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# Finance Transformation and digitalization of the transport sector

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**Abstract**. The paper investigates financial innovations as simultaneously an outcome and a means of economic development and development of transportation means and system since growth of economy necessitates innovative means and facilities allowing for lower costs of carrying cargoes to new areas and markets. Most important innovations were those related to invention of ever new types of money to resolve a major economic problem of deficient funds necessary for development of trade, markets and transportation. Classification of financial innovation is intricately related to the functions money and financial instruments perform in economy and these were developed with the development of the latter two. Beginning with invention of coins to more sophisticated forms money has been a core value and function in economic system and causes emergence of financial systems and markets with modern forms of money and financial instruments providing for payments, lending, investment, pricing assets and financial instruments, risk management and pricing risk instruments etc. In modern mixed economies regulation of currencies, money supply and national financial systems, also regarded innovative developments, allows governments to perform targeted intervention in national economy the outcomes and economic and social consequences of which, as demonstrated by the example of Russian economy and economic policies, may appear ambiguous and controversial.

## 1. Introduction

Innovations have become integral to modern financial system underlying all elements of the system and providing for its functioning – markets, financial institutions and instruments, systems of payments, regulation of financial activities, expansion of trade and transport infrastructure. In analysis and examination of the role of financial innovations various criteria are used, which proves the complex and heterogeneous nature of both phenomenon itself and its impact on the economic system on the whole and financial system in particular. The principal function of innovations in finance and simultaneously the reason for any of these is increasing the effectiveness and efficiency of financial system promoting sustainable development of economy. In relation to both historical development and modern state of money, financial institutions, financial systems, markets, etc. innovations in finance are to be given a broad understanding corresponding to all various functions finance perform in modern economic systems and thus innovations refer to a wide range of phenomena: money and currencies in all their possible forms, new uses of already existing units and instruments, new financial institutions and new functions of already existing ones, new types of financial markets and sectors in them, new developments in investment, loan and equity capital, new or changed regulations affecting currencies, money supply and national financial system, etc. Thus understood financial innovations require profound both theoretical and empirical studies to analyze their nature, influence and role in economic development.

Financial instruments are means for development of financial systems which transform with new developments. Innovations in finance are drivers of economy – primarily, trade, markets and transport infrastructure required for their functioning – and the role played by them in economic development of European nations deserves attention. The questions which the present study attempts to investigate are: (1) functions and efficiency of financial innovations; (2) history of financial innovations and their role in development of economy; (3) government regulation in finance and economy and its implications for the economy of Russia.

The study aims at revealing the role and impact of financial innovations on economic development of European nations posing questions of feasibility and applicability of financial instruments for government intervention in national economy.

## 2. Defining financial innovations and their functions

In studies of financial innovations two approaches to their definition and understanding can be identified: the narrower approach and the broader approach. When understood narrowly, innovations refer to establishment of new financial instruments, including both the process of invention and novel combination or new applications of existing instruments, modification to those and the like. When taken more broadly, financial innovation refers to any innovative development in any of the elements of financial system including emergence of new financial market segments, new types and forms of financial institutions, new financial instruments, changes in current legislation and regulation of financial sector, etc. [1, 2].

The basis for most classifications of financial innovations is the purpose they serve. Three major categories of innovation (or groups of innovations) in finance are: (1) innovations aiming to expand financial markets; (2) new instruments or new applications of financial instruments for risk management; (3) new arbitrage instruments and procedures [2]. Innovations of the first category result in increased liquidity of financial markets and availability of loan and equity funding for market participants in need of these, new opportunities for investments and lending. Innovations of the second type allow transferring financial risks to those market participants for whom both the risks and their negative effects will be minimal and the last category of innovations aims at maximizing profitability of investments for financial markets participants by operations in several different markets with different prices for capital and rates of return.

Using a more detailed function classification five principal groups of innovations can be identified: (1) innovations related to transfer of price risks; (2) innovations related to transfer of credit risks; (3) innovations aimed at increasing liquidity and creation of new financial instruments; (4) innovations to increase loan capital and (5) innovations to increase equity capital required for development of businesses [3]. Innovations of the first group produce more effective instruments and methods for transfer and minimization of price and currency risks; those in the second group are to reduce risk levels of non-payments and bad debts; the third group results in the following effects: increased liquidity in financial markets, new sources of loan and investment capital, transfer to markets with more favorable investment climate and regulations. The fourth and the fifths groups are aimed at increasing the pools and availability of loan and equity funding.

Growth and changes in financial markets brought a broader understanding of functions performed by financial innovations: the earlier identified ones were added by a number of new ones – those characteristic of modern financial and capital markets and related primarily to derivatives, secondary instruments and the like [4]. Thus financial innovations can be aimed at reducing financial risks (price, currency, credit etc. risks) with the market participants by using derivatives, securitization, etc. including pricing of risks and trading them through operations, for instance, in secondary markets with collateralized debt obligations or asset backed securities. Such instruments as debt-equity swaps or certificates of deposits allow for increased loan and equity funding, additional sources of liquidity and funding for financial institutions, reduced financial risks and new approaches to assets and liabilities management, etc. [5].

Despite more particular and narrow applications of financial innovations the summary of their function and purpose is improved functioning of financial system. Innovations are to provide for: 1) payments and settlements with higher liquidity of financial instruments; 2) promoting investments by increased number of investment instruments and lower levels of risk; 3) funding through increasing availability of funding sources with both short- and long-term equity and loan capital; 4) improved techniques and procedures for pricing financial assets and development of strategies for pricing financial risks; 5) improved effectiveness and efficiency of financial risk management by redistribution among the participant of financial market or between several markets [6].

Thus functions of financial innovations underlying the financial system can be presented in the following way (Figure 1):

| FINANCIAL SYSTEM | payments<br>funding<br>investments<br>risk management<br>risk and securities pricing | FINANCIAL INNOVATIONS |
|---|---|---|

**Figure 1**. Functions of financial innovations in financial system.

Given the diversity of functions, the most essential issue in terms of financial innovations is analyzing the changes induced by them evaluating their efficiency and stability [5]. Changes as a result of innovative developments are to induce: 1) reduction of negative effects in financial system: reduced levels of financial risk, increased transparency and availability of financial information, lower costs of financial operations, etc.; 2) improvement of positive effects: provisions for stability in operation, increased efficiency and numbers of financial instruments and provision of customer-oriented investment opportunities

## 3. History of financial innovations

The basis of financial system and one of the lines in innovation development is invention of new means of payment. All other functions of financial system are derived from this basic one and are provided for by introduction and transformation of monetary or similar payment units. Financial innovations in monetary systems promoted development of trade and markets, in earlier times, and emergence of economic systems based on payments for goods, services and factors of production, at later stages.

Dating to approximately the same period, invention of coins in ancient China, Lydia and Greece proves the existence of conditions necessitating such development. More efficient means and methods of production, surpluses of produce and goods for exchange and inefficient barter transactions were unable to satisfy increasing economic needs of households. Despite forerunners of coins in the form of so called ‘accounting units’ it was only the invention of easily exchanged and widely circulated means of payment in monetary form which produced the impact required resulting in fast growth of trade and commerce in the Mediterranean and the Middle East.

Compared to earlier inventions coins provided for a number of opportunities: simple exchange of goods, simple system of payments and settlements (given the previous system of debt records unable to provide for the security desired), increased efficiency of rule in provisions for military campaigns, emergence and development of markets as they are understood today. Minted coins resulted also in development of main functions performed by money in economy – as a means of exchange and payment, as a measure of value and as a means of storing value.

Minting of coins can also be regarded a starting point for money supply. In ancient times it consisted exclusively of coins circulating within a given territory. One of most common and widely accepted coins were Athenian tetradrachms circulating in Athens and other Greek cities and beyond them which fact is often regarded a basis of Athenian rise and power. In minting, mostly silver, less often gold, were used and many military conflicts and conquers of that time appear connected to control over the gold and silver ore deposits. Domination of Athens in Ancient Greece, warfare and empire of Alexander the Great, continuous military conflicts of Rome with Carthage and the power of the Roman Empire were primarily conditioned by accessibility of ore and ability of minting coins [7].

Another important stage in financial innovations which promoted development of trade and resulted in emergence of the first financial institutions was establishment of banks and burses – first in Italy of the Renaissance and later in the Netherlands. This innovation was a solution of that time to the problem of deficient funds (one monetary unit deposited with a bank is estimated to produce three units of payments at minimum). With invention of coins deficiency became intrinsic to monetary systems resulting primarily from the condition of coins being used a store of value, with inevitably withdrawing of means from the economy for keeping. This condition remained in later systems also making invention of ever new forms of money and financial instruments imminent and is still an irresolvable problem even given modern primary and secondary financial markets with such extensions as certificates of deposits or traded financial risks. First joint stock companies also produced a major financial innovation, i.e. securities. Thus, new forms of money in economy – bank deposits and equity stock – allowed solving the problem of insufficient funds for that date and promoting further economic growth [8].

One of most crucial innovations in the history of monetary systems was introduction of paper money. First they were fully backed by coins and could be exchanged for them on demand. As earlier, the reason underlying this innovation was deficiency of funds and primarily cash – this fact provides an explanation for early American states to begin using them extensively and promoting them into markets and population since at that time the shortage of cash required for exploration of lands and fast-growing New World economy was reaching extreme degrees being separated from European markets with months of travel. Starting with Paper Money economy of Benjamin Franklin to these days the most acute problem with paper money has been and still is its value and backing: banknotes themselves worth almost nothing compared to coins of silver or gold and the trust to paper money is established either by their convertibility into bullion or coins or their connection to a sustainable leading economy [9]. Invention of paper money allowed multiplying the money supply and unprecedented economic growth [10]. Despite its positive influence circulation of paper money can have major negative impacts: since they have no limitation in the form, for instance, of silver ore for minting, a condition of oversupply with money in economy can develop as a consequence of excessive issue and given no support with development of productive forces, increased productivity, wages and salaries and outputs it can cause strong inflationary trends and crisis in economy [11].

Technological change and early computer and network technologies stimulated a range of innovations in financial sector, mainly related to innovative methods of payments and procession of financial data, the major of these being emergence of electronic money – another condition causing growth of money supply in economy and reducing significantly limitations of cash handling. Its most essential outcome was simplification of cross-border trade intensifying export-import operations and promoting global markets [12].

The most recent innovation in terms of monetary units was invention of digital coins, or crypto currencies the functions of which are in many respects similar to those of other money with still unidentified and undefined relation to national and global financial and economic systems [8].

Lastly, in addition to novel forms of money, another major line of innovations in financial system and markets are novel financial instruments. Following the principles of earlier invented bank deposits and equity stock beginning with late 19th century ever new instrument and types of financial markets appear in financial systems, with their main purpose staying the same – providing solutions to deficiency of funds for business operation and development and promoting sustainable growth of economies [13].

## 4. Role of financial innovations in modern economies

Resulting from the above described innovations, a money supply has been formed in modern economies which comprises, in addition to coins and banknotes, savings deposits, traveler’s cheques, fixed

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deposits, government bonds, financial market instruments, international liquidity etc. (in modern economic theory aggregates M1, M2, M3, M4). Increased money supply in economy is simultaneously a cause and a consequence of economic development. Analysis of changes in the money supply and gross domestic product (GDP) reveals an undisputable correlation of these and has been stated in the theory of real money [14]. On examination, plotting graphs for changes in a country's GDP, level of prices and money supply shows their close to each other development: increases in money supply result in increased GDP, while GDP is a condition for increasing money supply and moderate inflationary trends in economy (see Fig.2 and the diagram illustrating correlation of the general price level and the money supply in the economy of the UK during the period of over 100 years [15]), showing relation with the rates of stock performance of biggest companies in economy (see Fig.3 illustrating correlation of money supply, GDP and the rate of S&P500 in the USA during the period of 25 years [16]). A sharp increase in money supply, as demonstrated by recent economic history of some countries including Russia, unsupported by relevant increase in the country's GDP inevitably results in high inflationary pressures, devaluation of currency and profound crisis in national economy [17].

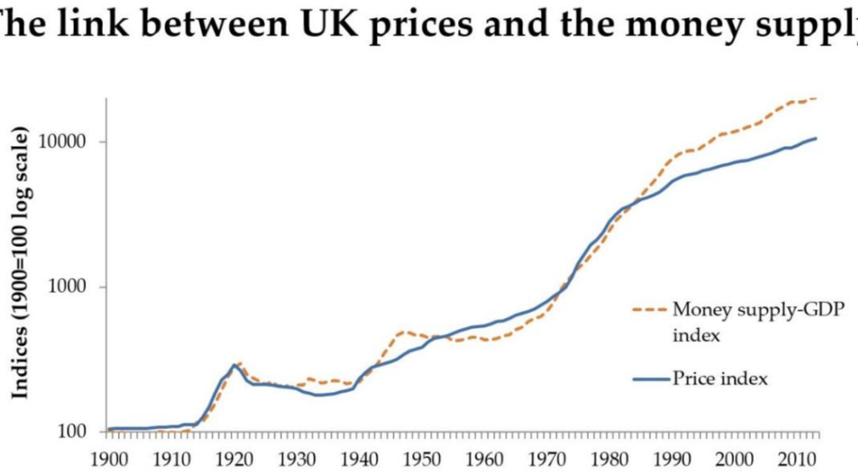
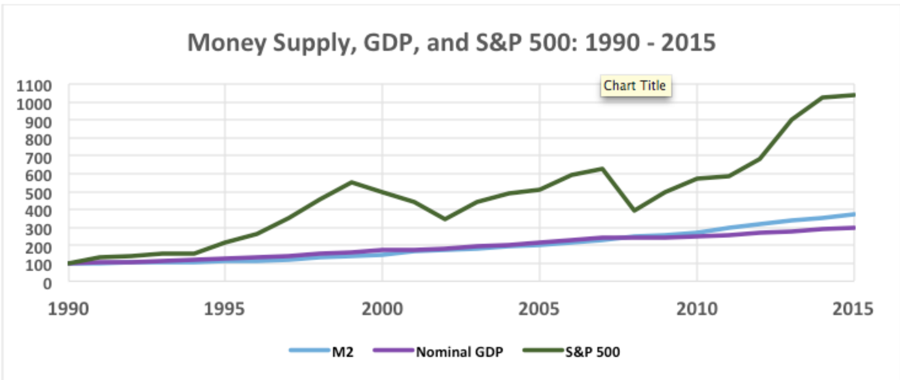



**Figure 2.** Correlation of money supply and price levels in the UK in 1900-2010 Source: http://www.investing.com/.




Source: St Louis Federal Reserve FRED data base, Morningstar

**Figure 3.** Correlation of money supply, GDP and S&P500 in the USA in 1990-2015 Source: https://fred.stlouisfed.org/.

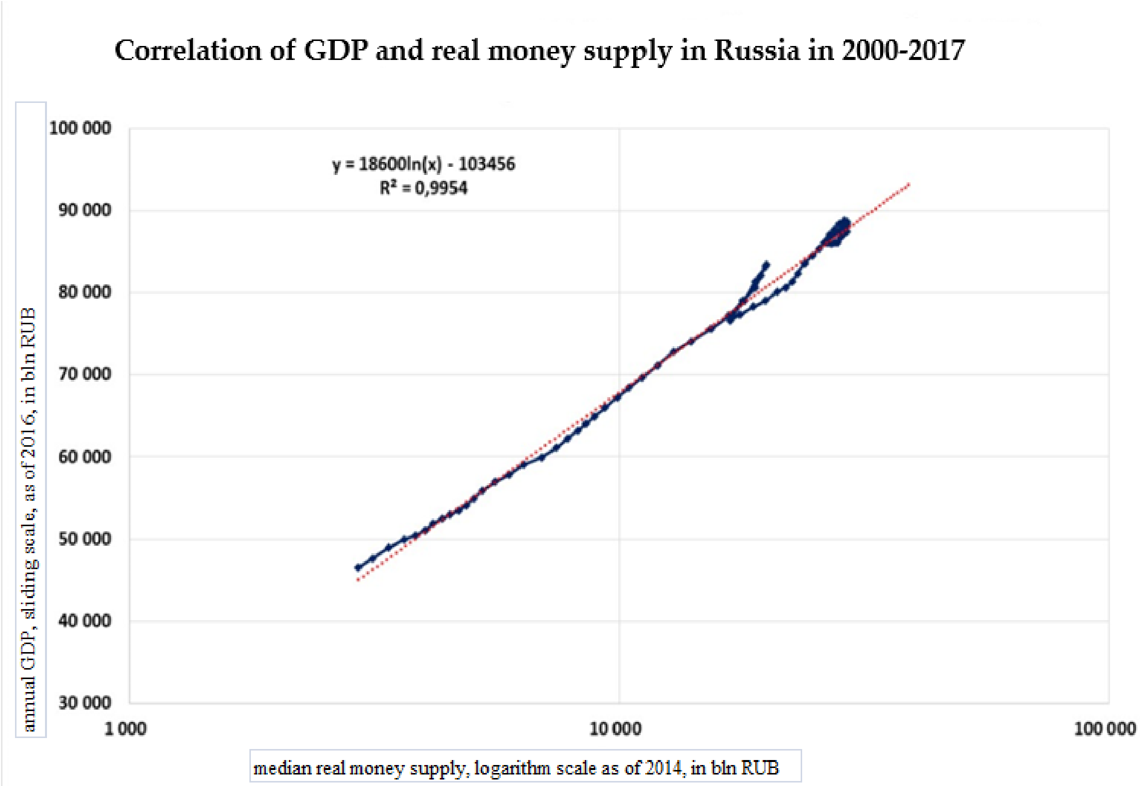



**Figure 4.** Correlation of money supply and GDP in Russia in 2000-2017 Source: http://global-finances.ru/vvp-rossii-po-godam/.

The graphs plotted in Fig.4 visualizes interrelation of the country's GDP and the money supply M2, with the ratio for Russia R2 = 0,995. Segments with sloping down lines characterize crises periods in economy – the crisis of 2008-2009 and the crisis of 2014-2015, with reductions in the GDP rate indicating lower rates of economic activity. During such periods levels of trust to financial instruments lower significantly while increasing demand for cash. Provided an acute shortage of cash develops in the economy, 'substitute money', often in the form of highly demanded goods as cigarettes or alcoholic beverages may be introduced, as in times of perestroika in Russia, or in the form of multiple 'micro financial innovations', e.g. promissory notes, cheques and similar surrogate financial instruments aiming to resolve the condition of cash deficiency in economy.

Another essential aspect of financial innovation in relation to a sector of monetary and financial regulation is increased degrees of influence rendered by governments and their policies on economic conditions and growth. From ancient times, to the Middle Ages, to times of the Renaissance and later Enlightenment to as late as early 20th century government regulation of economy was insignificant and restricted to regulation of money issue (minting in earlier times, issuing banknotes in later periods). With most national economies having transformed into mixed economies the function of regulating money supply and monetary system has been effected much more often for achieving political purposes, with economic ones being subordinate to the former. Today governments have much more powers to regulate economic and financial system through financial instruments, money issue, currency exchange and market intervention, denomination, system of taxation, licensing and permits, tariffs and duties, direct legislative restrictions on trade, investments, state orders, changes in redistribution of incomes and income structure of population with social security payments etc. High degrees of influence on national economy and economic development by the government may result in market failures and failures of financial system interfering with natural processes in economic development [18].

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This statement can be illustrated by examination of financial polices declared and effected by the Russian government beginning with 2010. Following the crisis of 2014-2015 a condition of sharp reductions in demand by both the private and the public sectors was established in economy. Falling prices for oil in global markets led to severe reduction of public revenues necessitating borrowing from the State Stabilization Fund. Russian government pursued policies of austerity and minimization of public spending which resulted in lower rates of national economic development and real disposable incomes of population with lower inflation pressures and volatility of the Russian ruble exchange rate. The policy developed by the Russian government aimed at sustaining national economy in conditions of low prices for fossil fuels, a major source of revenues for the public sector, and new sanctionary pressures. In 2018 a new economic policy was declared – measures to promote fast and sustained economic growth, development of agricultural and manufacturing sectors, increased real disposable incomes and higher standards of living. A principal means of achieving the purposes declared was to become a set of 'national projects', i.e. programs developed and adopted at the federal level with one of the lines of development being creating incentives and foundations for economic development in Russia with a substantial support by the state by allocating investments in most promising sectors of Russian economy: knowledge-intensive industries, support of small and medium-size businesses, employment, international business cooperation and programs, development of infrastructure and digitization of economy (as stated by the relevant federal government agencies of the Russian Federation [19]).The funds planned for project implementation amounted to trillion rubles: funding assigned for 'The Digital Economy' national project for 2019-2024 made up 1,634.9 billion rubles, the total of investments assigned for all national projects for the same period reached 22,608.8 billion rubles. Over-bureaucratization caused primarily by alleged misappropriations of funds allocated for investments resulted in underspending of the funds assigned and extremely low efficiency of the measures taken within the national projects – the rate of economic growth in Russia in 2019 increased by as little as 1.9%.

In 2020 the President of Russia announced a new economic strategy appointing new Cabinet for that purpose – stimulation of economic growth by increased disposable incomes of population though a wide-range program of social security payments thus increasing domestic demand. This measure applied, apart from the expected increased investments in production due to increases in demand, is to induce at least a 0,2-0,3% growth of national GDP, analysts predict as reported by the Russian agency Meduza. Many economists worry such measures to result in increasing inflationary pressures while rendering extremely limited and local impact on economy and unable to create incentives for national economy growth. Changes in economy become more drastic given the consequences of the global pandemic and extremely harsh economic condition in most countries: depression of certain industries (tourism and hospitality, catering, transportation and the like), almost non-existent profits or large-scale losses for many businesses, sharp reduction in incomes of considerable proportions of population, predicted closure of great number of businesses (some analysts forecast the number of businesses to be out of business by August 2020 will reach 1 million entities as the Russian news agency Tass reported in late April. Given that background allocation of enormous funds for social security payments for a proportion of population, mainly stimulating higher birth rates, unsupported by respective development of productive forces, technologies and facilities, higher productivity and remuneration rates for the working population, improved investment climate and the like factors may lead Russian economy to a most profound crisis.

## 5. Conclusion

From the above it can be concluded that the history of economy, economic growth and development of transportation is based on multiple financial innovations: first invention of coins stimulated trade, emergence of markets and related development of transportation means; coins of precious metals started being used as both a means of exchange and payment and as a store of value and a measure of value in economy promoting trade and the need for transporting cargoes. Further financial innovations were caused primarily by deficiency of money supply and search for new means to effect transactions and settlements and to provide for the funding required for operation and development of economic entities. Money supply is a foundation and a factor of major importance in modern economies – changes in money supply have direct and immediate consequences for national economy. Government regulation so broadly applied in modern mixed economies requires clear vision and understanding of economic processes, functioning of economy and the impact of political decisions on the well-being of population and sustainable growth of both national and global economies.

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