calculated at the level of a single firm, an industry, or even internationally. Capital constantly seeks to reduce the value of commodities in order to increase profit margins. Reducing value means accelerating production—so that the same number of labor hours, which are tied to a certain monetary value, suddenly produce more goods. Although labor costs do not increase, surplus profit accumulates more rapidly.

3. Sustainable Development

One of the most significant achievements of modern science has been the development of the concept of sustainable development (SD). Today, SD has become an indispensable requirement of the current stage of global progress, representing a fundamentally new and still-evolving field of synthetic knowledge.

The emergence of this concept should be understood as the outcome of a broad set of studies across the natural sciences, the social sciences, and economics. Scholars emphasize both the novelty and the inherently interdisciplinary nature of this field, which calls for systematic research in order to more accurately reflect and integrate the results already achieved.

In this context, the subject of sustainability science has begun to take shape—a developing field that rethinks the interconnections between different domains and scales. At its core, it explores the interaction between nature and society, between science and practice, and between the global and the local. At the same time, it reflects on the relationship between the past, the present, and potential futures. Experts emphasize that, in the search for sustainable solutions, the structuring of knowledge within this complex and interdisciplinary domain is of fundamental importance (Danilina and Gerbina, 2024), (Jerneck et al, 2011), (Komiyama and Takeuchi, 2006).

With regard to the intellectual heritage of sustainable development, it should be noted that it has been shaped over a long period of time and can be divided into several distinct stages. The first stage, which dates back to the 19th century, reflects the emergence of a conscious approach to interaction with the environment and the rational use of natural resources. This period is represented in the works of T. Malthus, K. Marx, A. Comte, H. Spencer, and others. The philosophical and worldview foundation of the concept of sustainable development

is often associated with the doctrine of the *noosphere*, developed by the French thinkers É. Leroy and P. Teilhard de Chardin, as well as the Russian scientist V. Vernadsky.

The second stage is linked to the 1960s, when the global scale of emerging challenges became increasingly evident, and the search for collective solutions gained momentum. During this time, social and economic crises became a subject of systematic investigation by scientists, policymakers, business leaders, and civil society. In order to analyze the pressing issues of energy and raw materials—particularly in the context of the growing automobile industry—the Club of Rome was established. Its activities had a significant impact on the development of the concept of sustainable development. A milestone in this regard was the 1972 report *The Limits to Growth*, which is often considered one of the key stages in shaping the concept (Meadows et al, 1972). The report presented computer modeling of global system dynamics, taking into account trends in industrialization, population growth, food production, environmental pollution, and the scarcity of resources.

Although the report was widely criticized for its methods and conclusions (Robinson, 1973), it drew much-needed attention to the idea that delaying responses to global problems, and failing to take preventive measures in time, leaves fewer viable options for development. The 1972 Stockholm Conference reinforced this perspective by highlighting the necessity of shifting priorities toward the ecological and economic sustainability of society. One of its outcomes was the creation of the United Nations Environment Program (UNEP), which stimulated new developments in environmental law, international cooperation, and global environmental policy.

A further landmark in the evolution of the concept was the 1987 publication of the report „Our Common Future“, prepared by the independent Brundtland Commission after 900 days of work. The Commission’s primary task was to identify practical ways of addressing global challenges. The report introduced the now-classic definition of sustainable development: *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*.

The Sustainable Development Goals (SDGs), also known as the Global Goals, are a set of 17 ambitious objectives adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals provide a shared blueprint for peace and prosperity for people and the planet, aiming to achieve sustainable development in a balanced and integrated manner.

Among the recent developments, the Fourth United Nations Conference on Financing for Development, held in Seville, Spain, and concluded on July 4, 2025, stands out. The conference outlined concrete measures to translate ambitious goals into tangible actions to overcome the financial crisis and accelerate the achievement of the SDGs. The adopted resolutions identify specific steps to reduce the financing gap for sustainable development, which amounts to

approximately 4 trillion dollars annually (UN, 2025), (Wells, 2025) in developing countries.

4. The Digital Economy and Shadow Digital Economy

The digital economy refers to the extensive integration of information technologies—hardware, software, applications, and telecommunications—across all areas of economic activity.

The digital economy can be visualized as a pyramid. At its apex are semiconductors and silicon foundries, small but essential for enabling digital functionnality across a wide range of products, from consumer electronics to vehicles, machinery, and appliances. The core sector below this apex consists of the computer and telecommunications industries, which support the broader digital ecosystem. The main body of the pyramid includes IT-intensive sectors in both manufacturing and services. These rely heavily on digital technologies for daily operations. In services, this includes e-commerce, media, IT-enabled business services, and financial services; in manufacturing, sectors such as automotive and aerospace use IT extensively throughout product lifecycles. Even within these industries, digitalization varies across departments and locations, creating a distinction between knowledge-intensive and fully digitalized work.

The rise of the Shadow Digital Economy (SDE)—characterized by hidden, unregulated, and often illicit digital activities—intensifies the complexity of cybersecurity. As evidenced by China's experience, rapid digitalization, while fostering innovation and growth, also amplifies systemic exposure to cyber threats that erode economic resilience. These threats are not merely technical disruptions but manifestations of deeper structural vulnerabilities within digital ecosystems.

This convergence of SDE and cybersecurity concerns also transcends the economic domain, as (Olejnik and Kurasiński (2023). highlights: the societal implications of cybersecurity failures—from critical infrastructure to democratic institutions—are profound. Authors (Olejnik and Kurasiński (2023). argue that cybersecurity cannot be reduced to data or computer protection alone; rather, it encompasses the security of society as a whole. They stress that cybersecurity concerns affect almost everyone, including individuals who may not actively use computers, smartphones, or social networks. Their analysis begins with the concept of risk and its typologies, and continues through discussions of cyberattacks. Importantly, they examine the vulnerabilities of users and the exposure of critical social domains such as infrastructure, healthcare, military and strategic systems, and the state itself. Their conclusion is unequivocal: as digitalization advances, the challenges of cybersecurity cannot be avoided as cybercrime advances, as well.

The conceptual model of the SDE represents a structured and functionally interconnected quasi-market ecosystem in which illicit digital products, criminal services, and specialized personnel interact through a network of stakeholders who organize, finance, and sustain cyber-criminal activity. At the core of the

model lies the SDE as an integrated ecosystem that operates according to economic logics similar to legal digital markets, yet remains entirely outside institutional regulatory frameworks. Surrounding this core are three major components—products, services, and SDE labor market (personnel)—which collectively ensure the continuity, scalability, and adaptability of shadow digital operations.

The products within the SDE include a wide range of malicious digital tools such as DDoS and DoS attack kits, phishing and spear-phishing mechanisms, ransomware, botnets, SQL-injection instruments, credential-theft software, and other forms of malware and exploit packages. These products serve as the foundational technological assets of cyber-criminal activity. They enable unauthorized access, data theft, system disruption, and numerous forms of digital manipulation. Their availability in ready-to-use or customizable formats lowers entry barriers, allowing even actors with limited technical skills to deploy sophisticated attacks.

Complementing these products are services, which reflect the growing „platformization“ of cybercrime. The principal services operating within the shadow digital economy include the following (Ohrimenco et al, 2026):

• Cybercrime-as-a-Service (CaaS). A business model in which cybercriminals package and sell turnkey criminal capabilities to third parties. Also descrybed in the literature under labels such as Attacks as a Service, Malware as a Service, and Fraud as a Service, CaaS providers deliver ready made tools, infrastructure, and operational support to paying customers who wish to carry out illicit operations.

• Ransomware-as-a-Service (RaaS). Under this model, attackers assemble and market ransomware kits that other offenders can deploy to encrypt victims' data; the perpetrators then demand payment for restoration. RaaS offerings continually evolve, adding new features and sophistication, and have become an efficient vector for highly targeted and profitable intrusions.

• Phishing-as-a-Service (PhaaS). PhaaS vendors supply end to end phishing solutions—pre built landing pages, message templates, hosting, victim lists, and data harvesting utilities—often through user friendly interfaces that enable even non technical actors to design, launch, and manage credential harvesting campaigns.

• DDoS as a Service (DDoSaaS). This service provides the tools and backend capacity to mount distributed denial of service attacks against websites and online services, rendering them inaccessible to legitimate users.

• Botnets for hire. Compromised networks of devices (botnets) are leased to clients for a range of malicious activities—spam distribution, DDoS attacks, propagation of malware, and other tasks—while control remains in the hands of the botmaster.

• Credential theft services. These offerings focus on acquiring and selling authentication data—usernames, passwords, API keys—harvested from individuals or corporate systems, often through automated probes, phishing, or breaches.

• Research as a Service (ReaaS). In the cybercriminal ecosystem, ReaaS denotes the provision of real time analytical products—vulnerability discovery, target profiling, market segmentation, and operational intelligence—that allow offenders to make timely, data driven decisions. The demand for instant, actionnable information has turned research itself into a commodified service supporting illicit operations.

The effective functioning of both products and services relies on diverse categories of personnel, whose roles range from technical execution to organizational coordination. This includes hackers, programmers, data analysts, fraudsters, IT technicians, chief security officers involved in illicit activities, and project managers who oversee or coordinate operations. Their expertise determines the quality of criminal tools, the sophistication of attacks, and the resilience of illicit infrastructures. Personnel also facilitate connections between technical tasks and the broader strategic objectives set by criminal networks.

5. Conclusion

The presented material confirms the urgency of classifying the shadow digital economy (SDE) within the broader framework of cyber-enabled crime. Mirroring historical criminal infiltration into economy sectors, SDE follows a similarly concealed logic of placement, layering, and integration—only now facilitated by the speed, anonymity, and scale of digital infrastructures. Law enforcement limitations, incomplete victim profiles, and the evolving nature of cybercriminal actors enable this parallel economy to thrive.

The conceptual model of the Shadow Digital Economy presents the SDE as a digitally embedded quasi-market ecosystem in which illicit products, criminal services, and specialized labor function as interdependent economic goods and factors of production, collectively reproducing the logic of a digital market operating entirely within the sphere of the shadow economy.

The analysis yields several key findings regarding the structural nature and consequences of SDE:

1. Dual Value Chains: Legal and illegal digital markets increasingly overlap, creating hybrid chains of value. Shadow actors exploit the same infrastructures—telecommunications, cloud services, and financial systems—relied upon by legitimate enterprises. This entanglement blurs regulatory boundaries and normalizes shadow practices.
2. Institutional Erosion: SDE erodes state capacity by shrinking tax revenues, incentivizing corruption, and weakening enforcement. This institutional degradation is most visible in areas where regulatory frameworks lag behind technological change, but even advanced economies experience diminished fiscal sovereignty.
3. Asymmetric Power Relations: The results highlight stark asymmetries between states and private actors. While governments face jurisdictional limits, transnational corporations and shadow networks exploit digital flows

across borders, deepening inequalities both domestically and internationally.

4. Parasitic Dynamics: SDE exemplifies a parasitic relationship with the formal economy, extracting value without contributing to the maintenance of public infrastructure. The costs of policing, cybersecurity, and institutional repair are externalized to the state, while shadow actors capture rents with near impunity.
5. Latent Digital Warfare: Finally, SDE functions as a form of low-visibility digital conflict providing 'Shadow Fog' on economic activities. Rather than dramatic, one-time cyberattacks, its impact accumulates gradually through lost revenues, weakened trust, systemic data breaches, and widening inequalities—constituting a chronic mode of institutional disruption.

Together, these findings underscore that SDE is not reducible to isolated cybercrime events but should be understood as an evolving subsystem of global capitalism with long-term destabilizing effects.

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