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DIGITAL CURRENCIES AND FINTECH INNOVATION TECHNOLOGIES FOR ECONOMIC GROWTH

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Abstract: *The transition of the global economy to digital currencies is inevitable. Today's monetary methods of regulation do not provide a stable and inclusive economy, and central banks will be forced to move on to the implementation of the state digital currency in real practice, which will ultimately allow introducing total control over the use of customer assets and strict business regulation, especially in the field of the shadow economy and tax crimes. The main factors for the transition to digital currencies are technological progress, an increase in online transactions, independence from national currencies, and low commissions. The purpose of the article is to assess the potential for economic growth of digital currencies and FinTech innovation technologies in the context of growing government debts. The scientific novelty of the obtained results lies in the construction of a regression model of GDP growth dependence on inflation, government debt and the long-term interest rate. The regression analysis was conducted by building a linear multiple model for selected developed European countries based on statistical data from the European Central Bank, the European Commission, and other Internet resources. The equation of dependence of the GDP of European countries on the selected factors obtained as a result of regression modelling can be practically used to forecast future GDP indicators. The model showed that inflation growth has a negative impact on GDP growth and confirmed that further economic growth is possible with the introduction of digital currency, which will help to reduce the inflationary burden. The issuance of digital currency will be strictly controlled, which will contribute to the formation of an inclusive economy by attracting people who do not have bank accounts to business, and the shadow economy will be reduced. This will create opportunities for real economic growth. It is predicted that the introduction of digital currencies could lead to a faster, more convenient, cheaper and more private payment system, which is important for citizens and businesses.*
Keywords: CBDC; regression model; trend; GDP; government debt; inflation; European countries.

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1. Introduction. Today, in a global environment, there are many problems of humanity: an aging population, a slowdown in productivity growth, and the effects of climate change, migration, pandemics, military and political instability (Lukianenko & Simakhova, 2023). For economic development, rising prices, apandemic and an energy crisis in Europe are quite problematic. Already at the beginning of the 21st century, banks began to "securitize" previous loans to finance new ones. This was initially concentrated on residential mortgages before moving on to other forms of bank liabilities. All this has led to the incorporation of numerous high-risk derivatives (secondary securities) into the economy. At the same time, as soon as the financiers realized that their obligations were worth little, they issued even more debt for their own refinancing. At the same time, the costs of the speculative bubble are mainly borne by society because the process of bailing out banks during the 2008 crisis was carried out by governments at the expense of the state budget. In this case, banks transfer their risks to society, knowingfull well that their collapse will be a great burden for the economy, and, based on this logic, they believe thatthe state is obliged to take care of their salvation. With unparalleled securitization, the volume of securities transactions skyrocketed, spurring the IT revolution and setting off an entire industry – FinTech (Baltgailis & Simakhova, 2022). With the help of the innovation technology FinTech, commercial banks could now use their enormous balance sheets based on customer deposits for speculation, be completely unconcerned about the growing risks and develop financial instruments of ever greater complexity, especially since the most qualified personnel are concentrated in the FinTech industry, able to actually implement almost any banking requests using digital currencies and blockchain technologies, and without special banking supervision and regulation. The high risks generated by banking securitization can be assessed not only by the volume of issuance, bankruptcies in the real sector of production, and job losses but also by the amounts of money that governments had to inject into private banks, since they are "too big to fail": the quantitative easing (QE) schemes that followed the crisis could have been used to prop up the economy but ended up bailing out the banks again. In 2008-2014, the US Federal Reserve launched three different QE schemes for a total of 4.2 trillion dollars. In the UK, the Bank of England in 2009-2012 conducted a QE of 375 billion dollars. Pounds sterling, and in Europe, the ECB allocated 60 billion Euros per month for these purposes from January 2015 to March 2017 (Wray & Nersisyan, 2016). The purpose of the article is to assess the potential of digital currencies and FinTech innovation technologies in the context of the growing global debt crisis and its opportunities for economic growth.

2. Literature Review. The forecast of the World Bank for the current and next year does not inspire optimism yet. Rising prices and high inflation will continue, and the recession in Europe and the US will continue (World Bank, 2023a). Today, the deficits are caused mainly by predictable structural factors: our aging baby-boom generation, rising healthcare costs, and a tax system that does not bring in enough money to pay for what the government has promised its citizens. The coronavirus crisis has accelerated an already unsustainable fiscal trajectory, both because of its devastating effect on the economy and the necessary legislative response. Once we have emerged from the pandemic, it will be critical for American and European leaders to address our rising debt and its structural factors. Under these conditions, the problem ofensuring the stability of the financial system will grow, and many countries are turning their attention to the possibilities of digital currency.

The issues of studying digital currencies were studied by scientists such as Carstens (2022), Zhang et al. (2021), and Ward & Rochemont (2019). It is important to note that Latvian FinTech researchers (Lavrinenko et al., 2023) conclude that innovation technology FinTech has a significant impact onfinancial development. FinTech has a strong impact on financial markets. The positive correlation of financial development with the Financial Market Depth Index and the Financial Market Efficiency Index, as well as the Financial Institutions Depth Index, shows that the advent of fintech has enabled financial institutions to attract more consumer deposits and savings, which can be attributed to both traditional banks and FinTech services. This may also be helped by the fact that traditional financial service providers are investing heavily in their digital transformation. Thus, FinTech innovation technology and digital currency are the future of the international finance system. It is a matter of time for the introduction of digital currencies in all countries of the world. Further research requires the implications of the introduction of digital currency in the short and long term.

3. Methodology and research methods. The following scientific methods were used in the study: analysis and synthesis (for indicators of inflation and public debt); literature analysis (to study sources on

the introduction of digital currency); and the data systematization method (to analyse the level of GDP growth and factors that affect it). The article also included a positive experience of regression modelling. The hypotheses of the study were that the high levels of inflation and government debt in European countries slow GDP growth and that further economic growth is possible with the introduction of digital currency. The authors confirmed this hypothesis by constructing a regression model of the dependence of GDP growth on factors such as the inflation rate, long-terminterest rate, and level of government debt. The regression analysis was conducted by building a linear multiple model for selected developed European countries based on statistical data from the European Central Bank, the European Commission, and other Internet resources. Additionally, the information basis of the research was the scientific publications of World Bank publications, articles and monographs by scholars.

4. Results. The financial system is currently in a period of exceptionally rapid technological and organizational change, with the adoption of cloud computing to store and process financial data, artificial intelligence to analyse it, and blockchain to secure it. It is fashionable to assert that digital currencies will be part of that future. However, cryptocurrencies such as Bitcoin are too volatile to possess the essential attributes of money. Stablecoins have fragile currency pegs that diminish their utility in transactions. Central bank digital currencies are a solution in search of a problem. The situation is exacerbated by the fact that private IT corporations have long been creating their own payment systems. In addition, as their ecosystems develop, the risk ofconcentrating an enormous amount of economic information and personal data in the hands of a limited number ofcompanies (which is especially dangerous: foreign ones) increases. To counteract this threat, states are beginning to seize the initiative in the development of payment and settlement infrastructure and Big Data from the private sector and transnational business. One hundred percent of all central banks were either at the stage of creating digital currencies or studying this possibility, and of course, most of them want to create a national project with a national currency, which will naturally narrow the turnover of the dollar and the euro (Georgieva, 2022).

Approximately 100 countries are exploring CBDCs at one level or another. Some studies, some testing, and a few have already distributed CBDC to the public. In the Bahamas, the Sand Dollar—the local CBDC—has been in circulation for more than a year. Sweden's Riksbank has developed a proof of concept and is exploring the technology and policy implications of CBDC. In China, the digital renminbi [called e-CNY] continues to progress with more than a hundred million individual users and billions of yuan in transactions. In thinking about digital money, three categories are usefully distinguished. Bitcoin is the best known, although it has many rivals. These cryptocurrencies rely on a distributed ledger verification technology popularly known as blockchain, and their prices fluctuate with supply and demand, sometimes wildly.

The second category is so-called stablecoins. These are cryptocurrencies that run on either a distributed ledger or a centralized system maintained by the issuer, which stands ready to convert them into legal tender, such as the US dollar, at a fixed price on demand. The best known example is Tether, which is "tethered" to the dollar (one Tether is worth one dollar). A couple of years ago, Facebook made a splash by proposing to enter this space with its own stablecoin, initially called Libra, but subsequently rebranded as Diem and hived off to an independent governing association.

The final category is made up of prospective central bank digital currencies (CBDCs). These are digital units with fixed value; they would be made available to consumers as a token, by depositing them into digital wallets, or by allowing individuals to open retail accounts at the central bank. Central banks around the world are actively studying these possibilities. To avoid the destabilizing consequences of bank-run problems, governments today insure retail deposits up to a specified ceiling, and central banks act as lenders of last resort to aid embattled financial institutions.In return, they require banks eligible for assistance to follow regulations designed to limit the incidence of such problems. Presumably, stablecoin issuers, to receive similar protection, would be required to apply for bank charters or their equivalent. From the vantage point of the monetary system, this would not be anythingnew under the sun.

A second way to cut corners is by holding a portion of the collateral backing the stablecoin not in cash but in interest-earning assets, such as US treasury bills or high-quality private securities known as commercial paper. In this case, the stablecoin issuer would function like a kind of money market mutual fund. Money market mutual funds pool their customers' share purchases. They use the proceeds to purchase treasury bills and commercial paper, making money on the spread between the interest earned on these investments and that paid to their clients. Like a stablecoin issuer, they promise their customers that shares can be redeemed at

par—that a share purchased for a dollar can be redeemed for a dollar. They obtain funds to finance redemptions by selling off a corresponding quantity of liquid securities.

The study in this area is coordinated by a committee of the supranational Bank for International Settlements in Basel (BIS). Central banks promote their digital currencies under the slogan that they are simply an addition to the existing settlement systems. Retail CBDC – it is she who will radically change the rules of the game in the financial market. It is on it that the main interest of both developers and financiers is now directed.

Another option is to make a digital euro based on deposit accounts directly with the central bank. Technologically, this will not be an innovative phenomenon, although an enormous number of accounts will have to be opened. If we talk about the eurozone, the ECB will have to increase deposit accounts from approximately 10 thousand to 300-500 million – that is, residents of the eurozone will be able to have accounts not in a commercial bank but directly in the ECB. This type of CBDC will allow the ECB to control all transfers between users, which, among other things, will allow it to combat money laundering and other illegal operations (ECB, 2020).

In this case, central banks provide an open, neutral, trusted and stable platform. Private companies use their ingenuity and dynamism to develop new payment methods and financial products and services. This combination has been a powerful driver of innovation and welfare.

However, we cannot take this successful symbiosis for granted. Some recent developments may threaten money's essence as a public good if taken too far.

To illustrate this, let me offer three plausible scenarios for the future of money:

- In the first, big tech stablecoins compete with national currencies and against each other too, fragmenting the monetary system.
- The second relates to the elusive promise of crypto and the realization of sized finance, which claims to offer afinancial system free from powerful intermediaries but may actually deliver something very different.
- The third realizes the vision of an open and global monetary and financial system that harnesses technology for the benefit of all.

The key interest of Carstens and central banks is that this currency gives central banks the opportunity to strengthen their control not only in the economy but also in individuals and enterprises. This allows you to create an inclusive economy, which, according to the ideologists of CBDC, will not only involve people without bank accounts in business activity but also create conditions for full control over all residents and even nonresidents. For example, using expiring CBDCs, after which they become useless, central banks can accelerate the spending of funds by market participants or expand consumer demand in privileged industries, such as green energy, or choose to apply positive and negative interest rates for digital currencies. Such a methodology will also limit inflation since the digital money supply will be automatically sanitized at the right time. Currently, in most countries of the world, there is a two-tier banking system. The first level is the central bank, which has a monopoly on the issue of national currency in cash and is the government's agent for the placement of government debt obligations, as well as the lender of last resort to banks.

The second level is commercial banks that provide payment and settlement and credit and deposit services to citizens and organizations. In turn, payment and settlement operations and noncash circulation are based on the system of interbankpayments. Digital currencies of central banks, as the name suggests, assume the existence of a monopoly of central banks on their issuance and make it unnecessary for commercial banks to multiply the money supply. Thus, the central bank will be the creator, operator, and custodian of the pool of digital currencies. The role of commercial banks in such a system is to check customers and their operations for compliance with the requirements of the legislation on combating the legalization of illegally obtained income. They will also provide customers with payment and settlement infrastructure for transforming their funds from one form to another (cash, noncash, digital). In the future, such a system may lead to central banks providing the nonfinancial sector of the economy not only with settlement but also with credit and deposit services. This will make the traditional business model of banks uncompetitive, and therefore, many of them are already actively investing in ecosystems and FinTech. The central bank's digital currency, used for electronic payments, risks almost completely depleting the commercial banking network of deposit money, which can lead to the flight of money from commercial banks and replace them with a supermonopoly in the form of a central bank. For now, central banks are forced to choose between raising interest rates to boost the purchasing power of their currencies and continuing to provide inflationary financing to their governments. In modern conditions, this is the path to economic disaster. Thus far, instead of avoiding empty financing of political rather than economic projects, additional taxes are imposed on the population,

especially hidden taxes such as inflation.

The expansion of the money supply or the so-called QE procedures, combined with the loss of confidence in the issuer and any confidence in its reliability, is always a precursor to any economic catastrophe. In addition to the fact that there is a token-based CBDC option to ensure anonymity, given the desire of central banks for total control to minimize criminal transactions and tax evasion, anonymity will certainly be eliminated. Already now, a step has been taken to this quite within the framework of laws, such as international and implemented in most countries procedures Foreign Account Tax Compliance Act (FATCA), Automatic Exchange of Information (AEOI), Base erosion and profit shifting (BEPS), creating conditions for the control of tax payments in the field of international business and corporate activities and providing access to real control over the assets of companies and individuals.

A second argument for contemplating a CBDC, mooted by US Treasury Secretary Janet Yellen among others, is to enhance financial inclusion. The Treasury Department had difficulty obtaining COVID-19 stimulus checks for individuals who had not filed a tax return and did not have a bank account. Although nearly15 million American adults are unbanked, almost everyone has a smartphone. If they all downloaded a digital wallet that automatically registered with the Federal Reserve, the government could deposit digital dollars into it directly. The new principles complement the 2010 G20 Principles for Innovative Financial Inclusion, which were critical in drawing global attention to the issue of financial inclusion and spurring initial policy actions.

The new 2016 Principles are intended to catalyze country-level actions by G20 governments to drive financial inclusion using digital technologies, including through country action plans. Governments play a critical role in creating the enabling conditions for financial service providers to reach financially excluded customers while also ensuring that risks are mitigated and consumers are properly protected against threats such as fraud, cybercrime, overindebtedness, and unethical business practices.

The World Bank formulates that financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way. Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way. Digital technologies offer a powerful solution for expanding access to financial services to the estimated two billion adults globally who are still excluded from the formal financial system. By enabling innovative business models, digital technologies can help connect more people at lower costs – including those living in rural and remote areas – to critical financial services that help them manage their financial lives and, ultimately, offer a pathway out of poverty (World Bank, 2023b). Financial access facilitates day-to-day living and helps families and businesses plan for everything from long-term goals to unexpected emergencies. As accountholders, people are more likely to use other financialservices, such as credit and insurance, to start and expand businesses, invest in education or health, manage risk, and weather financial shocks, which can improve the overall quality of their lives.

The ongoing COVID-19 crisis has also reinforced the need for increased digital financial inclusion. Digital financial inclusion involves the deployment of cost-saving digital means to reach currently financially excluded and underserved populations with a range of formal financial services suited to their needs that are responsibly delivered at a cost affordable to customers and sustainable for providers. Digital financial services — including those involving the use of mobile phones — have now been launched in more than 100 countries, with some reaching a significant scale. As a result, millions of formerly excluded and underserved poor customers are moving from exclusively cash-based transactions to formal financial services using a mobile phone or other digital technology to access these services.

The danger of CBDC is that the state, which has become a leader in this technology, will be able to offer this tool to nonresidents to service transactions in other countries. The circulation of digital currencies can occur only on the servers of the issuer. This means that information about transactions will not be able to go to the tax authorities of the states of residence of foreign users. In addition, foreign digital currencies will be able to "displace" cash and noncash national monetary units, contributing to the imbalance of monetary circulation. The issuer of a digital currency that is in demand in foreign markets will also be able to influence its foreign users. For example, to offer interest-free (or even negative rate) trade credit to foreign buyers of products of domestic manufacturers or service providers.

Established by Congress in 1917, the debt limit or debt ceiling sets the maximum amount of outstanding

federal debt that the U.S. government can incur. As of January 2023, the total federal debt and debt ceiling stood at 31.4 trillion dollars. Since 2001, the U.S. government has run a deficit averaging nearly 1 trillion dollars each year, meaning it spends that much more money than it receives in taxes and other revenues. Since 1960, Congress has raised the ceiling seventy-eight times, most recently in 2021. Forty-nine of these increases have been under Republican presidents and twenty-nine under Democratic presidents. (Berman, 2023).

Few countries adhere to a debt ceiling, and nowhere else regularly threatens serious economic dislocation. Denmark has one, but it is so much higher than the country's spending that it has not been a problem. In 2021, Denmark's national debt was approximately 14% of the ceiling. Today, the U.S. national debt is 129% of GDP (Trading economics, 2023b). Moreover, the Bidengovernment is aimed at increasing the debt limit, and there is nothing to cover such large debts. GDP covers only 82% of U.S. debt, plus the budget deficit and trade deficit. If we take the total debt of the United States,which also includes the debts of private business, then GDP is almost four times less than this debt.

If we look at the volume of money, securities and other derivatives (secondary securities) issued in the US, according to our calculation, GDP is only 4% of these assets, the vast majority of which are speculative in nature. Derivatives laid the foundation for the financial crisis of 2008; they were the first to be thrown off and sold by participants in the speculative market, spinning the spiral of the next crisis. At the same time, among the main components that form the US GDP, only 11% is manufacturing and construction, and almost 35% is professional services and finance (Stiglitz et al., 2010). To cover the growing debts with the existing deficits and their trends, the sprawling speculative sector and the declining real production, where the added value is formed, is simply unrealistic. The calculation of intellectual production and its return still has many shortcomings, which many economists (US Debt Clock, 2023) discuss, so the real US GDP can be confidently stated to be overestimated, and the real public debt is still in question. Moreover, there is a tendency to increase the debt burden in almost all countries of the world. For example, in the European Union, debt already accounts for 85% of the GDP of all EU countries; Belgium, France, Italy, and Greece have already overcome the 100% debt barrier to GDP, and other EU countries are actively accumulating debts (Statista, 2021).

Thus far, there are no prospects for returning public debts in the United States – 129% of GDP, Greece – over 178% or Japan – over 225% (European Union, 2022), while in the context of crisis phenomena and falling GDP (of course, some countries have a slight increase in GDP, but as a rule this is due to rising energy prices or). Under these conditions, the idea of completely switching to cryptocurrencies is becoming increasingly attractive for central banks, thereby carrying out the rehabilitation or denomination of existing currencies, trying to balance the economy, giving it a more attractive look for investors, ensuring the confidence of the local population and, most importantly, fighting inflation, ensuring the sustainable development of its economy for the near future, since monetary regulation can no longer overcome structural imbalances in the economy.

As a result of the research, a regression model was used to model the dependence of the inflation rate in developed countries on the size of government debt in 2018 and 2022 (Table 1, Table 2, Figure 1, Figure 2).

Table 1. Level of government debt (% of GDP) and inflation rate (%) of selected developed countries in 2018

Country	USA	UK	Latvia	Germany	France	Italy	Estonia	Japan	Canada
Central government debt, total (% GDP)	99	158	36.5	61	101.6	136	8.1	197.4	48.2
Inflation rate, %	2.4	2.5	2.5	1.7	1.8	1.1	3.4	1	2.3

Sources: developed by the authors based on (CEIC, 2023; State Statistics Service of Ukraine, 2022).

As a result of the correlation-regression analysis of the indicators in Table 1, a polynomial trend line was built, and a regression equation was derived (Figure 1). The correlation coefficient of 52.2% indicates the average degree of reliability of the resulting equation.

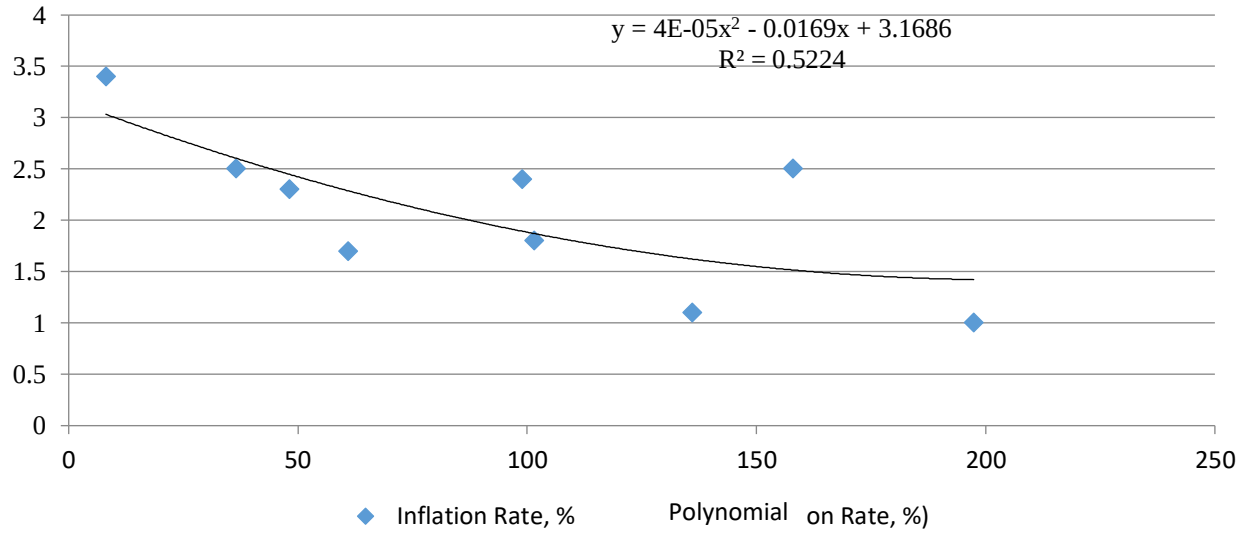

Figure 1. Polynomial trend of dependence of the inflation rate on government debt in some developed countries of the world in 2018
Sources: developed by the authors based on Table 1.

A comparison of the indicators given in Table 1 and Table 2 indicates that over 4 years, the level of government debt and the level of inflation in the countries has increased. As a result of the correlation-regression analysis of the indicators in Table 2, a polynomial trend line was built, and a regression equation was derived (Figure 2). The correlation coefficient of 79.7% indicates a high degree of reliability of the resulting equation, which can be used for further forecasting.

Table 2. Level of government debt (% of GDP) and inflation rate (%) of selected developed countries in 2022

Country	USA	UK	Latvia	Germany	France	Italy	Estonia	Japan	Canada
Central government debt, total (% GDP)	129	108.69	40.1	79.4	127.74	172.1	18.4	128.76	298.82
Inflation rate, %	6.5	11	17.3	6.9	7	8	22.5	6.8	2.5

Sources: developed by the authors based on (US Debt Clock, 2023; CEIC, 2023; Trading economics, 2023a).

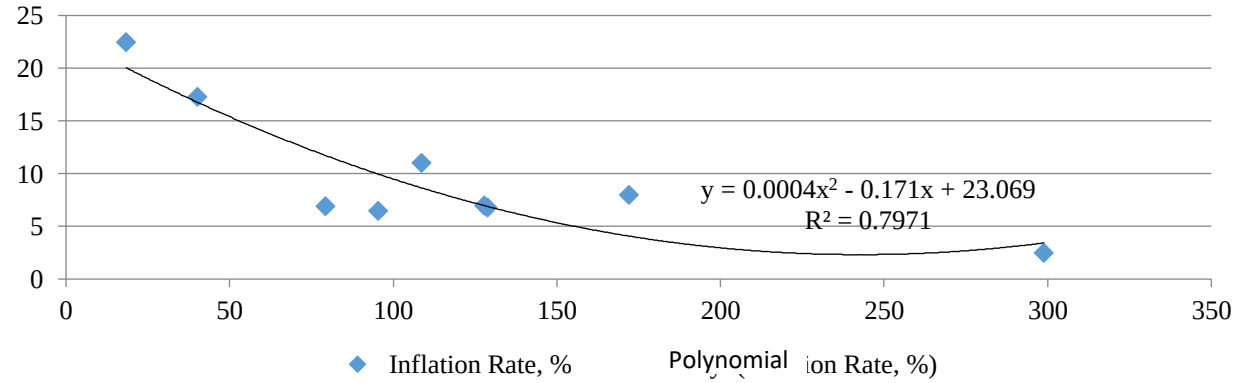

Figure 2. Polynomial trend of dependence of the inflation rate on government debt in some developed countries of the world in 2022
Sources: developed by the authors based on Table 2.

To reflect the situation in the financial market, it is important to consider the level of interest rates of the analysed countries in 2022-2023 (Table 3).

Table 3. Long-term interest rate (%) of selected European countries in 2022-2023

Country	Belgium	Spain	Latvia	Germany	France	Italy	Estonia	Lithuania
April 2022	1.30	1.69	1.59	0.75	1.28	2.44	1.49	0.16
April 2023	3.06	3.40	3.88	2.36	2.90	4.23	3.89	2.88

Sources: developed by the authors based on (European Central Bank, 2023).

The long-term interest rate has risen over the past year. However, macroeconomic regulation is no longer able to cope with the situation, and a change (growth) in the interest rate still has little effect on prices or on the price index, which is growing. This strains the social situation, business activity is slowing down due to rising costs, and GDP in current prices is practically not growing. Therefore, during 2021 and 2022. GDP growth in the United States decreased from 3.2% to 2.6%. Italy, Brazil, Germany, Argentina, South Korea, and South Africa had negative GDP growth in 2022 (Figure 3).

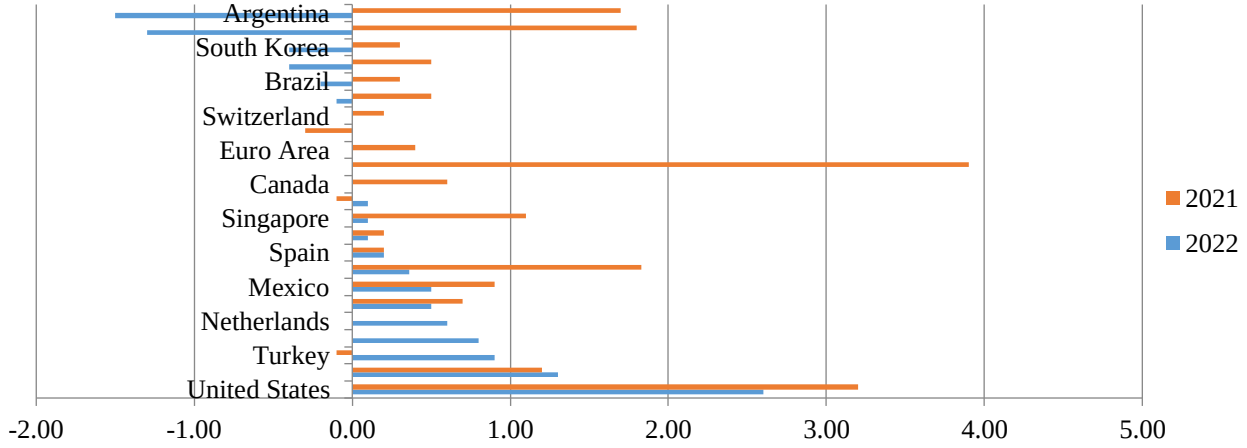

Figure 3. GDP growth rate by country in 2021 and 2022, %
Sources: developed by the authors based on (Traiding Economics, 2023a).

As statistics show, in many developed countries, government debts are many times greater than GDP, so in the end you will have to look for an alternative to macroeconomic regulation with an interest rate that no longer justifies its purpose and switch to digital currency and possibly denominate the currency in circulation in order to nominally reduce government debt and, all this, to combine with the confiscation procedure, when in the course of the digital reform to limit the circulation of cash, under the pretext of combating the shadow economy. The auditing company PWC (Krishnan, 2018) published an article about a similar experiment in India five years ago, when part of the money was not exchanged during the currency reform, supposedly to exclude the black market from circulation and force everyone to pay taxes. This option is possible not only in India but also in developed Europe and America with digital currencies. The European Economic Forecast 2023-2024 shows that inflation will fall, but then business activity will slow down, and GDP growth will slow down (Table 4).

Table 4. Economic forecast for GDP growth (%) and inflation (%) for selected European countries in 2023-2024

Country	Belgium	Spain	Latvia	Germany	France	Italy	Estonia	Lithuania
				2023				
GDP, %	0.8	1.4	0.1	0.2	0.6	0.8	0.1	0.3
Inflation rate, %	4.3	4.4	7.9	6.3	5.2	6.1	6.2	8.7
				2024				
GDP, %	1.6	2.0	2.7	1.3	1.4	1.0	2.8	2.5
Inflation rate, %	2.7	2.3	1.5	2.4	2.5	2.6	2.2	2.1

Sources: developed by the authors based on (European Commission, 2023).

To build a linear regression model of the dependence of economic development for the countries under study on the inflation rate, long-term interest rate, and level of government debt, we use statistical data in Table 5.

Table 5. GDP growth (%), inflation (%), long-term interest rate (%), level of government debt (% of GDP) for selected European countries in 2023

Country	GDP growth, %	Inflation, %	Long-term interest rate, %	Government debt (% of GDP)
Belgium	0,8	4,3	3,06	105,1
Spain	1,4	4,4	3,4	113,2
Germany	0,2	6,3	2,36	79,4
France	0,6	5,2	2,9	127,74
Italy	0,8	6,1	4,23	172,1
Latvia	0,1	7,9	3,88	40,1
Estonia	0,1	6,2	3,89	18,4
Lithuania	0,3	8,7	2,88	38,4
Belgium	0,8	4,3	3,06	105,1
Spain	1,4	4,4	3,4	113,2

Sources: developed by the authors based on (CEIC, 2023; Trading economics, 2023a; European Central Bank, 2023; European Commission, 2023.

Regression modelling considers the dependence of GDP growth on other factors (inflation rate, long-terminterest rate, level of government debt). As our study shows, further economic growth is possible with the introduction of digital currency. We confirmed this hypothesis by the constructed regression model.

Linear multiple regression will have the form of the following equation:

$$GDP\ growth\ = a^* \cdot Inflation + b^* \cdot Long - term\ interest\ rate + c^* \cdot Government\ debt + d \quad (1)$$

where *a, b, c, and d* are unknown parameters of the model, which are calculated using normal equations.

The results of regression modelling are presented in Table 6.

Table 6. Regression Summary for Dependent Variable: GDP growth

R= 0,79676070 R^2= 0,63482761 Adjusted R^2= 0,36094832 F(3,4)=2,3179 p						
	Beta	**Std.Err.**	**B**	**Std.Err.**	**t(4)**	**p-level**
Intercept			0,90125	1,04643	0,86126	0,43766
Government debt	0,42452	0,37633	0,00367	0,00325	1,12807	0,32237
Inflation rate	-0,4672	0,37554	-0,136	0,10932	-1,2441	0,28137
Long-term interest rate	0,06428	0,30652	0,04582	0,21848	0,20972	0,84414

Sources: developed by the authors.

According to the calculations in Table 6, R^2= 0.63482761, the dependence between GDP growth and selected factors is average, and only 63% of changes in GDP growth can be explained by changes in selected factors. The standardized beta coefficient shows that the greatest contribution to the change in GDP growth is brought by inflation; the higher the inflation rate is, the slower the growth of GDP, and the level of government debt leads to GDP growth. Changes in the long-term interest rate practically do not affect the change in GDP. Since p>0.1 for all the coefficients of the regression equation, they are statistically insignificant.

The data in Table 7 confirm that the selected factors can be ranked by the degree of influence on GDP growth as follows (Partial Cor.): inflation, government debt level, and long-term interest rate. The first two factors have a moderate influence, and the third factor has a weak influence on GDP change.

Table 7. Variables currently in the equation

	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t(4)	p-level
Government debt	0,42452	0,49128	0,34084	0,64463	0,35537	1,12807	0,32237
Inflation rate	-0,4672	-0,5282	-0,3759	0,64732	0,35268	-1,2441	0,28137
Long-term interest rate	0,06428	0,10429	0,06337	0,97165	0,02835	0,20972	0,84414

Sources: developed by the authors.

It is necessary to check the distribution of the residuals (Figure 4).

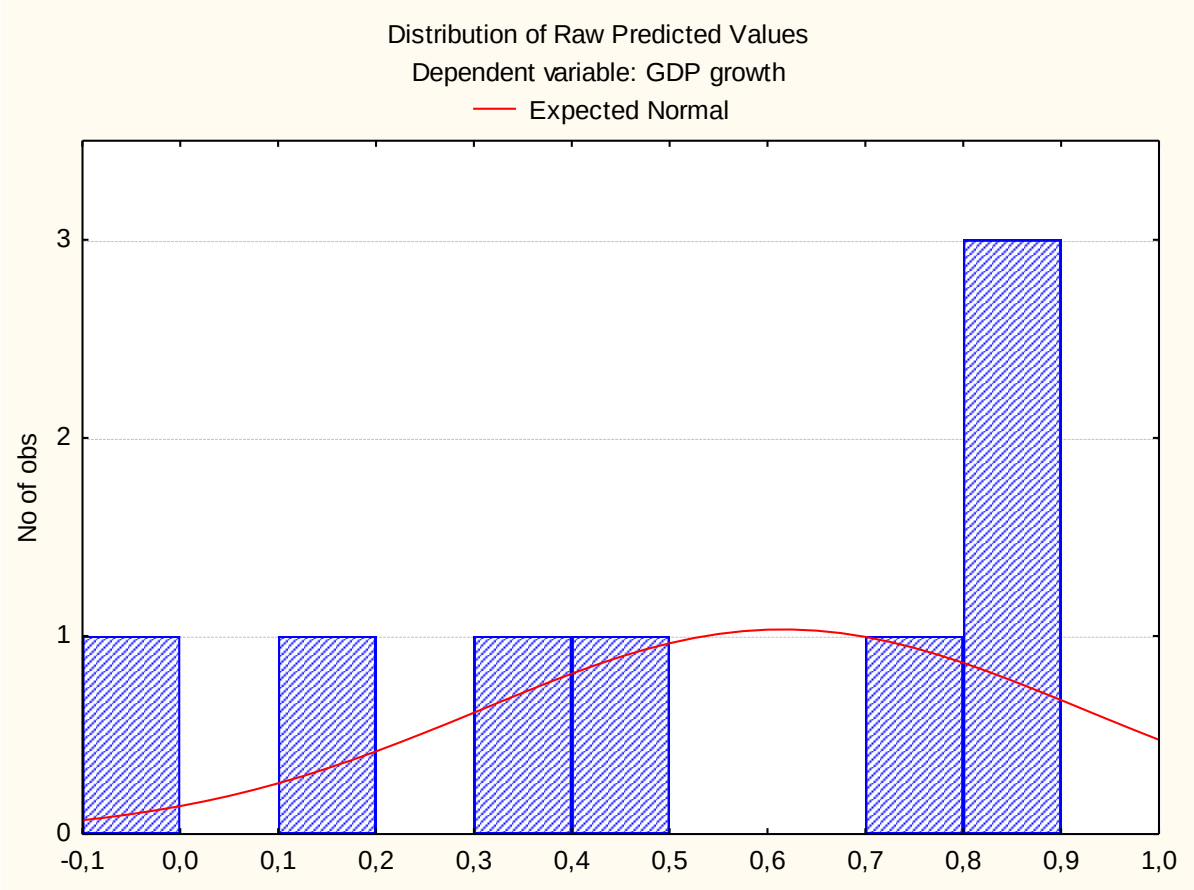

Figure 4. Distribution of raw predicted values
Sources: developed by the authors.

Figure 4 shows that the distribution of residuals differs from the normal law, so the model has low adequacy.

The equation of dependence of GDP growth on the selected factors will have the following form:

$$GDP\ growth\ = 0{,}901 - 0{,}136 \cdot Inflation + 0{,}046 \cdot Long - term\ interest\ rate + 0{,}004 \cdot Government\ debt \quad (2)$$

This equation can be used to forecast GDP growth using selected factors. As the model shows, further economic growth for developed European countries is not possible with higher inflation and further borrowing, but it is possible with the introduction of a digital currency of the central bank because in this case, there will be strong pressure on the shadow market (accounts will be controlled by the central bank), and an inclusive economy will begin to form due to the involvement of the vast majority of the population in legitimate business. The study shows that to quickly pull assets and deposits from commercial banks to the

ECB, it is necessary to keep the interest rate in the ECB on deposits in the cryptocurrency CBDC higher. The problem of inflation can be solved by digital currencies. The Working Paper of the European Central Bank provides a calculation of CBDC stability models (ECB, 2023a):

1) The economy extends over three dates t = 0; 1; 2 and is populated by a bank and a unit continuum of consumers indexed by $i \in 2$ [0; 1]. Consumers are endowed with one unit of funds at $t = 0$ only. At $t = 0$, the bank has access to a profitable but risky investment innovation technology. Investment returns $L \in 2$ (0; 1) if liquidated at t = 1 (the liquidation value) and RQ upon maturity at t = 2, where Q ~ U[0; 1] represents the economic fundamental and R > 2 is a constant that reflects the return from lending.

As alternatives to bank deposits, consumers can store their wealth in CBDC or cash. A deep-pocketed central bank offers consumers deposits with a per-period gross return w≥ 1. Therefore, consumers strictly prefer CBDC over cash as long as w> 1. They are indifferent for w = 1, so that this case is equivalent to a model without CBDC. Thus, w is the remuneration of CBDC.

Failure threshold. Changes in CBDC remuneration induce the bank to adjust the terms of the deposit contract, which will affect Q. Therefore, there can be total differentiation:

$$\frac{dQ}{dw} = \frac{\partial Q}{\partial w} + \frac{\partial Q * dr_1}{\partial r_1 * dw} + \frac{\partial q * dr_2}{\partial r_2 * dw} \quad (3)$$

where r_1 and r_2 – are equilibrium deposit rates.

2) CBDC design. The central bank aims to maximize W (welfare), which is given by the sum of expected bank profits and consumer surplus:

$$W = \int_Q^1 (RQ - r_2) dQ + \int_Q^1 r_2 dQ = \frac{R}{2}[1 - Q^2] \quad (4)$$

While it was previously said that CBDC, cash and private digital currency would run in parallel (Bohme, Auer, 2020), we are now talking about the dominance of CBDC, as neither quantitative easing nor interest rate increases change or have little effect on inflationary processes, which was proven a decade ago by John Doukas (Doukas, 2013). In the long run, central banks using the above models will quickly be able to fully switch to the CEDC to reduce inflation. Moreover, Christine Lagarde proposes to suddenly start fragmenting currencies this year, which means aiming for a transition to state digital currencies, as inflation problems are growing and, in our opinion, a crisis and hyperinflation could start in winter (ECB, 2023b).

5. Conclusions. The growing government debt of all European countries and the United States will lead to problems with debt repayment, which is practically unrealistic with low or even negative GDP growth. Emission injections of money cause inflation, and attempts to raise the bank rate lead to increased costs for business, stagnation and growth prices for the population, which can ultimately lead to serious social upheavals. The regression model of GDP growth dependence on the inflation rate, long-term interest rate, and public debt level has shown that the growth of inflation leads to a slowdown in GDP growth, while the growth of public debt leads to an increase in GDP. However, further economic growth with the inclusion of the selected factors is no longer possible, and it is necessary to introduce digital currency. Macroeconomic adjustment of the interest rate only holds back inflation for a short period but does not lower prices, which are eventually set at a higher level.

The transition to a digital currency will lead to a failure or even a complete reformation of the entire commercial banking system, since in this situation, the central bank should take over the maintenance of accounts and customers, which will be forced to maintain accounts of customers' electronic wallets on their own digital platform using blockchain technology. Commercial banks will be forced to completely merge with the FinTech innovation system, without any prospect of using customer deposits to their advantage. Therefore, all thoughts boil down to the fact that CBDC or the state digital currency becomes the main one, which gives the state the right to take control of all financial activities of the population and business.

Since macroeconomic instruments such as quantitative easing and interest rate hikes cannot suppress inflation, the ECB model calculations (ECB, 2023a) allow for a new scheme of macroeconomic regulation. That is, instead of printing money and raising the interest rate, there is the possibility of CBDC supply. Thus, clients can calmly, from the beginning at the current rate, then of course their rate will increase to transfer existing assets into digital assets of the central bank, as more sustainable and form the economy, that is for a wider range of clients, including the poor. This is a whole new era of economic regulation and full control over the finances of the population.

In our opinion, the main reasons for the possible transition to cryptocurrencies will be the following:

1. Create a stable economy with a stable currency tied to the real economic capabilities of the country.
2. Limit the expansion of private IT companies to form private crypto money, seize the initiative from them.
3. To create an inclusive financial system, which, in addition to combating the shadow economy and attempting to involve people who are not covered by the legal financial system in business activity, will make it possible to control any human activity globally. The shadow economy will be reduced.
4. Maintain the dominant position of the world's major currencies in the international market by reformatting them into a new digital format.

The prospects for further research will be the analysis of social aspects of digital currency use.

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Цифрові валюти та інноваційні фінтех-технології для економічного зростання

Перехід світової економіки на цифрові валюти неминучий. Сьогоднішні монетарні методи регулювання не забезпечують стабільної та інклюзивної економіки, і центральні банки будуть змушені переходити до впровадження державної цифрової валюти в реальну практику, що в кінцевому підсумку дозволить запровадити тотальний контроль за використанням активів клієнтів і жорстке регулювання бізнесу, особливо в сфері тіньової економіки та податкових злочинів. Основні фактори переходу на цифрові валюти: технологічний прогрес, збільшення обсягів онлайн-транзакцій, незалежність від національних валют, низькі комісії. Метою статті є оцінка потенціалу для економічного зростання цифрових валют та інноваційних технологій FinTech в умовах зростання державних боргів розвинутих країн Європи. Наукова новизна отриманих результатів полягає в побудові регресійної моделі залежності зростання ВВП від рівня інфляції, державного боргу та довгострокової процентної ставки. Регресійний аналіз проводився шляхом побудови лінійної множинної моделі для окремих розвинених європейських країн на основі статистичних даних Європейського центрального банку, Європейської комісії та інших Інтернет-ресурсів. Отримане в результаті регресійного моделювання рівняння залежності ВВП європейських країн від обраних факторів може бути практично використане для прогнозування майбутніх показників ВВП. Модель показала, що зростання інфляції негативно впливає на зростання ВВП, і підтвердила, що подальше економічне зростання можливе за умови впровадження цифрової валюти, яка допоможе знизити інфляційне навантаження. Емісія цифрової валюти буде суворо контролюватися, що сприятиме формуванню інклюзивної економіки через залучення до бізнесу людей, які не мають банківських рахунків, а також зменшенню тіньової економіки. Це створить можливості для реального економічного зростання. Прогнозується, що впровадження цифрових валют може призвести до створення більш швидкої, зручної, дешевої платіжної системи, що є важливим для громадян та бізнесу.

Ключові слова: цифрова валюта центрального банку; регресійна модель; тренд; ВВП; державний борг; інфляція; європейські країни.