YEREVAN STATE UNIVERSITY

JOURNAL OF ECONOMY
Bulletin of Yerevan University

VOLUME 15 - ISSUE 2(44)

DECEMBER - 2024

Three issues of "Journal of Yerevan University. Economics" are published annally. The journal has been published since 2010. It is the successor of "Journal of Yerevan University" published in 1967-2009

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 5-18
https://doi.org/10.46991/BYSU.G/2024.15.2.005

ARMENIA'S DEPENDENCE ON FOREIGN COUNTRIES AND SOURCES IN KEY ECONOMIC AND FINANCIAL SECTORS

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Abstract: The Republic of Armenia's economic and financial sectors are heavily reliant on foreign countries, particularly the Russian Federation. This reliance spans critical areas, including energy, agriculture, trade, transportation, foreign direct investment (FDI), and remittances. This report evaluates the risks associated with Armenia's dependence on a narrow set of external partners and underscores the need for economic diversification. Key highlights are that the majority of Armenia's natural gas and petroleum imports originate from Russia, while its agricultural trade, machinery imports, and textile exports also exhibit significant concentration. Additionally, Russian entities dominate strategic infrastructure such as telecommunications and rail transport, as well as electricity generation, transmission and distribution. Remittances from Russia have constituted an average of 60% of total remittance inflows in 2013-2022, further exposing Armenia to external economic shocks. Such dependence threatens Armenia's economic sovereignty, heightening vulnerability to foreign economic leverage and periods of economic instability abroad. To mitigate these risks, the report advocates for diversification of trade partnerships, investments, and domestic production, aiming to bolster resilience, encourage innovation, and foster sustainable economic growth.

Keywords: *Republic of Armenia, Russian Federation, economic dependency, energy security, foreign direct investment (FDI), trade diversification, remittances, agricultural trade, infrastructure control, economic resilience*

1. Goals of This Report

The goal of this report is to highlight key economic and financial areas in which the Republic of Armenia is highly reliant on foreign countries and sources. High reliance of Armenia on foreign countries in key economic and financial sectors may pose strategic economic threats to the country, including the possibility of greatly exposing the economy of the country to external shocks, making it highly sensitive to economic conditions abroad and thus introducing significant economic uncertainty for Armenian businesses

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Received: 05.12.2024
Revised: 13.12.2024
Accepted: 27.12.2024

and households alike. Based on the data and analysis presented in this report, we conclude that Armenia should make efforts to diversify the portfolio of its economic partners in these key areas. This would not only help the country avoid creating a more uncertain economic environment for its households and businesses, but would also prevent granting foreign entities economic leverage upon the Armenian economy. Moreover, trade with more countries in key areas would instigate the diffusion of knowledge and productivity advancements to Armenia, accelerating technological development in the country and helping the country keep its competitive edge in a rapidly modernizing and evolving international economic environment.

2. Brief Overview of the Armenian Economy

Armenia's economy transformed significantly in the 20th century, shifting from a rural base to industrialization during Soviet rule. Between the 1930s and 1960s, investments in hydroelectric plants, roads, and pipelines connected Armenia to the Soviet economy. Post-WWII, industries like electrical and chemical production thrived, with 31% of the workforce in industry by 1939, contributing 62% of economic output by 1935 (Curtis, 1995). Armenia became a hub for innovation, establishing the Yerevan Computer Research Institute in 1956 and the Metsamor Nuclear Power Plant in the late 1970s.

However, Armenia's dependence on Soviet economic integration left it vulnerable after the USSR's collapse. By the late 1980s, defense enterprises lost up to 80% of their business due to reduced Soviet spending (Curtis, 1995). Compounding this were the 1988 Spitak earthquake, which killed 60,000 and destroyed infrastructure, and geopolitical challenges like the First Karabakh War and Turkey's blockade, which disrupted energy supplies.

From 1992 to 1995, Armenia faced severe energy and goods shortages, with GDP halving and inflation peaking at over 5000% in 1994 (Odling-Smee, 2001). The crisis eased by 1995 through recommissioning Metsamor and restoring critical energy facilities. Transitioning to a market economy, Armenia privatized key sectors and implemented reforms, reducing inflation to under 1% by 1999. Economic growth surged, with double-digit GDP increases from 2002 to 2007, and by 2022, GDP per capita reached $16,042 (PPP), placing Armenia among upper-middle-income nations.

Despite progress, Armenia remains reliant on Russia, which accounted for 35.6% of trade in 2022 and dominates sectors like energy and transportation. Its 2014 Eurasian Economic Union membership deepened this dependence. The next sections examine Armenia's strategic reliance on foreign actors and the need for policies to reduce vulnerabilities and enhance economic resilience.

3. Areas of High Reliance on Foreign Entities

This section is the main bulk of this report and tries to identify the key economic areas in which the Republic of Armenia is highly reliant on one or a few foreign entities or countries.

3.1 Trade

There are several areas of trade in which Armenia is highly reliant on a few countries. These areas include Energy, Food and Agriculture, Machinery and Equipment, Construction Materials, Textiles and Clothing, Metals, Metal Ores and Diamonds, and Tourism.

1) Energy

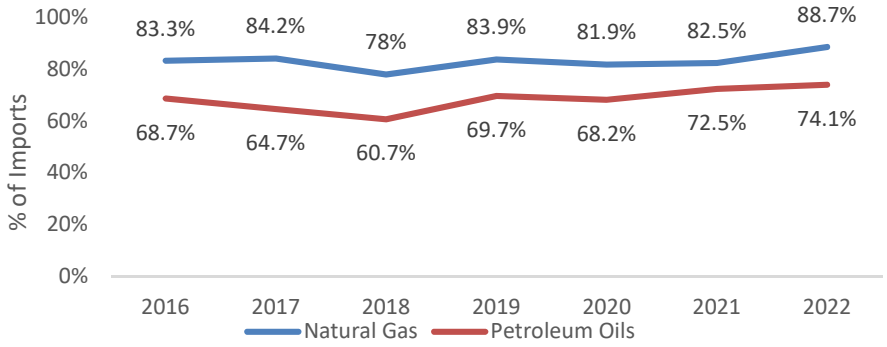
The top two imported products in Armenia as of 2021 were natural gas and petroleum oils. Armenia imported $414.4 million worth of natural gas and $270 million worth of

petroleum oils from the Russian Federation, which constituted 82.5% of Armenia's total 2021 natural gas imports and 72.5% of Armenia's total 2021 petroleum oil imports, respectively (Nazaretyan, 2023). In particular, Gazprom Armenia, the Armenian subsidiary of the Russian state-owned energy giant Gazprom, has a monopoly over supplying gas to Armenia and was granted exclusive rights in the Armenian energy market until 2043 (Nazaretyan, 2023).

The following figure shows the structure of Armenia's energy imports from the Russian Federation in 2016-2022. It is evident that the overwhelming majority of Armenia's energy imports came from Russia in this period.

Figure 1

Percentage of Fossil Fuel Imports from Russia, 2016-2022



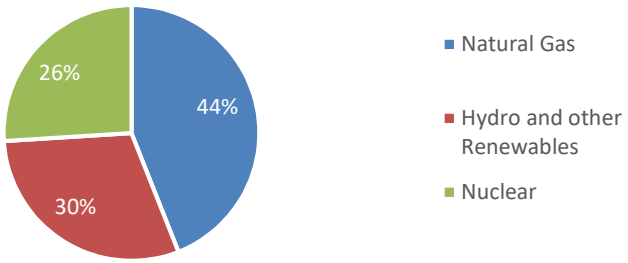
Source: EVN Report, 2023. https://evnreport.com/tag/2023/ .

In 2006, Armenia's reliance on a single gas source proved to be very costly, when the government agreed to a "property-for-gas" deal with Gazprom, in which it gave up key Armenian infrastructure to this company, including majority control of ArmRosGaz, in order to be able to subsidize the gas price hikes, which would increase from $54-$56 to $110 per 1,000 cubic meters by 2009 (Socor, 2006). While subsidies softened the impact on consumers, the deal gave Gazprom a monopoly over Armenia's gas infrastructure, including the pipeline coming from Iran.

The next figure shows the sources of Armenia's electric generation in 2021.

Figure 2

Sources of Electric Generation in Armenia, 2021



Source: International Energy Agency: https://www.iea.org/reports/armenia-energy-profile/energy-security

Armenia's Metsamor Nuclear Power Plant, which produces 31% of the country's annual electricity, relies entirely on Rosatom, a Russian state enterprise, for nuclear fuel, repairs, and updates (Nazaretyan, 2023). Since 2003, RAO Unified Energy Systems, a Russian state-controlled company, had also managed Metsamor's finances under a contract to settle the plant's debts to Russian nuclear fuel suppliers, which expired in 2013 (Socor, 2006). Combined with Armenia's heavy reliance on Russian natural gas, over half of the country's electricity generation depends on a single foreign supplier.

2) Food and Agriculture

Armenia is highly reliant on foreign countries for key agricultural staples. In particular, Armenia is deeply integrated with Russian markets in terms of both its imports from and exports to the Russian Federation in food and agricultural products. Russia is by far the largest player in Armenia for food imports. For example, 98.9% of Armenia's wheat imports came from the Russian Federation as of 2022 (Observatory of Economic Complexity, 2024). In fact, most of Armenia's wheat production is imported: for example, in 2021, only about 26% of wheat consumed in the country was produced domestically (ReportLinker, 2024). Poultry is another area in which Armenia lacks self-sufficiency.

In 2021, Armenia only produced 27% of its annual poultry consumption domestically (ReportLinker, 2024). Moreover, the poultry imports are highly concentrated. In 2023, 32% of Armenia's poultry imports came from Russia, with an additional 23% from Ukraine (TrendEconomy, 2024): together, these two countries accounted for more than half of Armenia's poultry imports.

On the export side, Armenia is known for its high-quality brandy. About 90% of Armenia's brandy products are exported abroad, mostly to the Russian Federation (International Trade Administration, 2022).

Armenia is also famous for its fruit exports. According to data from the TrendEconomy website, Armenian fruit exports were $62 million as of 2022. Armenia also exported $58.4 million in vegetables (Observatory of Economic Complexity, 2023), $6.46 million in coffee (Observatory of Economic Complexity, 2023) and $238 million worth of rolled tobacco in 2021 (The Observatory of Economic Complexity, 2023).

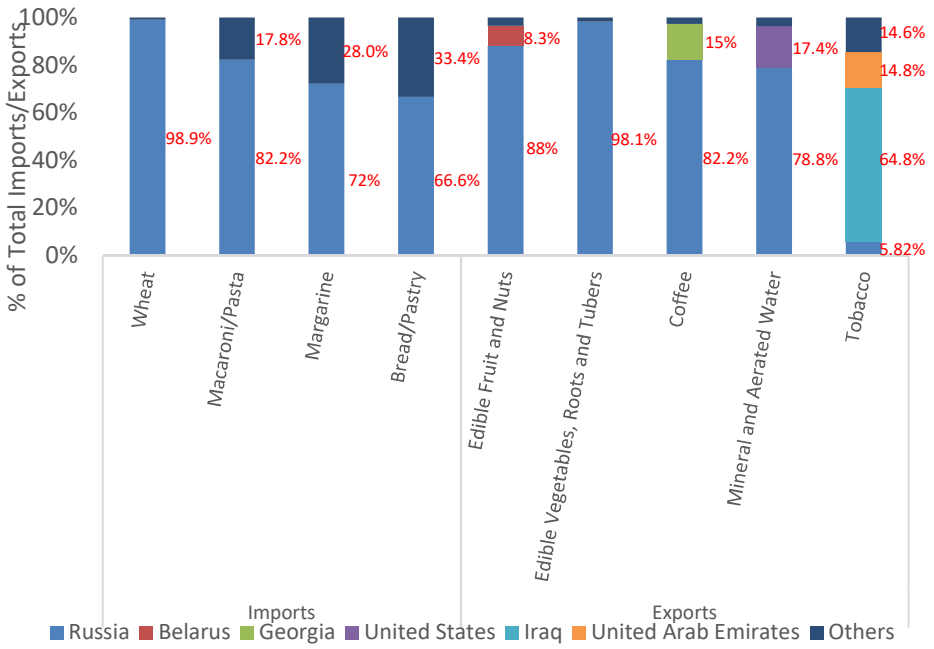
The figure below depicts Armenia's import and export structure in some food and agricultural commodities. Heavy reliance on only a few trade partners in most agricultural and food products is clearly visible in this figure. In most of the categories below, imports from and exports to the Russian Federation constitute more than half of all the trade in the selected commodities. This clearly signals the need to diversify Armenian imports and exports in food and agricultural products.

3) Machinery and Equipment

Machinery and equipment are crucial to Armenia's external trade. Imports include industrial, manufacturing, construction machinery, and specialized tools used across various sectors such as textiles, food processing, infrastructure, agriculture, and transportation. Exports primarily consist of consumer electronics and hi-tech goods. According to data from the Observatory of Economic Complexity, Armenia imported $978 million in machinery and equipment in 2021, while exports totaled $60.2 million in that year. Both imports and exports are highly concentrated, as shown in the figure below. Armenia must diversify the countries from which it imports high-quality machinery, and also find new trade partners to export its machinery products to those markets.

Figure 3

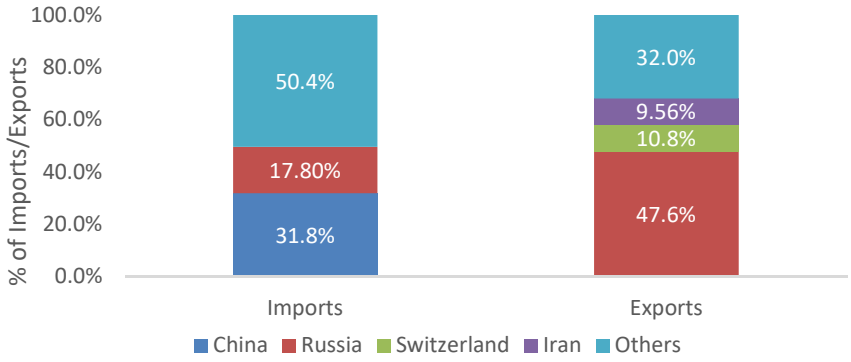
Armenia's 2022 Imports and 2021 Exports Structure in Food and Agriculture



Sources: Observatory of Economic Complexity, Trend Economy, The Jamestown Foundation ("Significant Economic Reliance on Russia Stunts Armenia's Integration With West"). https://oec.world/en, https://trendeconomy.com/, https://jamestown.org/.

Figure 4

Imports and Exports of Armenia in Machines and Equipment in 2021



Source: Observatory of Economic Complexity: https://oec.world/en.

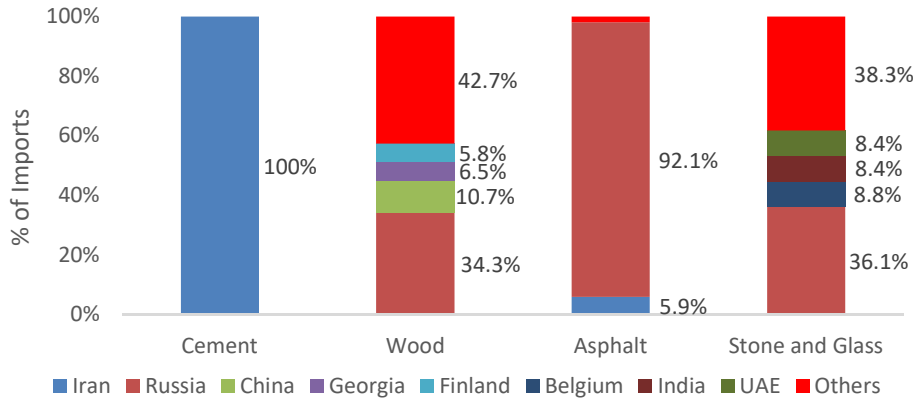
4) Construction Materials

The construction sector is crucial for Armenia's economic development, and relies on

imported materials for infrastructure, buildings, and urban projects. In 2021, Armenia imported significant amounts of key materials: $4.05 million in cement, $181 million in wood, $4.03 million in asphalt, and $356 million in stone and glass. Notably, these imports are highly concentrated, with more than half of each material coming from just one to three main sources. The figure below represents the structure of Armenia's imports of construction materials in more detail.

Figure 5

Imports of Armenia in the Construction Materials Sector in 2021



Source: Observatory of Economic Complexity. https://oec.world/en.

Since the construction sector contributed a sizable 6.4% of Armenia's GDP in 2022 (Statistical Committee of the Republic of Armenia, 2023), diversifying the country's imports in construction materials is essential for enhancing Armenia's economic resilience to external shocks.

5) Textiles and Clothing

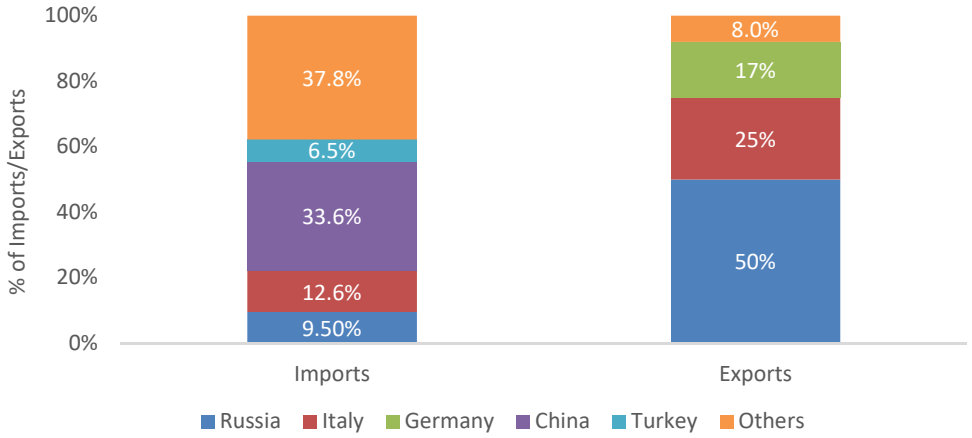
In 2021, Armenia exported a total of about $183 million worth of textiles and clothing, according to data from the World Integrated Trade Solution (World Integrated Trade Solution, 2023). It also imported about $301 million in textiles and clothing in that same year (World Integrated Trade Solution, 2023). The following figure illustrates the structure of these imports and exports. Armenia's exports especially exhibit high concentration, with more than 50% of Armenia's textile exports going to the Russian Federation in 2021.

6) Metals, Metal Ores and Diamonds

Metals, metal ores and diamonds are Armenia's largest export categories. According to the Observatory of Economic Complexity, Armenia exported $93 million worth of diamonds in 2021 (The Observatory of Economic Complexity, 2023) and $425 million in metals (The Observatory of Economic Complexity, 2023). Armenia also exports heavily in metal ores such as copper ore, molybdenum ore and zinc ore.

Figure 6

Armenia's Imports and Exports of Textiles and Clothing in 2021



Source: Observatory of Economic Complexity. https://oec.world/en.

The most important Armenian metal and metal ore exports are in gold, copper ore, molybdenum ore, zinc ore, as well as iron and steel. Here are more detailed statistics about each of these metal and metal ore exports. In 2021, Armenia exported $256 million in gold, $844 million in copper ore, $127 million in molybdenum ore, $16.2 million in zinc ore and $255 million worth of iron and steel. It is important to note that copper ore was the most exported product in Armenia in 2021 (The Observatory of Economic Complexity, 2023).

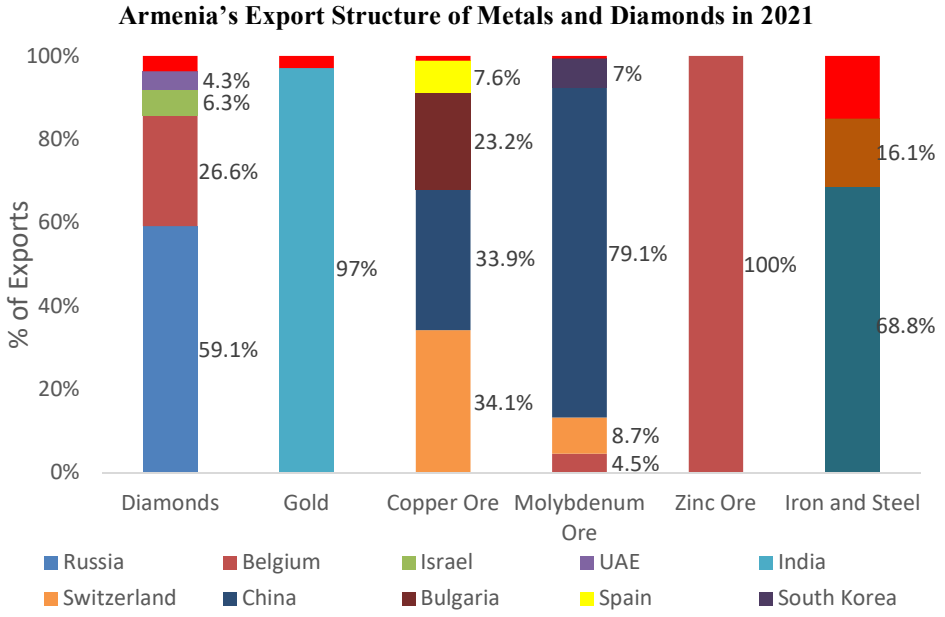
The figure below shows visually that Armenia's exports in diamonds and metals are not well-diversified, and in many cases consist of a few main destinations. For example, all of Armenia's zinc ore exports are to Belgium and almost all of its gold exports are to India. Moreover, almost 60% of Armenia's diamond exports went to one country in 2021 – Russia.

Considering that metals, metal ores and diamonds are the main Armenian exports, it would be wise for the country not to rely on a few foreign countries as export destinations, as this would give these countries the power to upset the Armenian trade balance, thus causing economic upheaval in the country. Armenia should seek to diversify the foreign markets to which it can deliver its diamond and metal exports.

7) Tourism

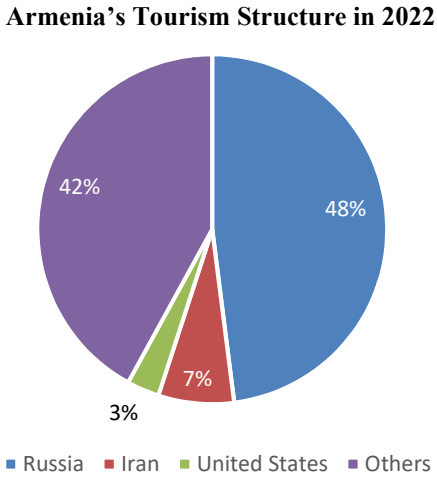
According to the Statistical Services of the Republic of Armenia, 1,665,658 tourists visited Armenia in 2022: about 48% came from the Russian Federation and 7% came from the Islamic Republic of Iran (Statistical Committee of the Republic of Armenia, 2023). This means that more than half of Armenia's tourism industry depends on just two countries, and about half comes just from the Russian Federation. Tourism in Armenia would highly benefit from diversification. Outreach and advertising efforts could encourage tourism from countries of the West, as well as Asia and the Pacific, as Armenia possesses an incredible tourist potential that unfortunately still remains untapped.

Figure 7



Source: Observatory of Economic Complexity, https://oec.world/en.

Figure 8



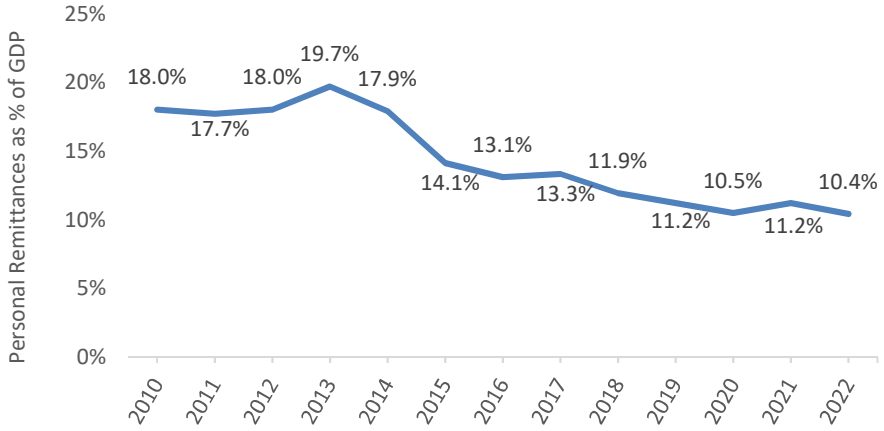
Source: Statistical Services of the Republic of Armenia, https://armstat.am/en/.

3.2 Remittances

Remittances received from abroad have historically made up a large portion of the Armenian GDP every year and have been in the billions of US dollars. The following graph represents personal remittances as a percent of GDP in Armenia during the 2010-2022 period.

Figure 9

Personal Remittances Received as Percent of GDP in Armenia during 2010-2022



Source: The World Bank

From 2010 to 2022, personal remittances averaged 14.4% of Armenia's GDP, with most coming from Russia (The World Bank, 2023). Since the start of the war in Ukraine, remittances from Russia have surged, but they have consistently been the majority, averaging 60% of total remittances during 2013-2022. The U.S. averaged another 14% for the same period, with both countries contributing an average of 74% of remittances in 2013-2022. According to the Central Bank of Armenia, the country received $3.6 billion from Russia and $671 million from the U.S. in remittances in 2022, totaling $4.3 billion, which represented 22% of Armenia's GDP in that year. Even in 2021, before the start of the war in Ukraine, Armenia received $1.4 billion in remittances from these two countries combined in 2021, $866 million from Russia and another $580 million from the USA, representing 69% of total remittances received in that year.

Given remittances represent a sizable part of the Armenian GDP each year, this reliance on a few foreign economies leaves Armenia vulnerable to external economic shocks, which could severely impact growth and household welfare in the country. To strengthen economic security, Armenia must reduce dependence on remittances by fostering domestic job creation, economic growth, and consumption.

3.3 Foreign Aid and Loans

Armenia has historically relied on Russian loans and aid for economic projects, such as a $500 million loan in 2009 to mitigate the 14.1% economic contraction resulting from the Global Recession during that time period (Babayan, 2009). However, Armenia often struggles to meet loan obligations, leading to "property-for-debt" deals that harm national interests. In 2002, Armenia transferred key state assets, including the Hrazdan Thermal Power Plant and several research institutes, to Russia to settle a $100 million debt (Tatikyan, 2023). Similarly, in 2003, Inter RAO gained control of Metsamor Nuclear Plant's finances

and five hydroelectric plants in exchange for repaying $40 million in debt (Tatikyan, 2023). These agreements have placed critical infrastructure under foreign control, allowing leverage against Armenian interests. To address this vulnerability, Armenia must diversify its loan sources to reduce economic dependence on a single country.

3.4 Foreign Direct Investment (FDI)

Russia is Armenia's primary foreign direct investment (FDI) partner, accounting for 70% of FDI inflows in 2022, valued at $697 million (Modex, 2023). Russian companies held 46% of Armenia's total foreign investments as of 2023, and dominate strategic sectors like energy, communications, and transportation. Gazprom Armenia has a monopoly over Armenia's entire natural gas sector following a 2014 "property-for-debt" deal in which Gazprom inherited the debt of ArmRosGaz in exchange for full ownership of the company (International Energy Agency, 2023). The Tashir Group, a large conglomerate with significant Russian ties, owns the Sevan-Hrazdan hydroelectric cascade (Caucasus Watch, 2019), the second-largest power plant complex in Armenia, as well as Armenia's entire electric grid (Grigoryan, 2015).

In the transportation sector, Russian Railways, a fully state-owned Russian railway company, manages all rail transport in Armenia through its South Caucasus Railway subsidiary. The telecommunications sector in Armenia is less monopolized but still significantly dominated by Russian companies, with VivaCell-MTS and Rostelecom Armenia, subsidiaries of major Russian telecom giants, holding substantial market shares in the country. VivaCell-MTS was Armenia's 10th largest taxpayer in 2022 (State Revenue Committee of the Republic of Armenia, 2024).

Given this heavy reliance on Russian FDI, including in key sectors of the country's infrastructure, Armenia faces risks during times of economic uncertainty and economic crises in Russia. To safeguard its economy, Armenia must diversify its FDI sources and attract non-Russian investors to these critical infrastructure sectors.

4. Policy Recommendations and Concluding Remarks

The aim of this report was to outline key strategic areas in which Armenia depends on one or a few foreign actors. This overdependence may highly expose the economy of Armenia to external shocks and undermine its ability to cope with economic downturns resulting in a compromised economy for the country in the future, jobs lost for thousands of Armenian citizens, revenues lost for Armenian businesses, and overall, a more uncertain economic environment in Armenia leading to lower domestic and foreign investments. The report identified that Armenia depends heavily on the Russian Federation in the areas of trade, energy, communications, transportation, FDI, foreign aid and loans for various projects and for economic stabilization, as well as remittances coming from abroad. More specifically:

- Armenia's fossil fuel imports are highly concentrated, with 82.5% of Armenia's 2021 natural gas imports and 72.5% of Armenia's petroleum imports coming from the Russian Federation. As Armenia does not possess local fossil fuel reserves, this jeopardizes the country's energy security
- Russian companies also own controlling stakes in Armenia's electricity grid and generation facilities. As well, Armenia's electricity is mostly generated from fossil and nuclear fuel: most of Armenia's fossil fuel and all of its nuclear fuel come from Russia. This puts Armenia's whole electricity sector in a critical dependence on the Russian Federation

- Imports in key agricultural staples are highly concentrated, with most of Armenia's imports in wheat, bread and pastry, macaroni/pasta and margarine coming from Russia, presenting an existential dilemma for the country, in case economic conditions worsen in Russia
- Russia accounted for about 70% of FDI inflow into the real sector of Armenia in 2022. In the event of an economic crisis in Russia, Armenia would lose enormous capital inflows, which would most likely result in an economic recession in the country
- Armenian Railways are completely owned by a Russian state-owned company. The telecommunications sector is heavily dominated by companies that are direct subsidiaries of Russian telecommunications giants, such as VivaCell-MTS and Rostelekom. This puts key Armenian infrastructure in the hands of foreign corporations and entities
- Armenian imports of machinery and equipment were highly concentrated, with Russia and China accounting for more than half of these imports in 2021. Diversifying the sources of machinery and equipment would instigate advancements in technology and economic productivity in Armenia.
- Remittances have historically made up a large proportion of the Armenian economy. In 2013-2022, Russia accounted for nearly 60% of Armenia's remittances coming from abroad on average. Armenia has also relied historically on Russia for loans to stabilize its economy during challenging economic periods
- In the Tourism sector, about half of Armenia's foreign tourists in 2022 came from the Russian Federation. Armenia has great tourism potential, and advertising can help attract more tourists from diverse countries and increase the country's visibility on the international stage

There were other players that formed monopolies in other sectors of the economy – for example, all of Armenia's cement imports in 2021 came from Iran.

Armenia's exports were also highly concentrated in a variety of areas. Half of Armenia's exports of textile and clothing went to Russia in 2021. More than half of Armenia's exports in diamonds also went to Russia in that year, whereas almost all of its exports in gold went to India. Armenia's exports of agricultural products and food are also highly concentrated, with most of Armenia's exports in fruits, vegetables, coffee and mineral water going to Russia in 2021, while most of Armenia's tobacco exports went to Iraq in that year.

These statistics raise alarming questions about Armenia's self-reliance in sectors that support its independence as a sovereign state. The electricity and energy sector is perhaps the most problematic in this regard: as this sector depends heavily on Russian sources not only for raw materials, but also for management and logistics, economic shocks in Russia can have great reverberations in Armenia and put Armenian businesses and households alike at risk. The transportation and telecommunications sector is another key piece of the Armenian economic infrastructure and is in a critical dependence on the Russian Federation, Russian companies having controlling stakes in these markets in Armenia.

Based on these remarks, it would be highly advisable for the Armenian government to enact policies that encourage the entry of local economic agents in these markets, as well as stimulate investments from other regions of the world, such as the European Union, North America, India, China, Australia and others. This would not only help Armenia diffuse the dominant power that Russian enterprises hold in key areas of the Armenian economy, but will also encourage competition, entrepreneurship and innovation, resulting in a more stable, less volatile economy, less dependence on one foreign country in strategic

areas, and advancements in technology and economic productivity coming from diversification and diffusion of knowledge. This diversification would also help create quality jobs in Armenia, helping Armenian consumers rely less on remittances from foreign countries, which, due to the large number of Armenians residing in Russia, mainly come from that country and have historically represented a significant share of the Armenian GDP. As far as exports go, the Armenian government should encourage local producers to seek out new markets and assist them in making their products more competitive for Western markets, such as the EU and the US. This would make Armenian businesses more resilient to economic shocks in one country, protecting the local economy on the production side.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 19-31
https://doi.org/10.46991/BYSU.G/2024.15.2.019

PROBLEMS OF STRUCTURAL DEVELOPMENT OF ECONOMY IN ARMENIA

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Abstract: The structure of the economy refers to the forms of organization of economic activity and the proportions existing between different sectors and spheres of the economy, the ratio changes of which determine the process of economic growth and the nature of economic development. On the one hand, economic development is impossible without structural changes, on the other hand, structural changes, in turn, are a consequence of this development. Here, special significance is given to revealing the problems of structural economic development, tasks effective interaction between various structural units and stimulating economic growth. It is of paramount importance in the condition of modern structural complexity of the economy. The current stage of global economic development is characterized by major structural shifts in the economy, leading to a transition to new structural proportions: primary spheres of the economy are giving way to secondary, processing spheres, and secondary ones – to services.
The overall picture of the structural development of the Armenian economy is quite close to the picture of the development of the economies of developed countries: the predominance of the service sector in creating added value in the economy is accompanied by a decrease in the weight of agriculture and industry. However, if we take into account the fact that trade, which is growing rapidly and comprises a big part of the service sector but does not bring added value to the economy, the development of the service sector is at a disadvantage. The structure and quality of the economy are not improving despite the fact that in recent years Armenia has become one of the fastest-growing economies in the world. Structural distortions and adverse shifts in the economy undermine real economic growth. Even more worrisome is the fact that this growth is short-term, caused by the cessation of the influx of people and financial resources to Armenia and/or their possible outflow. This is a serious structural problem of the economy and a serious challenge to economic security.

Keywords: *the structure of the economy, economic growth, gross added value, economic sectors and subsectors, spheres and sub-spheres of the economy, services, structural changes in the economy*

Introduction

Today's global economy is characterized by acceleration of technological changes, market rate fluctuations and increasingly growing competition. For their in-depth understanding, we need to review the structural developments in the economy, in particular, the mutual interaction between the economic structure – value added – economic growth and development and in this context, reveal the structural development challenges. To this end, we have analyzed the developments in the Armenian economy, its sectors and sub-sectors in parallel to modern structural shifts.

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Received: 19.09.2024
Revised: 13.10.2024
Accepted: 27.06.2024

The obtained results may become guidelines for efficient interaction between various structural units and future robust economic growth.

Theoretical and methodical bases of the research and methods of analysis. Driven by the research purpose and tasks, we conducted our analysis on the basis of domestic and international statistics, publications and international theoretical and practical investigations with the application of comparative analysis and reconciliation, as well as quantitative and qualitative methods and approaches in evaluating the current state of the Armenian economy.

Determinants of Development of Structural Economics. Role and Importance of Structural Analysis

The interpretations of the *Economic structure* concept are numerous owing to increasingly growing manifestations of structural changes. The economic structure refers to forms of organization of economic activities and existing proportions between different sectors. It is reasonable that so far there have been no all-embracing and comprehensive definitions of economic structure. They refer mostly to individual components of economic structure such as institutions, markets, sectors, companies, etc. Douglas North prioritizing the role of institutions in the formation of economic structure, emphasizes the impact of informal constraints and formal rules on economic behavior and performance. (Douglas North, 1990, 17-36). Oliver Williamson focuses on the role of the structure of economic transactions, including the choice between markets and hierarchies in organizing the economy and enhancing efficiency (Oliver Williamson, 1985, 18-19). Ronald Coase also emphasized the role of transaction costs in economic structure, particularly at the enterprise level. (Ronald H. Coase, 1988). Joseph Schumpeter contributed to the perception of the economic structure focusing on the role of creative and innovative minds. He maintains that economic development encompasses an ongoing innovation process replacing the structures that are left behind. Hernando de Soto prioritizes property rights in furthering economic structure (Hernando de Soto, 2000, 59-61). Lalande views the *Structure* concept in terms of its territorial and functional location (**Barre, R.,** 1995, 191). According to F. Perrow, the structure of an economic unit is a set of proportions and interactions depicting the unit at that very moment and under the existing conditions. Jean Lhomme deems the simultaneous use of *proportion and relationship* concepts unacceptable since they are identical, in the opinion of the author. Lhomme viewed social and economic structure as a set of relations, adding time determinant to the location factor which makes it possible to conduct the analysis of the components not only in quantitative terms but also in dynamics, tracing the behavior of components through time (**Roshchina Irina V.**, 2012, 20). R. Barr, the founder of the analysis of national economy structure together with prioritizing the time factor, distinguishes two types of compatible structures:

1. Economic structure in the form of:
   - Plain economic entities such as households, organizations, etc.,
   - Complex economic entities such as sectors, branches, etc.
2. Framework structure forming the economic environment (institutional structure, social, demographic structure, technological, environmental structure, etc.) (**Barre, R.**., p. 193-195).

As time passed, *economic structure* definitions became more precise. McConnell and Brue consider the structure of the economy a result of activities of economic entities: state, enterprises, households aimed at the creation of gross national product (**McConnell, C., Brue, S., & Flynn, S.**, 1992, 135). Here, the emphasis falls on the entire structure of the economy formed as a result of interaction between closely interconnected macroeconomic elements. According to a less complicated definition of economic structure, the economy is a composition of prevailing forms of ownership: state, private, mixed and public sectors (**Yakovets Yuri V.**, 1992, 23). These clarifications make it possible to characterize the economic structure as per distinctive features underlying its perception. In particular:

1. by economy sector: it reflects the interrelationships between different economic sectors within the national economy, particularly,

- Primary sector: it involves the extraction and production of raw materials (farming, mining, forestry),
- Secondary sector: it includes manufacturing and processing sectors that convert raw materials into finished goods,
- Tertiary sector: involves services and intangible goods,

2. by process criteria: *reproduction structure – expresses possibilities of economic growth and economic efficiency, as well as the relationship between consumption and accumulation*,

3. by territorial criteria: *territorial structure* (**Zhuk, Sergey I.**, 2005, 37).

The system of national economy is a composition of global, regional and in-country economic relationships within the state endowed with particular features of development of the given country and 'operating within an inherent hierarchical framework of that country' (**Kirakosyan G., Khlghatyan I.**, 2009, 55). The national economic system is formed primarily on the basis of exuberance of internal sources contributing to the system's reproduction, formation of a structure appropriate to the time-period and available resources, regulation of social and economic relationships, external economic interaction. Here, the proper perception and evaluation of the *' pre-industrial -industrial -post-industrial'* development trace is important. The present stage of economic development is characterized by the transition from an industrial labor-intensive economy to a post-industrial, science-intensive economy implying changes in the hierarchy of economic development factors. Particularly, a more decisive role will be ascribed to public needs' structural changes resulting from emerging differences in average income rates and productivity levels in different economic sectors. Thus, the income growth of the population brings about other qualitative structural changes: a significant shift in the structure of population demand for material products to intangible goods of the service sector. So, it is the structural cycle that characterizes the post-industrial society.

Here, the analysis of economic structure plays a vital role.

The issues referring to the ***analysis of economic structure,*** identification of determinants of structural development and formation of flexible economic structure are especially important in the context of balanced development of the economy, robust economic growth, satisfaction of the population's needs and exercise of their rights and interests**.** The importance of the structural analysis of the economy is more straightforwardly defined by Tinbergen, he maintains that 'a set of structural ratios depicts an architectural image of the economy determining the areas of economic reaction to certain fluctuations' (Assous M., Carret V., 2021, 17). Structural analysis is especially vital at the national economy level. It

makes it possible to conduct a full-scope analysis of economic phenomena and become a basis for effective interaction between structural components. It plays a crucial role as, *on the one hand, the economic development is impossible without structural changes in economic sectors, on the other hand, structural changes, in their turn, are the result of economic growth.* So, the enhancement of efficiency of manufacturing processes is decisive in ensuring economic sustainability, which may be manifested in an *increase in value added to* the cost of the product as it goes through different production stages.

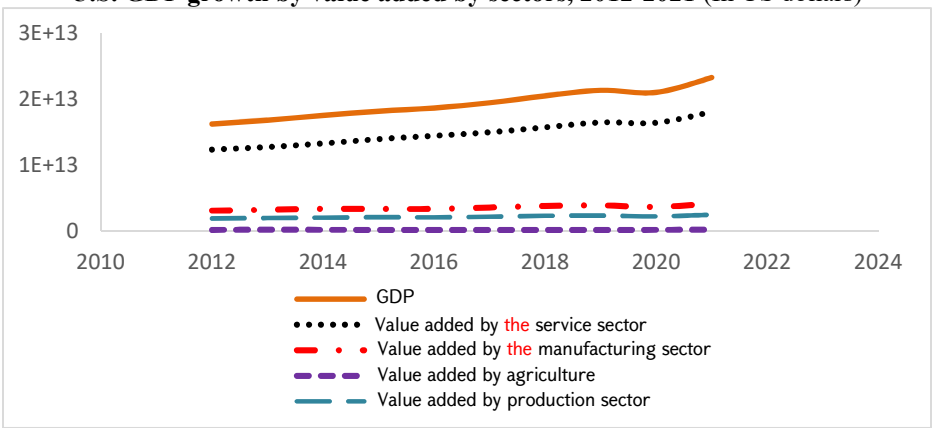
Modern Structural Economic Dynamics. Characteristics of Developed and Developing Countries

Owing to harmonious interaction between the services and manufacturing sectors and improvement of technology and productivity, countries with developed service sectors move to a new level of development thus contributing to the enhancement of their competitive position in the global market.

The U.S. holds a rather high position in terms of service development. Around 80% of GDP is created by the service sector (Figure 1).

Figure 1

U.S. GDP growth by value added by sectors, 2012-2021 (In US dollars)



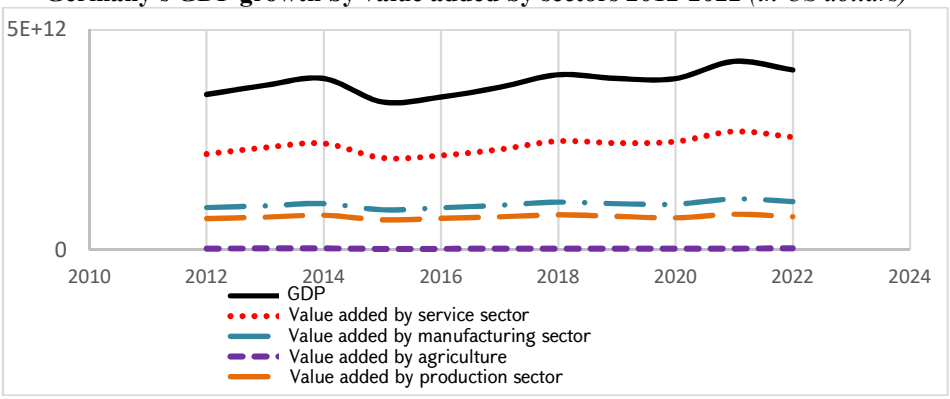
Source: https://data.worldbank.org/country/US /last logged in on 20.08.2024/

It is worth noting that in U.S. economic structure, the share of agriculture is the lowest. The share of the manufacturing industry (including construction) is also rather low. The economic growth has progressively weakened in both sectors. In the U.S. economic structure, the percentage of material manufacturing is comparatively high with the processing industry (machinery manufacturing, arms industry) remaining an important factor of economic development contributing to high technical development of other economic sectors.

The structure of the economies of ***Germany*** and the U.S. are almost identical**.** Germany's economic growth is hugely dependent on the service sector. The only difference is that in the latter's economic structure the percentage of manufacturing industry is bigger and has more influence compared to the similar sector in the U.S. In Germany, the service sector is largely dependent upon the success of the manufacturing sector (Figure 2).

Figure 2

Germany's GDP growth by value added by sectors 2012-2022 *(in US dollars)*



Source: https://data.worldbank.org/country/germany /last logged in on 20.08.2024/

Owing to structural reforms, ***China*** has become one of the global leaders. China develops its own educational system, encouraging technological innovations, the IT sector, telecommunications, biotechnology and healthcare sectors. Although in 2005, 40.3% of its GDP was created in the service sector, it is still lower than in many other countries (**The Economy of China.** Structure of the Chinese Economy, 2021).

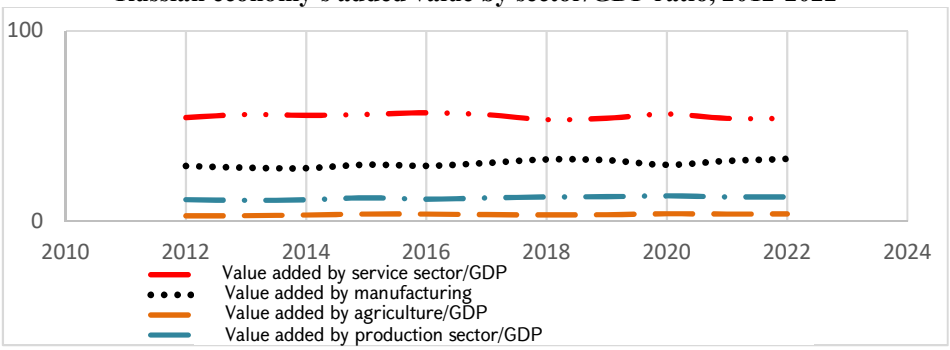
One of the most crucial prerequisites of ***Japan's*** economic advancement is its efficient structural policy. High-technology sectors such as biotechnology, robot building, conductors and semiconductors manufacturing are the driving force for the Japanese economy.

So, we can state that the developed countries, as a rule, have all the elements of the post-industrial stage which is not the case with ***developing countries***.

In spite of economic sanctions, the ***Russian*** economy demonstrates stable growth. Positive growth rates are observed in agriculture and manufacturing sectors contributing to the augmentation of gross value added in the economy. The service sector having a large share in the Russian economy, has declined in terms of producing added value (Figure 3).

Figure 3

Russian economy's added value by sector/GDP ratio, 2012-2022

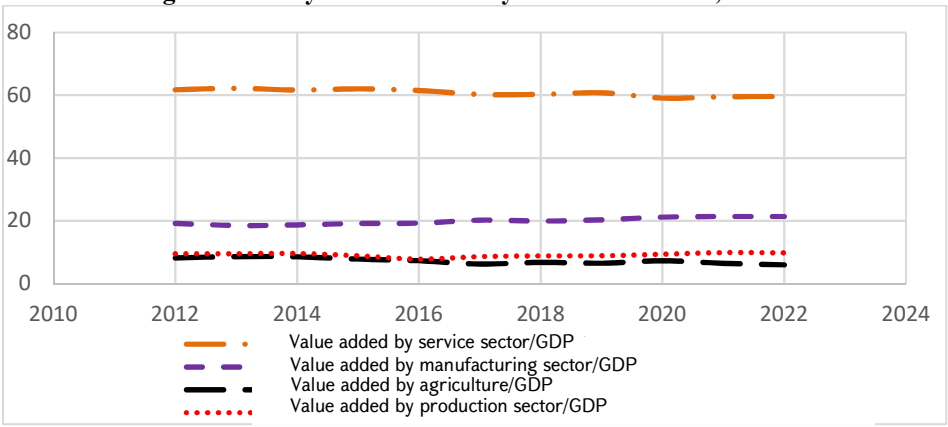


Source: https://data.worldbank.org/country/Ru /last logged in on 20.08.2024/

After the economic decline in 2020, the ***Georgian*** economy has demonstrated significant growth rates in all sectors of the economy. The percentage of the service sector is the largest although it yields to the manufacturing industry in terms of the creation of added value. The agriculture sector also has a downward trend in terms of the creation of added value (Figure 4).

Figure 4

Georgian economy's added value by sector/GDP ratio, 2012-2022



Source: https://data.worldbank.org/country/Georgia /Last logged in on 20.08.2024/

The structure of ***Azerbaijan's*** GDP significantly differs from the economic structure of other developing countries /Figure 5/.

Figure 5

Azerbaijani economy's added value by sector/GDP ratio, 2012-2022

Source: https://data.worldbank.org/country/AZ/ /Last logged in on 20.08.2024/

The main driving force is the manufacturing industry in which the share of oil extraction is significant. The service sector's share is essentially lower than that of the manufacturing industry and agriculture. Interestingly, since 2012, the percentage of agriculture almost hasn't changed, while the shares of the manufacturing industry and services underwent changes with the retention of the prevailing role of the manufacturing industry.

To sum up, we can state that *the present stage of global economic development is characterized by significant structural shifts for transition to new structural proportions: primary economic sectors are yielding their primary role to secondary – processing sectors, while the latter in turn are surrendering positions to services.*

Structural Developments in the Armenian Economy: Dynamics and Challenges

During the last ten years the growth rates of the Armenian economy were unstable (Table 1).

Table 1

GDP indicators of the Armenian economy

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024** expected	**2025** Fore cased	**2026 f**ore cased
GDP(USD, million)	10,55	0,55	11,53	12,46	13,62	12,64	13,86	19,51	24.21	25.41	27.15	29.15
GDP (annual % change)	3,3	0,2	7,5	5,2	7,6	-7,2	5,7	12,6	8.7	6.0	5.3	4.5

Source: LLOYD BANK, Armenia: Economic and Political Overview, https://www.lloydsbanktrade.com/en/market-potential/armenia/economical-context#/, World Bank Data https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=AM

In 2019, GDP growth rate was the highest - 7.6%, followed by COVID-19 pandemic-triggered economic decline in 2020 with GDP going down by up to 7,2%, and thereafter, by positive though fluctuating growth rates of GDP. The economic growth rate of 12.6% in 2022 (which is attributed to a sharp upward trend in the jewelry sector in November-December 2022) was followed by a decline to 8.7% in 2023 with retention of the external impacts which according to predictions, will still be effective also in 2024, 2025, and 2026.

The external factors, although manifested in economic growth rates, should be viewed as a short-term phenomenon requiring measures to prevent potential impediments to other economic sectors. Here, structural analysis at the national level is needed in order to reveal the challenges posed to economic growth and identify the problems arising out of structural shifts.

Dynamics of structural development by economic sector, control criteria and type of economic activity

The value added as a component of national accounts makes it possible to present the GDP by structural unit and sector and share in the formation of GDP. Within the RA national accounts system (NAS), structural units with consideration of their main functions, behavior and goals, are grouped into five main structural sectors:

1. non-financial corporations
2. financial corporations
3. general government
4. households
5. non-profit institutions serving households (NPISH).

The dynamics of gross value added in 2016-2022 show that the biggest portion of gross value added (55.5% on average) is created by non-financial corporations which during the mentioned period went up by around 1.8 times. The next big portion (26.4% on average) belongs to householders (its share has been reduced by 5.7% due to householders growth slowdown). Instead, the value added by the public sector in 2022 went up by 1.5 times compared to 2016, its share in GDP averaged 10.3%. During the same period, the value added by financial corporations also went up by around 3.2 times making 9% of GDP (Socio-economic situation of the RA, 2018, National accounts of Armenia, 2017- 2022, 119): *To summarize, we can state that during 2016-2022 the percentage of households in gross value added went down, in contrast to the public sector and financial corporations, which is a rather negative phenomenon. The distribution of gross value added by control criterion* is also an important determinant of the structural picture of the economy (Table 2).

Table 2

Structure of gross value added by sector and control criterion (in % of total value, at basic prices)

	2018				2020				2022			
	Distribution by institutions' control criterion											
	public	national private	foreign	**total**	public	national private	foreign	**total**	public	national private	foreign	**total**
Non-financial corporations	3.8	35.8	14.1	**53.7**	3.7	39.6	13.0	**56.3**	3.5	40.7	12.2	**56.4**
Financial corporations	0.4	2.9	2.6	**6.0**	0.3	3.6	3.7	**7.6**	0.1	4.6	4.3	**9.0**
General government	9.3	-	-	**9.3**	11.7	-	-	**11.7**	9.4	-	-	**9.4**
Households	-	30.5	-	**30.5**	-	23.9	-	**23.9**	-	24.8	-	**24.8**
Non-profit institutions serving households (NPISH)	-	0.5	-	**0.5**	-	0.5	-	**0.5**	-	0.4	-	**0.4**
Total value added	**13.5**	**69.8**	**16.7**	**100**	**15.7**	**67.6**	**16.7**	**100**	**13.0**	**70.5**	**16.5**	**100**

Source: Socio-economic situation of the Republic of Armenia, National accounts of Armenia, 2021, p. 113, 2023, p. 110, January-May 2024, p. 16, Gross value added by sub-sector.

In 2018 – 2022, the share of the national private sector in gross value added is rather high, which went up from 69.8% in 2018 to 70.5% in 2022 owing to participation of non-financial corporations by 40.7% and households by 24.8%. Some investments were made by financial corporations whose share increased from 2018 to 2022 by 1.7% p.p., amounting to 4.6%. *The growth of the national private sector's share was accompanied by an augmentation of the share of non-financial corporations and a reduction in households' share.*

The dynamics of gross value added by the publicly controlled sector fluctuate, with the total value of GVA amounting to 13.5% in 2018, 15.7% in 2020 and 13% in 2022. The contribution of the public sector in gross value added was ensured by general government and non-financial corporations. The share of foreign-controlled entities in gross value added has remained almost the same, making 16.5% in 2022. It was accompanied by a stable reduction in the share of non-financial corporations and steadfast growth of financial corporations, amounting to 12.2% and 4.3% in 2022.

The gross value added by foreign-controlled entities by economic activities is worth noting. In particular, in 2022, foreign-controlled entities have a rather high share in gross value added in the following sectors: mining and quarrying - 86.5%, electricity, gas, steam and air conditioning supply - 67.6%, water supply, sewerage, waste management and remediation - 73.2%, information and communication - 42.2%, financial and insurance activities - 47.4% (National accounts of Armenia, 2023 թ., 100]. *In fact, the sectors of strategic importance are foreign-controlled and directly depend on foreign capital which is a serious challenge to national security.*

The structure of gross value added by non-financial and financial corporations is noteworthy in terms of economic activities. In particular, in 2022 the contribution of agriculture was 11.1%, processing industry - 12.5%, construction - 7.5%, wholesale and retail trade - 12.8%, real estate activities - 8.9%, information and communication - 4.9% (Socio-economic situation of the RA, 2024, 16, 14-16, 112). *The declining share of the mentioned*

types of activities in GDP gives rise to concerns. Thus, the major part of the Armenian economy is contributed by the national private sector. It is mainly contributed by non-financial corporations encompassing almost all sectors of economic activities, except agriculture whose contributors are households with an increasingly declining share.

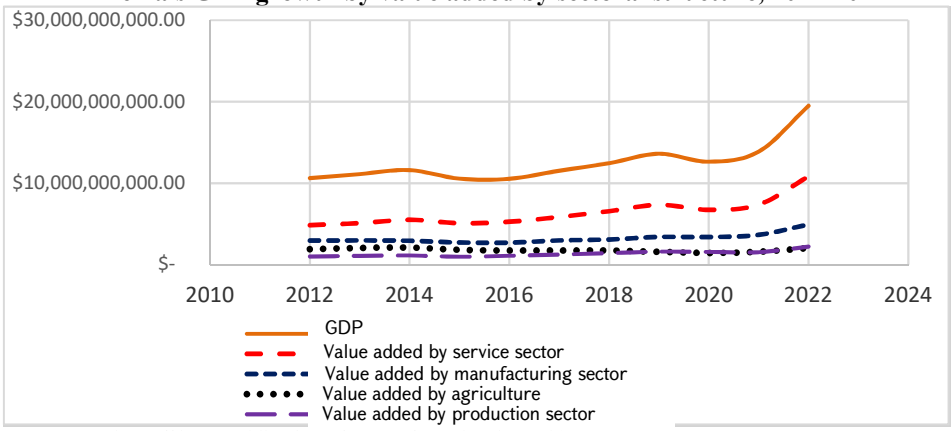
Manifestations and challenges of structural development of the Armenian economy

The sectoral structure of the economy attributed to component features and nature of manifestations, predetermines the course of economic development. Here, the issues referring to structural development and their interaction with the economy are of special importance.

The review of the economic growth with dynamics of value added by GDP structural components is worth noting /Figure 6/.

Figure 6

Armenia's GDP growth by value added by sectoral structure, 2012-2022



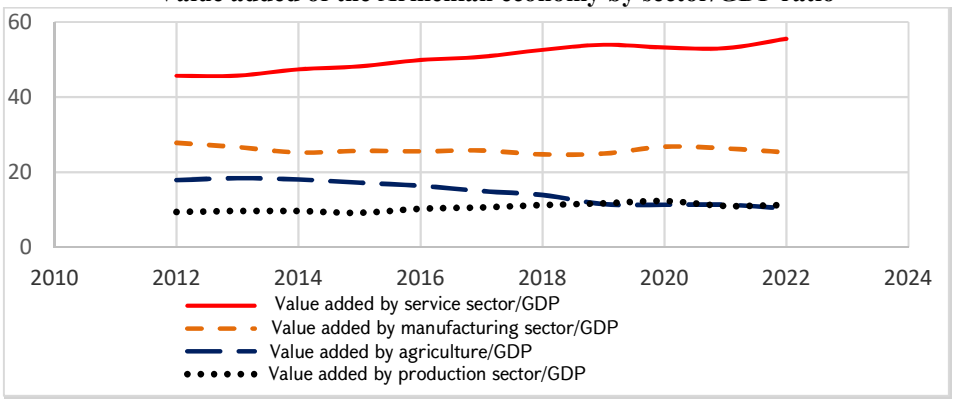
Source: https://data.worldbank.org/country/AM, last logged in on 20.08.2024

So, the 12.6% growth rate of the Armenian economy was contributed to by the service sector, manufacturing industry, agriculture, whose values added amounted to 47%, 34%, 28%, 44% respectively (https://data.worldbank.org/country/AM).

In the structure of GDP, the share of the service sector was 55.5%, manufacturing industry - 25.2%. While agriculture recorded a double-digit growth rate of 21%, its impact on GDP growth was insignificant. Thus, in 2020, the 12.6% growth rate of GDP was contributed to by growth of the service sector of around 26.5% and the manufacturing industry by 8.5%. The dominance of the service sector in the formation of value added was accompanied by a decrease in shares of agriculture and manufacturing industry (Figure 7).

Figure 7

Value added of the Armenian economy by sector/GDP ratio



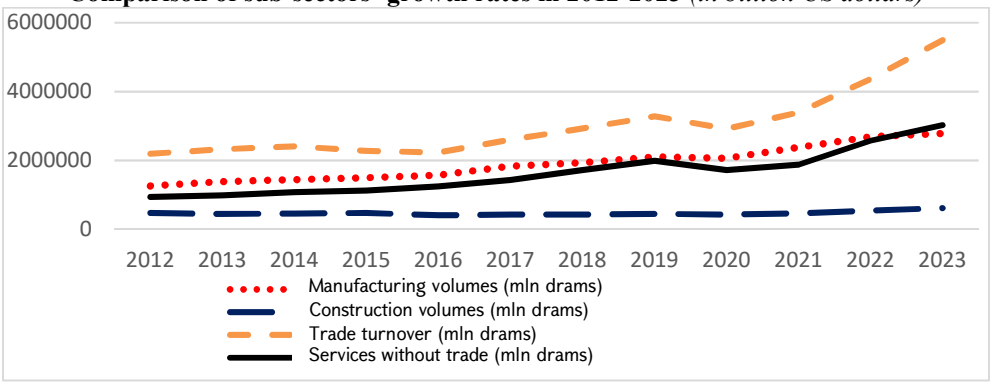
Source: https://data.worldbank.org/country/AM /last logged in on 20.08.2024/

In essence, the overall picture of sectoral developments of the Armenian economy is similar to the picture of developed countries with the service sector having a high share in the economy, and a relatively lower share of manufacturing industry while the contribution of the agriculture sector is not significant and has a downward trend.

For a more comprehensive analysis it is necessary to review the structure of the Armenian economy by sub-sector (Figure 8).

Figure 8

Comparison of sub-sectors' growth rates in 2012-2023 *(in billion US dollars)*



Source: https://statbank.armstat.am/pxweb/hy/ArmStatBank/ArmStatBank

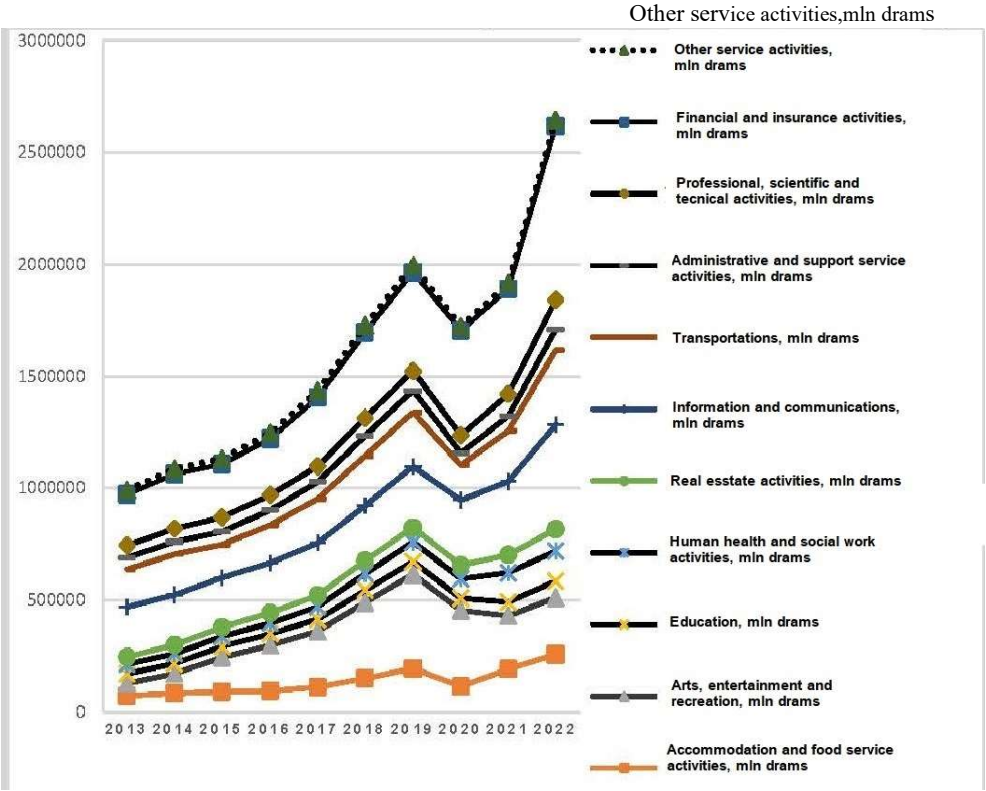
Thus, during 2012-2023, the manufacturing industry recorded impressive growth. Here, the structural developments in the manufacturing sector are worth noting by sub-sector breakdown (https://statbank.armstat.am/pxweb/hy/ArmStatBank/ArmStatBank/, industry sector). The Armenian manufacturing industry includes over 39 sub-sectors, with mining and its related subsectors holding the major portion (growth of 173%), in spite of its decline by around 14% in 2022. In 2012-2022, the metal mining sector recorded a growth of around 158% while in 2021-2022 it declined by 15%. Other sectors of metal mining and quarrying grew by 294%, and only in 2021-2022 - by 18%. The share of *the process industry* in the manufacturing sector is significant – around 12.5%. During 2012-2022, it rose by around 124% and only in 2021-2022 - by 23%. Thus, in spite of some downward trends in the

manufacturing sector, and particularly in mining, some growth was officially acknowledged. The *construction* sector recorded a 30% growth rate basically due to the effectiveness of the income tax refund program and as a consequence, growth in mortgage loans as well as augmentation of market demand for real property attributed to regional developments.

As shown in figure 7, during the observed period, the *services* without trade recorded a 220% growth rate, while the trade volumes went up by 150%. The growth gained momentum as a result of financial and migration inflows due to the Russian-Ukrainian war in 2022. Although we observed some activation of the service sector and augmentation of its share in GDP, the service proportions were not favorable in terms of gross value added with a high share of trade that does not create added value, rather, it is a channel of distribution of goods and services. Here, the service component's behavioral tracking is important (Figure 9).

Figure 9

Breakdown of service sector by sub-sector, 2012-2022 (AMD, million)



Source: https://statbank.armstat.am/pxweb/hy/ArmStatBank/ArmStatBank

During the observed period, the sub-sector of financial and other insurance activities held the highest share in services, growing from AMD 228030.9 million in 2013 to AMD 776502.6 million (by around 3.4 times). The second sub-sector is information and communication which rose by around 2.1 times during the mentioned period. It is worth tracking the dynamics of education, professional development and healthcare sub-sectors, which significantly contribute to the value added by the service sector, have moderate shares and demonstrate modest growth of 1.7, 2.4, 3 times respectively. In contrast to it, higher growth rates were recorded in sub-

sectors generating less added value such as accommodation and food service activities (growth by around 3.5 times) and arts and entertainment (growth by around 4.6 times).

Thus, in spite of certain downward trends, the official statistical data acknowledge double-digit economic growth. Armenia became one of the fastest-growing economies in the world. Meanwhile, such growth rates don't improve the economic situation at all. The quality and structure of the economy are not getting better. Moreover, production volumes are going down, and exports are declining requiring urgent measures and in-depth understanding of the nature of the mentioned growth.

It is worth noting that the huge portion of growth recorded in the economy, its sectors and sub-sectors is attributed to 2022, 2023 and 2024. In the first half of 2024, the economic activity indicator grew by 10.4% compared to the same period in 2023. Interestingly, the economic growth was due to the *manufacturing* sector (18,2%), primarily owing to precious metals. During the observed period, the *service* sector grew owing to the financial sector (19,0%, mostly mortgage and interrelated consumer loans which maintained high growth rates in the construction sector (in January to June - 15,7%, annual)). In the first half of 2024, external trade volumes rose by 2,3 times: precious stones and metals reached 71% of overall export volumes (8,1 times higher than in the first half of 2023), and imports rose by 86,5 % mainly due to precious stones and metals (with their volume rising by 9.4 times) (https://statbank.armstat.am/pxweb/hy/ArmStatBank/ArmStatBank, services).

In fact, the growth rates are hardly linked to Armenian economic performance: the national economy, especially the manufacturing sector would have sharply declined had it been filtered out of external factors. In particular, the production of precious metals and stones grew more than the entire manufacturing sector. This is a huge structural problem and a serious challenge to national security. Re-export, which has fueled the growth of the Armenian economy, has brought about structural distortions and economic imbalance thus undermining the real economic development and advancement of the service sector and as a consequence, the generation of added value.

According to analysts of the Eurasian Development Bank, since the economy cannot be expanding any more, it will no longer grow and in the second half it will slow down to a 7.5% annual growth rate (Eurasian Development Bank, 2024).

The economic situation gives rise to concerns not only in terms of unfavorable structural shifts but also sometimes illogical economic dynamics. It is worrisome that these growth rates are of situational nature caused by migration and financial inflows and their possible outflow may bring about extra economic problems the external manifestations of which are already evident.

Conclusion

Structural analysis of the economy is particularly important at the national level, in terms of identifying both the challenges and opportunities involved in ensuring a harmonious relationship between economic growth and the resulting structural changes.

The current phase of global economic development is marked by significant structural shifts, driving a transition toward new sectoral proportions: the primary sectors of the economy are giving way to secondary, processing sectors, which are themselves being overtaken by services. In this context, the importance of knowledge-intensive industries, based on high technologies, is crucial. The sectoral structure of the Armenian economy closely mirrors that of developed countries. Industry's contribution to the economy is relatively

small, while agriculture represents a modest and declining share. The services sector, however, accounts for a significant portion of the economy. The emerging picture is still concerning, particularly regarding the insufficient added value being generated in the services sector. The increase in re-exports has resulted in situational economic growth in Armenia during 2022, 2023, and 2024, causing structural distortions and economic imbalances. This hampers the real economic growth and the development of the services sector that supports it, as well as the generation of added value, moving Armenia further away from the potential of achieving a post-industrial structural economy.

The research conducted provides a more in-depth understanding of the structural development challenges facing Armenia's economy. It can serve as a guiding framework for future economic policy directions and the initiatives necessary for their implementation.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 32-40
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"GREEN GROWTH" MEASURING CHALLENGES IN THE BUSINESS SECTOR

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Abstract: Green growth assessment is considered relevant in assessing the effectiveness of sustainable organizations. However, while internationally recognized "Green growth" indices are used in the macroeconomic sphere, simultaneously green growth assessments are not yet regulated at the microeconomic level. The article explains the specifics of green growth in the business environment and presents recommendations on their accountability and measurability. In particular, it is recommended to assess the green growth generated by organizations using KPIs and implement appropriate accountability in this regard.

Keywords: *green growth interpretation, sustainable business, sustainable management, green entrepreneurship*

Introduction

Entrepreneurship has traditionally been considered a way to create material goods, generate additional profit, and improve people's well-being. Entrepreneurs always pursue private interests when carrying out economic activity, on the one hand, gaining profit in the competitive market and aiming to increase their entrepreneurial capital, on the other hand, by creating material goods or organizing services, contributing to the growing socio-economic needs of people's satisfaction. However, by using entrepreneurial services, the population is already making a public demand to preserve the planet Earth, to take care of the surrounding environment, which is often neglected in the course of the business, that appears in the race for profit formation and, unfortunately, does not enter into the enterprise within the framework of the goals of the owners (Tshughuryan A, Khachatryan N., 2023, 71-94).

As a result, the business mercilessly "devours" everything on its way that contributes to the formation of super profits, not sparing people's health, harming nature, recklessly

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Received: 23.11.2024
Revised: 08.12.2024
Accepted: 27.12.2024

wasting natural resources, and polluting water and air basins with harmful waste. Therefore, in the striving for super profit, new requirements arise, the purpose of which is the organization of an enterprise, which makes it possible to use socio-economic resources in such a way, that they are transferred to future generations and thus the business becomes continuous as well. in the foreseeable future, having a stable development course (Hakobyan A., Tshughuryan A., and Martirosyan G., 2023, 169-76).

Today, economic activity is dramatically shifting to the sphere of sustainable business. People are trying to implement management tools, that promote sustainable entrepreneurship. The scope of socially responsible investments is being expanded, and the formats of reports published by organizations are being transformed to inform everyone how successful business activities are in terms of both private interests and public expectations (Thshughuryan A., Savastano M., 2024, 44-55). Both internal and external beneficiaries of the economic activity are already interested in the evaluations of the sustainable development of the organization, and if they are not encouraging, then risks of losing business partners and weakening of competitive positions in the market arise in the organization (Khachatryan N., 2024, 44-55).

In this regard, the research aimed to separate the growth of green activities from the economic benefits of traditional businesses and propose approaches to recognizing and measuring green growth.

Results and findings

The problems of green growth measurement were formed in the 70s of the last century when it became clear to the community of businessmen striving for profit, that the relentless exploitation of the subsoil, and the pollution of the surrounding environment would cause catastrophic damage to the planet Earth, which will no longer be possible to intersect, or to re-establish even business with the resulting super profits. It became obvious, that the activity contributing to the positive growth of people's socio-economic level at the same time contains negative environmental, social, and managerial risks, the mismanagement of which leads to irreversible damages and future instability. And the instability can be formed due to the merciless exploitation of natural resources, their absence, violations of environmental balances, as a result of the instability of the business society (Khachatryan N., 2024, 24-31).

The concept of sustainable development at the initial stage of its formation was presented as "the exploitation of natural resources at the present moment in such a way as to create an opportunity for future generations to use these resources. In other words, initially, sustainable development was built based on the principle of intergenerational solidarity, when humanity, satisfying its current demands for natural resources, enables future generations to also satisfy their demands for using natural resources (Arbidane I, Khachatryan N., Martirsosyan N, 2023).

In such a case, resource-saving technologies, substitutes, and efficient approaches to natural use are used. From the beginning, the source of inspiration for the implementation of these ideas was the process of using forest wood, when people were well aware that the damages of deforestation should be restored with new tree plantations, which will be a wood resource for the next generations (Khachatryan N., Karapetyan S., 2024, 67-74).

In the simplest interpretation, in the case of green growth, we strive to transfer the Earth to future generations with the possibilities of natural use, that we once received from our ancestors. Naturally, in this case, stability is mainly related to ensuring a "stable

level" of natural resources. Years later, the green growth of the business was practically considered by the international community in a broader context, which, in addition to effective land use, also included poverty reduction, access to education, "green energy" use, and climate recovery requirements (Arbidane I., Khachatryan N., 2024, 23-31).

Green growth is an approach to addressing environmental challenges that relies on the advancement of science and innovation. It is interconnected with various factors, including the economy, resources, environment, technology, politics, market, culture, and society (Quacoe, D.; Kong, Y.; 2023).

Regulations for sustainable business development ultimately formed the ideology of the "green economy". And the green economy cannot function efficiently without "green entrepreneurship". Perhaps, until now, there is no universal definition of the term "green economy", but international structures, when presenting various interpretations in this direction, are guided not only by environmental but also by social, effective management, and reasonable resource use approaches intending to secure the sustainable development of management (see Table 1)

Table 1

Definitions of "green economy" according to international authoritative structures.

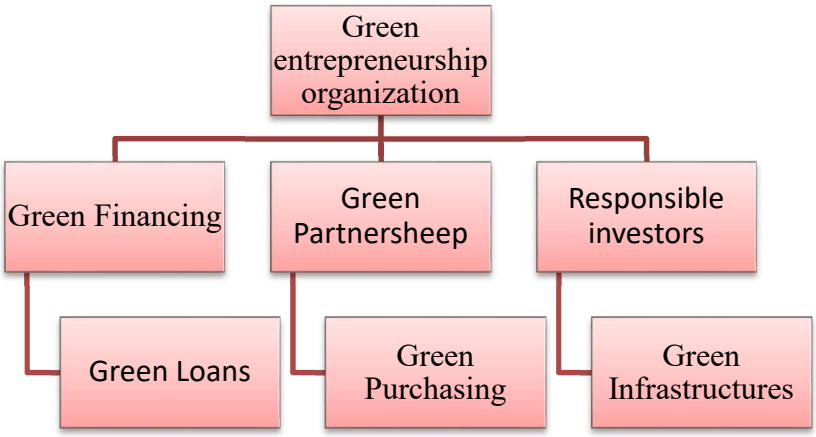
Organization	Definition
United Nations Environment Program (2011)	The "green economy" leads to improved human well-being and social equity by reducing environmental risks.
United Nations Conference on Trade and Development (2011)	"Green economy" is a component arising from the goals of sustainable development, which leads to the improvement of people's well-being and the reduction of inequalities, without transferring environmental risks and ecological scarcity problems to generations.
International Chamber of Commerce, Green Economy Task Force	In the "green economy", economic growth and environmental sustainability mutually cooperate, supporting progress and social development.
EEA (2013)	Environmental, economic and social policies and innovations in the "green economy" make it possible to effectively use resources, improving people's well-being, preserving natural systems.

In this sense, "Green Enterprise" basically focuses on investments, capital, infrastructure, employment level, and social and environmental positive results. It is defined as low-carbon, resource-efficient, and socially inclusive management, aimed at reducing environmental risks, handling limited resources, and sustainable development. Fostering green enterprises not only addresses environmental concerns but also unlocks economic, social, and technological opportunities that can drive holistic and sustainable development (Anna Misztal, 2023). It works with the structure of achieving employment and income growth, by attracting investments, through which the reduction of carbon emissions and pollution, the improvement of energy and resource use efficiency, and the preservation of biodiversity are realized. Thus, "green entrepreneurship" cannot be aimed only at increasing profit through "green procedures". It should enable necessary structural changes in the composition of used resources, management methods, level and structure of consumption, export in the context of actions aimed at reducing emissions and losses, as well as climate change prevention (Sahakyan N., 2023, 104-108).

Green entrepreneurship seeks to create more value year after year by introducing innovations in business while preserving natural systems and mitigating environmental damage with a special toolkit (see Figure 1.). In addition, the green entrepreneurship process can be applied in whole or in part, depending on the scale of the business.

Figure 1

Green entrepreneurship toolkits



Source: Developed by authors.

Consequently, green growth has three main characteristics:

- Low level of negative impact of business on the environment, wise use of natural resources, growth with low emissions implies the development and application of such strategies that will contribute to the sustainable economic growth of the enterprise.
- Resource efficiency, which contributes to increasing the efficiency of resource use, thereby extending their life and reducing the environmental impact associated with their entire life cycle.
- Social inclusion, when creating opportunities for the vulnerable classes of society to participate in the development processes of the green economy and to have an impact on them.

Therefore, "Green Growth" is a model focused on the harmonious coexistence of people and nature, with the main principles of its operations (Abesadze O., Martirosyan G. 2023, 44-56).

1. Principle of sustainability, based on which policies for environmental, social, and economic development are developed.
2. A principle of justice, that promotes equality in the distribution of natural resources between generations.
3. Principle of dignity, which respects the rights of employees and actively supports the development of new "green jobs and careers". It contributes to the self-development of employees.
4. The principle of a healthy planet, by which entrepreneurship preserves the integrity of the environment, ensures the wise use of natural resources.
5. Principle of inclusiveness, which ensures participatory decision-making in green entrepreneurship for all stakeholders.
6. The principle of effective management and accountability, when not only the sustainable progress of environmental, social, and economic measures is recorded, but also the beneficiaries are presented with a report on the fulfillment of obligations undertaken

in the field of "green development".

7. Principle of flexibility, which promotes the harmonious and interconnected activities of different models of green entrepreneurship development, aimed at cultural, social, and environmental issues.

8. Principle of resource efficiency, which aims at zero emissions and production waste, as well as considers renewable energy and resource recovery as a priority for resource use.

9. Principle of generations, by which investments in the "green economy" are made to ensure the well-being of current and future generations.

"Green growth" implies long-term business planning, when resources used to create any value do not disturb the simple and natural rules of "coexistence" between man and nature. Therefore, the business organized according to such principles is able, while preserving nature, to be as human-centered as possible, to ensure well-being (higher quality health care and education, safe work, social equality), to promote the process aimed at reducing negative impacts on the environment, as well as curbing ecological risks. "Green growth" provides an opportunity to create sustainable livelihoods by creating "green jobs", thereby increasing the availability of sustainable infrastructure and services.

The economic growth formed as a result of entrepreneurial activity is mainly connected with the increase of the profit of the organization or the expansion of the managed capital. However, when organizations make the transition to "green entrepreneurship", traditional approaches to assessing economic growth are revised, taking into account several factors of environmental, social, and corporate responsibility. In this case, along with the economic growth of the business, the "green growth" related to the result of entrepreneurship is also evaluated. Therefore, one of the important features of the entrepreneurial activity of the transition to the green economy is the necessity of recording "green growth", thus refusing to measure economic growth exclusively by profit.

"Green growth" formed as a result of entrepreneurship is not clearly understood in practice, and it is not at all determined only by solutions to environmental problems. This is also evidenced by the current definitions of international structures related to "green growth" (see table 2).

Table 2

Definitions of "green growth" according to international structures

OECD (2011)	"Green growth" refers to promoting the development of economic growth while ensuring that natural assets continue to provide the resources and environmental services on which human well-being is based.
World Bank (2012)	Growth that is efficient in terms of the use of natural resources minimizes pollution and environmental impact. It considers natural hazards and the role of environmental resource management and natural capital in preventing physical disasters.
United Nations Economic and Social Commission for Asia and the Pacific (2012)	"Green growth" is a strategy for sustaining economic growth and creating jobs aimed at overcoming poverty in the face of resource depletion and climate crisis.

It should be noted, that at the country level, a "green growth" index is currently calculated, which combines the sustainable development goals approved by the United Nations, as well as the assessments of the determinants of the Paris climate agreement, with

the following four pillars (Green Growth Index, 2023):

- efficient use of resources,
- protection of natural capital,
- opportunities for green economy development,
- social inclusion.

Moreover, the green growth index for each country is evaluated on the following 100-point scale: 80-100 efficient, 60-80 high, 40-60 moderate, and 20-40 low efficiency.

However, evaluations of "green growth" formed as a result of entrepreneurial activity are made with other approaches, relating to the micro-level business environment. And the environment of entrepreneurship requires financing, marketing, managerial, and legislative arrangements, which will act in terms of "green activity". Therefore, it is necessary to evaluate "green growth" with an integral indicator, taking into account the above-mentioned factors. In practice, it is easier to apply the evaluation of "green growth" from the point of view of performance, when key evaluation indicators (KPI) are defined for the functions of sustainable development accompanied by entrepreneurship, assessing the degree of their availability. At the same time, it is more appropriate to evaluate the performance of "green entrepreneurship" with percentage measurement, because the result indicators are presented with different measurement units and their comprehensibility in the integral index is possible through percentage measurements (Khachatryan N., 2024, 24-31).

Based on the characteristics of the enterprise, the range of "green growth" evaluation indicators can be expanded, or the definition of key indicators can be revised. However, a business should always strive for 100% "green growth" performance. Therefore, it is important to measure the "resultant growth of green entrepreneurship" and use a sound methodology of evaluation based on the directions of sustainable entrepreneurship.

Case study

Along with traditional management, the supermarket is transitioning to green management. In this regard, is setting the task of realizing the following goals:

• use of alternative energy, by setting solar panels,
• application of green logistic structures,
• introduction of circular consumption-production process.

The corporate social responsibility (CSR) of supermarkets necessitates that the outcomes of green entrepreneurship be distinctly separated from the indicators of traditional operations, with specific metrics being employed through a robust methodology. This methodology involves the measurement of key performance indicators (KPIs) and incorporates the present value of cash flows. To facilitate this, an annuity coefficient of 8% is applied, based on the prevailing bank deposit rate.

Supermarket management can use the following motivational levers to promote green entrepreneurship:

- recognizing the costs of installing electric panels on the roofs as a double deduction in the calculations of profit tax in the legislative way,
- providing a 3% discount to product buyers, if they present a receipt to charge their electric vehicles in the supermarket parking lot,
- making a 2% surcharge to the suppliers of goods, if the delivery is made by trucks powered by electric motors,
- in case of receiving 30 kg of household food waste from buyers, 2 kg of pork

meat is provided to them for free.

- buyers receive one bottle of carbonated drink for free, when they provide 40 empty plastic bottles.

For assessing of Green growth is used information from tables 3-5.

Table 3

Annual report on the performance of the supermarket "green activity" results

#	Green activities	KPI	Actual
1.	Installation of electrical panels	120m^3	110m^3
2.	Charging electric cars of customers	2500 kw/h	2700 kw/h
3.	Deliveries of cargo with electric motors	6400 t	6100 t
4.	Collection and realization of household food waste	3950 t	4200 t
5.	Collection and realization of plastic bottles	15 000 pcs	15 200 pcs

Source: Developed according to authors' calculations.

Table 4

Expected economic results of the organization's "green activities" (million AMD)

#	Green activities	Investment costs	Years of project implementation	Expected annual benefits
1.	Installation of electrical panels	75 000	7	15 000
2.	Charging of electric cars	65 000	8	12 000
3.	Deliveries of cargo with electric motors	50 000	5	14 000
4.	Collection of household food waste	54 000	4	17 000
5.	Collection of plastic bottles	4000	8	700

Source: Developed according to authors' calculations.

Table 5

Calculation of the integral indicator of "green growth" of supermarket activity

#	**Green Activates**	KPI	Actual	Performance (%)
1.	Installation of electrical panels	120m^3	110m^3	**91,6%**
2.	Charging of electric cars	2500 kw/h	2700 kw/h	**108%**
3.	Deliveries of cargo with electric motors	6400 t	6100 t	**95%**
4.	Collection of household food waste	3950 t	4200 t	**106%**
5.	Collection of plastic bottles	15 000 pcs	15 200 pcs	**81%**
	"Green Growth"	X	X	**96,32%**

Source: Developed according to authors' calculations.

The economic confidence of the supermarket's sustainable entrepreneurship strategic goals, using an annuity factor of 8%, will be presented by the following calculations:

Installation of electrical panels

- investment: = 75,000
- discounted benefit inflow = 15,000*5.2064 = 78,096
- Positive NPV 78 096 > 75 000

Electric vehicle charging

- investment: = 65,000
- discounted benefit inflow = 12 000* 5.7466 = 68 959
- Positive NPV 68,959 > 65,000

Logistics with electric motors

- investment: = 50,000
- discounted benefit inflow = 14 000* 3.9927 = 55 899

- Positive NPV 55 899 > 50 000

Collection and disposal of household food waste

- investment: = 54,000
- discounted benefit inflow = 17 000*3.3121 = 56 307
- Positive NPV 56 307 > 54 000

Acceptance/disposal of plastic bottles

- contribution: = 4 000
- discounted benefit inflow = 700* 5.7466 = 4022
- Positive NPV 4 022 > 4 000

Conclusion

Green growth measurements in the business sector of organizations create an opportunity to assess the opportunities for business to support sustainable development. In this regard, it is important to identify the green development tendencies of businesses, based on the specifics of the business activities of organizations and identify the opportunities for their implementation. In this regard, the use of a system of KPIs for green growth will be considered quite useful, which will not only analyze the directions supporting green growth, but also assess the results of sustainable development at the level of organizations along with business activities**.** By supplying such information, an opportunity will be created to considerably improve green business management effectiveness at the business entity level and to implement effective management decisions in this direction. Currently, organizations are increasingly focused on ensuring accountability for corporate social responsibility, with KPIs designed to measure green growth being recorded in accordance with industry-specific characteristics, as illustrated in the case of supermarket.

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Journal of Yerevan University. Economy
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https://doi.org/10.46991/BYSU.G/2024.15.2.041

THE NATURE OF CONSUMER (HOUSEHOLD SECTOR) FOOD WASTE AND PRIMARY CAUSES BEHIND IT: EVIDENCE FROM ARMENIA (YEREVAN CITY).

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Abstract: This research aims to investigate the extent of consumer (household sector) food waste at the consumer level in Yerevan, in monetary terms. The study delves into the nature of food waste and identifies the primary causes behind it. An online survey was completed by a demographically representative sample of 385 participants. Yerevan residents highlighted a perceived deficiency in societal awareness regarding food waste in their responses: the survey's findings revealed that a noteworthy portion of participants, comprising 40%, rated themselves at four or below; conversely, 19% of respondents indicated a higher level of awareness, assigning themselves ratings of eight, nine, or ten points. The average rating provided by our respondents was 4.9, indicating a comparatively lower evaluation. The results of the study did not confirm our hypothesis regarding the correlation between education level, income level and food waste behavior among respondents. The economic impact of food waste was assessed by articulating the annual monetary losses incurred by individuals for each discarded product. Additionally, it examines the inclinations of Yerevan residents to mitigate waste, shoulder social responsibility, engage with educational initiatives, and suggests potential policy solutions to address the issue effectively.

Keywords: *Food waste, households, consumption, customer behavior*

Introduction:

The growing issue of food waste is becoming increasingly significant on a global scale. In today's geopolitical landscape, it is crucial for developing nations, including Armenia, to align with the necessity of efficiently utilizing resources, reducing waste, and promoting sustainable development practices. As per a 2011 investigation conducted by the Food and Agriculture Organization (FAO), around one-third of the world's food production, approximately 1.3 million tons, is lost annually.(Gustavsson and Cederberg, 2013) It is crucial to note a significant finding from the United Nations Environment Program's 2019 report, which reveals that a substantial 931 million tons of food waste were generated globally. Notably, 61% of this colossal waste originated from households.(Forbes, Quested and O'Connor, 2021)

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Received: 27.11.2024
Revised: 10.12.2024
Accepted: 27.12.2024

A study conducted in Denmark involved the observation of 1474 households, revealing that each household generated an average of 103±9 kg of avoidable food waste annually. Simultaneously, the unavoidable food waste for each household amounted to 80 ± 6 kg per year. (Edjabou *et al.*, 2016) An additional case study is derived from another Nordic country, Finland, where the average annual food waste was 23 kg per individual, 63 kg per household, with a cumulative total of around 120 million kg per year. (Silvennoinen *et al.*, 2014) The primary contributors to food waste in Norwegian households were fresh bread, fresh fruits, vegetables, and leftover dinner meals. The estimated per capita edible food waste in Norway was 46.3 kg based on the findings. On a weekly basis, each household produced an average of 8.86 kg of total waste, comprising 3.76 kg of food waste, 2.17 kg of edible food waste, and 0.60 kg of edible food waste still in its original packaging. (Hanssen, Syversen and Stø, 2016) In Europe, the average proportion of bio-waste in total municipal waste is 37%, but this percentage varies significantly among member states. It ranges from less than 20% in Lithuania, Norway, and Slovenia to over 50% in Greece, Portugal, Slovakia, and Malta.(Bräutigam, Jörissen and Priefer, 2014) An interesting study was carried out in Poland, where it was substantiated that the age factor significantly influences the quantity of food discarded by Polish women. Individuals aged 37 and above were found to waste less food and more frequently reported not engaging in wasteful practices compared to their counterparts. (Jungowska *et al.*, 2021)

With this data in hand, numerous political declarations at the high level have been endorsed both in Armenia and abroad. The Political Declaration, as adopted during the High-level Political Forum on Sustainable Development (HLPF) under the General Assembly's auspices in September 2023, reiterates the commitment of global leaders to effectively execute the 2030 Agenda and its Sustainable Development Goals (SDGs).(Sampedro, 2021) It underscores the dedication to uphold all principles embedded within the agenda, emphasizing the need for substantial changes in consumption and production patterns. This involves the shift towards sustainable economic and business models, the implementation of the 10-Year Framework of Program's on Sustainable Consumption and Production Patterns, and the provision of support to developing nations to enhance their scientific, technological, and innovation capacities. The acknowledgment is made that local and national initiatives promoting zero waste can significantly contribute to the realization of sustainable consumption and production objectives.(UN General Assembly, 2023)

The literature under review underscores the significance of the Comprehensive and Extended Partnership Agreement signed in 2021 between the Republic of Armenia and the European Union. Particularly highlighted in Article 46, this agreement emphasizes the cooperative efforts of the involved parties toward preserving, protecting, improving, and rehabilitating environmental quality. The objective extends to safeguarding human health, promoting the sustainable utilization of natural resources, and advocating for international measures to address regional or global environmental challenges, with specific attention to the domain of waste management. This legal framework provides a foundation for understanding the shared commitment to environmental sustainability between the Republic of Armenia and the European Union. ('Comprehensive and Extended Partnership Agreement between Republic of Armenia and EU', 2021)

Considering that food waste management issues are insufficiently addressed within the Armenian political and socio-economic discourse, this study aims to address the following research questions:

RQ 1: Which types of food are most frequently wasted by consumers in Yerevan, and what is the associated monetary loss for each category?

RQ 2: Is there a correlation between consumers' educational levels, income, and the amount of food waste they generate?

Materials and Methods:

The primary focus of this study is food waste in Yerevan. The conceptual framework involves examining both the quantity and monetary aspects of food waste, along with investigating the underlying causes and the public's awareness of this issue. To gather responses, an online questionnaire was utilized, which underwent a pilot test conducted by Armenian and German professors. Additionally, a preliminary version was shared with 10 informed families, who were tasked with calculating and reporting their food waste over a week. The feedback and corrections obtained from the pilot version guided the refinement of the final questionnaire, which was then administered to the residents of Yerevan. A total of 385 participants underwent the survey. The questionnaire comprises both quantitative and qualitative inquiries. Quantitative questions seek demographic information reflected in the surveys and details related to waste. Qualitative questions aim to explore the reasons behind food waste, its categorization, public awareness, and the extent of government initiatives to enhance awareness and promote investment in the circular economy. Subsequently, a more comprehensive breakdown of the questionnaire's structure and its scoring system is provided in the following subsection. The ensuing step involves a descriptive analysis of the collected data.

After the data collection, the quantitative analysis was carried out using a precise formula developed to convert the collected information into monetary units. The formula considered the reported quantities of food wasted as well as other relevant factors such as the average price of food and the frequency.

The formula for calculating the annual monetary food waste per capita could look like this, for example:

$$W = \frac{W_1 + W_2 + W_3 + W_4 + W_5}{5}$$

Where W is the average annual per capita expenditure for the respective product in money AMD/per person, per year. The following formula was used to determine, $W_{1,}W_2...W_n$.

$$W_n = \frac{(G_1 t_1 q_1 D) + (G_2 t_2 q_2 D) + (G_3 t_3 q_3 D) + (G_4 t_4 q_4 D) + (G_5 t_5 q_5 D)}{q_1 + q_2 + q_3 + q_4 + q_5}$$

Table 1

The representation of Variable 't' in the study.

Variable	Days	Frequency
t_1	365	daily
t_2	168	several times a week
t_3	52	once a week
t_4	24	twice a month
t_5	12	once a month

Source: Developed by author

The frequency of the "several times a week" option was determined by computing the average number of days in a week, resulting in 3.5 multiplied by 4 weeks and 12

months, equaling 168. Here, 3.5 represents the average days in a week, 4 stands for the weeks in a month, and 12 denotes the months in a year. The variable 'D' signifies the average market price of the relevant food product during July-August 2023, while $q_1, q_2, \dots\ q_n$ denote the count of respondents choosing the specified option.

In the data processing phase, algebraic operations were employed to compute statistical indicators, including the arithmetic mean, maximum, and minimum values. Utilizing Excel, corresponding diagrams and tables were generated to present the statistical findings.

Table 2

The representation of variable 'G'

Variable	Grams	Amount of waste caused
G_1	25 grams	less than 50 grams
G_2	75 grams	50-100 grams
G_3	150 grams	100-200 grams
G_4	250 grams	200-300 grams
G_5	300 grams	300 grams and more

Source: Developed by author

The gathered data served as input in the formula employed to compute the annual per capita monetary food waste. This calculation facilitated an accurate quantification of the economic ramifications of food waste on an individual basis. The outcomes of this quantitative analysis yielded explicit and measurable insights into the monetary losses incurred per capita due to food waste. The questionnaire methodology facilitated the acquisition of comprehensive data from a substantial participant pool, subsequently transformed into a quantifiable format. These calculated values stand as evidence-based metrics that can inform decision-making processes and initiatives targeted at diminishing food waste and enhancing resource utilization.

In this study, regression analysis was employed to unravel the intricate relationship between monthly income and the scale of food waste, as well as between the level of education and the extent of food waste. The analytical process was executed through a designated Excel function, with "x" serving as the independent variable and "y" as the dependent variable. Within this methodological framework, the objective was to discern potential relationships and patterns linking these socio-economic factors to the inclination for food wastage. Through this approach, the study aimed to enhance comprehension of the multifaceted underlying behaviors associated with food waste.

Results and discussion:

Demographic data.

In this study, 385 participants were involved, with 73.2% identifying as male, 26.3% as female, and 0.5% selecting the "diverse" category. The gender distribution highlights the composition of the sample and contextualizes the collected data. The age distribution reveals a notable asymmetry, potentially influenced by factors like online questionnaire selection and communication channels. The overrepresentation of the 19 to 29-year-old cohort, followed by the 30 to 45-year-old group, suggests a skewed demographic, with the over 61 age group being the smallest cluster.

The income distribution among our study participants reveals noteworthy insights. Notably, 9.6% reported having no formal income, including two individuals identifying as "diverse." A distinct segmentation is observed, with 6.2% having a monthly income up to 80,000 AMD (EUR 190.47), 34.5% falling within the 80,000 to 200,000 AMD

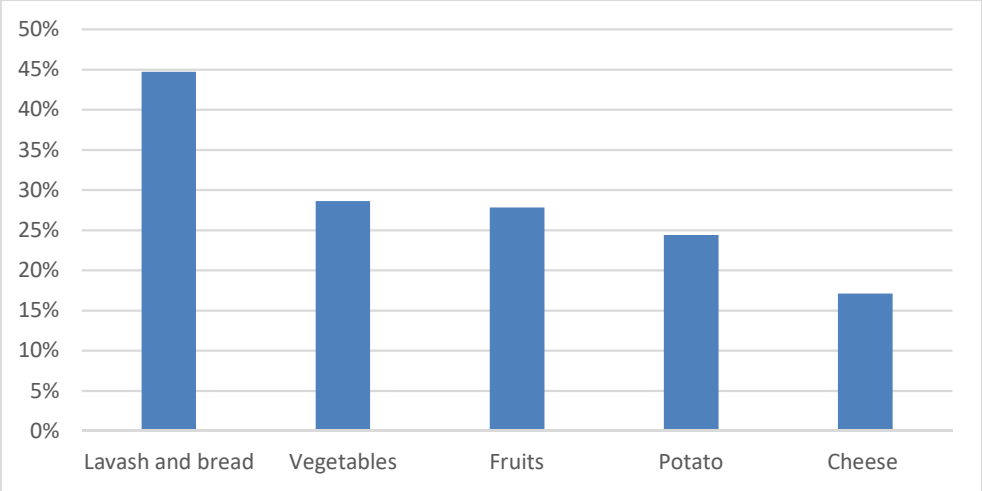
range (EUR 190.47 to EUR 476.1), and 35.3% earning between 200,000 to 500,000 AMD (EUR 476.1 to EUR 1190). Moreover, 14.3% reported incomes exceeding 500,000 AMD, equivalent to over 1190 EUR per month. These diverse income segments highlight the economic heterogeneity within our survey participants.

Quantitative analysis.

The survey unveiled the prevalent types of food wastage in Yerevan, with lavash and bread standing out as the most discarded items (44.7%). The figure 1 down below distinctly highlights the top five categories of frequently wasted foodstuffs, marked in yellow. The gathered data indicates that vegetables rank as the second most wasted food in Yerevan, constituting 28.6 % of the total, while fruit follows closely in third place with a reported percentage of 27.6% according to the participants. The noteworthy frequency of wastage for lavash and bread aligns with the significant role of cereals and baked goods in the Armenian diet, contributing substantially to the daily energy intake.(Stepanyan *et al.*, 2022)

Figure 1

Top 5 food items most discarded by consumers in Yerevan.



Source: Developed by author

A holistic understanding of the substantial food waste, particularly staple foods, necessitates an interdisciplinary approach that considers both ecological and nutritional perspectives. The wastage of fruits and vegetables reveals a complex phenomenon influenced by various dynamics. This behavior may be attributed, in part, to the prevalent summer season in Armenia, characterized by abundant and affordable fresh fruits in the markets. The data collection period coincided with a season boasting a diverse array of fruits like peaches, apricots, apples, cherries, contributing to the observed wastage. Notably, potatoes emerged as the fourth most wasted food in Yerevan, constituting 24.4% of the total waste in our study.

In August 2023, market statistics indicated an average price of 400 AMD for 1kg of fruits, 300 AMD for 1 kg of vegetables (without potatoes), 200 AMD for 1 kg of Potatoes, 600 AMD for 1kg of Lavash and bread (Prices and Prices Indexes in the Republic of Armenia, 2023). According to calculations, the average annual waste per person for the food category of Lavash and bread was found to be 13,793.82 AMD. Individuals who habitually waste Lavash and bread daily are losing approximately 42,966.85 AMD

annually, while those who waste these items once a month incur an average yearly loss of 630 AMD. Various studies suggest the reuse of bread waste and its valorization as a valuable resource through diverse technological processes aimed at enhancing efficiency across all stages. Numerous techniques for converting excess bread into ethanol, lactic acid, succinic acid, biohydrogen, hydroxy-methyl furfural, proteins, pigments, glucose–fructose syrup, aroma compounds, and enzymes have been extensively examined.(Ben Rejeb *et al.*, 2022) Among respondents from Yerevan, vegetables emerge as the second most wasted food category, with an average loss of 6,927.67 AMD per year, excluding potatoes, which incur an average yearly loss of 4,649.18 AMD. However, those who waste vegetables daily face a significantly higher waste of 20,257.50 AMD annually, while for potatoes, it amounts to 13,781.90 AMD. Conversely, individuals who exhibit heightened awareness of food waste and only waste vegetables once a month incur an average annual loss of less than 370 AMD, and for potatoes, it is 312 AMD. In relation to fruits, the average yearly waste was determined to be 16,750.20 AMD per person. Notably, individuals who waste fruits once a month incur a comparatively modest loss of 1,246 AMD annually. Conversely, those who habitually waste fruits daily face a significantly higher loss, amounting to 51,100 AMD annually.

Discussions

This study provides valuable insights into food waste behaviours in Yerevan, revealing significant trends in the types of food most frequently discarded and the economic consequences for consumers. The findings highlight that lavash and bread, two staple items in the Armenian diet, are the most frequently wasted foods, followed by vegetables and fruits. These results not only underscore the importance of cultural dietary habits but also indicate the potential for targeted interventions to reduce food waste at the consumer level.

The most striking result from this study is the high frequency of lavash and bread waste, which aligns with the findings of Stepanyan et al. (2022), who noted the significant role of cereals and baked goods in the Armenian diet. Bread and lavash are commonly consumed, making them a staple in daily meals. However, their frequent disposal suggests inefficiencies in consumption patterns. A possible explanation for this could be the overproduction or bulk buying of these items, leading to their early spoilage. Additionally, bread, due to its perishability, might not be consumed before it reaches a stage where it is discarded, especially in households with smaller populations or those with insufficient storage facilities. These patterns reflect broader issues related to food handling and storage, which may warrant educational campaigns or more efficient food distribution systems.

The second most frequently wasted food category, vegetables, is particularly noteworthy. Given the seasonal nature of many vegetables in Armenia, it is reasonable to assume that the abundance of fresh produce during the summer months contributes to overpurchasing, leading to higher wastage. The results from this study suggest that a mismatch exists between consumers' purchasing habits and their ability to consume the produce before it spoils, which is consistent with trends observed globally in seasonal food wastage. The findings of this study are consistent with those of several other studies on food waste patterns globally, yet they also highlight unique contextual factors in Armenia. For example, the overrepresentation of bread waste is echoed in other regions where baked goods are culturally significant, yet it also stands as an area with potential for reuse strategies. Their work on valorising bread waste into valuable products such as biofuels or enzymes could be

highly applicable in Armenia, where bread waste represents a considerable portion of the total food wastage. Additionally, the higher-than-expected wastage of vegetables and fruits in Yerevan suggests that the factors influencing food waste in this region may not be entirely linked to economic constraints, but also to consumer attitudes toward freshness and the perceived abundance of these items. This aligns with research from the European Food Information Council (EUFIC), which has found that attitudes toward food quality often dictate consumer waste behaviour. However, unlike some developed economies, Armenia may not have the infrastructure or cultural practices in place to reduce food waste, which could contribute to these high levels of waste. The implications of these findings suggest that reducing food waste in Yerevan could benefit from a multifaceted approach. First, raising public awareness about the economic costs of food waste, particularly in relation to bread, lavash, and vegetables, could help alter consumer behaviour. Public campaigns could encourage consumers to purchase only the amount of bread and vegetables they are likely to consume, thus reducing unnecessary waste. Furthermore, the introduction of food waste management policies that focus on the redistribution of excess food, particularly bread and vegetables, could significantly mitigate the economic and environmental costs. Existing initiatives such as food-sharing platforms (e.g., Too Good To Go) could be adapted to the Armenian market, providing a practical solution for redistributing unsold bread and vegetables at lower prices. Policymakers could also incentivize the establishment of partnerships between food producers, restaurants, and food banks to redirect excess food to those in need. While this study provides valuable insights, it is important to acknowledge its limitations. The sample predominantly consists of younger individuals, who may not fully represent the waste behaviour of older generations, who could have different purchasing and consumption patterns. Future studies should aim to include a broader age demographic to ensure more representative results. Additionally, the reliance on self-reported data could introduce bias, as participants may underreport or misreport their food waste behaviours. A more robust research design might include observational studies or diaries to track food waste over a longer period. Figure 2 shows that the average awareness level among the respondents was below 5 points out of 10, indicating the need for public awareness initiatives to address this issue and improve the situation.

Figure 2

Self-Evaluation Ratings of Respondents' Awareness of Food Waste as a Global Concern

Source: Developed by author

Policy makers, NGOs and activists have much work to do in this manner, and researchers need to find ways how this tendency can be changed, leading us towards sustainable consumption and social awareness. This research shows that further research in different policies of the EU and Armenia needs to be done; also, the tendencies of consumers in the regions of Armenia, and other representatives of the Food supply chain should be investigated.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 49-56
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ANALYSIS OF THE ORGANIZATION'S ACTIVITY ON THE EXAMPLE OF THE BOSTON CONSULTING GROUP MATRIX. THEORETICAL-EXPERIMENTAL APPROACH

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Abstract: More than four decades after Bruce Henderson introduced Boston Consulting Group (BCG) growth-share matrix, the concept retains its significance. Companies continue to need a disciplined approach to oversee their product portfolio, R&D investments, and business units. This article examines the relevance and application of the BCG growth-share matrix in contemporary strategic decision-making, aiming to provide a systematic approach to portfolio management. The BCG Matrix continues to be instrumental for organizations in categorizing business units based on market share and growth rate, thereby aiding strategic resource allocation. This study explores both theoretical and practical dimensions, focusing on the matrix's four quadrants—Stars, Cash Cows, Question Marks, and Dogs—and their implications for business strategy. An example analysis is conducted based on a hypothetical company producing five product lines. Sales data from 2022 and 2023 are used to calculate relative market share and market growth rate, positioning each product within the BCG Matrix. Results indicate that the company's TV and Laptop products are Stars, requiring continued investment due to high growth and strong market presence. Conversely, its Mobile product, a Cash Cow, generates significant revenue with low market growth, while PCs and Headphones are categorized as Dogs, where strategic divestment may be considered. This study underscores the BCG Matrix's value in guiding strategic decisions, enabling organizations to prioritize investments and optimize resource allocation across varying product life stages.

Keywords: *BCG matrix, market growth rate, relative market share, dogs, question marks, stars, cash cows*

Introduction. Over 40 years since Bruce Henderson introduced Boston Consulting Group (BCG) growth-share matrix, the concept remains vibrant. Companies still require a disciplined and systematic approach to managing their product portfolio, R&D investments, and business units. Harvard Business Review recently recognized it as one of the transformative frameworks. The matrix holds a central position in business school

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Received: 18.07.2024
Revised: 06.11.2024
Accepted: 27.12.2024

strategy teachings. However, the global landscape has undergone significant changes, impacting the original purpose of the matrix. Since its introduction in 1970, conglomerates have diminished, the pace of change has accelerated, and competitive advantages have become less enduring. Despite these shifts, the BCG growth-share matrix remains relevant, albeit with crucial enhancements.

Results and findings. Presently, the matrix can be customized to assist companies in navigating strategic experimentation essential for success in unpredictable markets. This adaptation encompasses four pivotal steps: hastening the innovation pace, maintaining a balance in investments between new, untested ventures and established, revenue-generating businesses, executing disciplined choices for investments and divestments, and meticulously measuring and monitoring the outcomes of experimentation (Martin Reeves, Sandy Moose, and Thijs Venema, 2014, 6-7).

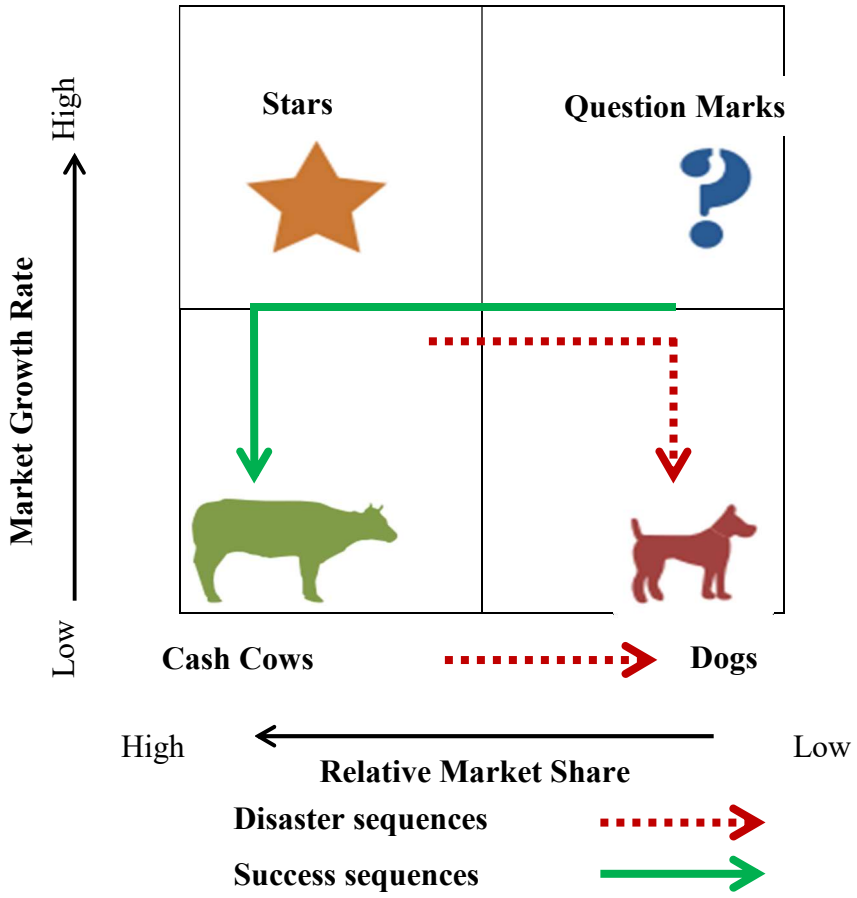
This methodology proves particularly beneficial for companies with multiple categories or goods, forming the organization's "business portfolio". The structure of this selection holds essential importance for the company's growth and development. The BCG matrix incorporates two key indicators: "Market Growth Rate" and "Relative Market Share". The market growth rate is depicted on the vertical (y) axis as a percentage. The range, somewhat arbitrarily set, spans from 0 to 20%, with a distribution between low and high growth at 10% (Boston Consulting Group (BCG). 1973. 5-7). Inflation or Gross National Product can influence this range, allowing the vertical axis to show an index where the boundary between low and high growth is set at 1.0. Industries growing faster than inflation or GNP would be above the line, while those growing less would be categorized as low growth below the line. The horizontal (x) axis illustrates the relative market share, calculated concerning the largest competitor in the market. The scale for high and low shares, again randomly, originally used a scale of 0.1, designating market dominance when the relative market share exceeded 1.0. The BCG matrix splits into four sections, each representing a specific category of business. Categories or products are denoted by circles, with the circle size indicating the relative significance of the division or product to group sales. An advancement of the matrix incorporates reflecting the comparative revenue input of each product category, depicted as a pie segment within the circle.

Once a firm's business units are positioned on the BCG matrix, strategies are formulated based on their relative positions. The matrix's four quadrants, established by categorizing the two variables into "high" and "low" areas, facilitate the grouping of units into four distinct categories: "stars", "question marks", "cash cows", and "dogs" (refer to Image 1). The rationale behind this categorization lies in the relationship between market growth rate and the firm's market share.

The concept is rooted in the understanding that as the market growth rate increases, the firm requires more cash to remain competitive and foster growth. Simultaneously, a higher market share allows the firm to generate more cash. The income accumulated by divisions exhibiting high "cash generation" potential can then be strategically deployed to invest in divisions with high "cash consumption" requirements. This strategic allocation of resources helps balance the financial needs of different business units within the organization (Temmerman, R., 2011, 48-61.).

Image 1

BCG matrix.



Source: Developed by author.

The subsequent sections delve into a more detailed examination of each category, namely dogs, question marks, stars, and cash cows (Boston Consulting Group matrix, AccaGlobal webpage).

"**Dogs**" represent divisions that are struggling. They typically possess low market share in markets with minimal growth. Usually, dogs neither demand substantial investment from the holding company nor produce significant income themselves-still there are instances where they may require corporate funding to sustain their operations. At best, dogs contribute little value; at the lowest point, they consume cash and demand considerable management time and attention. Typical strategies for addressing dogs involve efforts to reverse them, transition them towards the "question mark" category, divestiture, or shutting them down. However, there might be strategic reasons for retaining a dog within the business portfolio. For example, in the eyewear industry, there may be a niche market for sports protection. Even if immediate positive progress is not evident, the firm might find it prudent to continue offering products in this category, albeit without focusing extensively on it. Strategic considerations, such as maintaining a

foothold in a niche market or complementing the overall product portfolio, could justify keeping a dog within the business.

"**Question marks**" denote divisions with low market share in markets that are experiencing growth. Due to the expanding market, question marks typically require cash to sustain their competitiveness. Instead of being net cash generators, these divisions tend to consume the corporation's cash. The term "question mark" reflects the strategic ambiguity surrounding these divisions. In such cases, the strategic approach is unclear, prompting the designation as a question mark.

If a planner envisions potential for growing the division's market share and transitioning it into the "star" category, strategies can involve product improvment, market penetration, expansion, and other growth-oriented approaches. However, if the strateger does not perceive the potential for improvement within the division or if the company lacks the necessary funds to invest in the unit, divestiture becomes a viable alternative. The decision-making process for question marks often involves weighing the potential for growth against the available resources and strategic goals of the overall business portfolio.

"**Stars**" represent divisions with high market share in rapidly growing markets. These divisions are sources of excitement and generate substantial cash owing to their dominant market positions. However, they also necessitate substantial funds to sustain their ongoing growth in the swiftly growing market and resist competitors seeking to challenge their market share. While the income generated by stars often evens out, similar to dogs, they continue to hold substantial growth potential.

Strategic approaches for stars involve perpetuating their growth and expanding market share through initiatives such as market entrance, market expansion, product enhancement, synergy strategies, and even joint ventures. Defensive maneuvers to safeguard their high market share are also counted.

If a star preserves its dominant market share as the market life cycle progresses, it transitions into the "cash cow" category. At this stage, market players often exit the market, and the star demands less investment to sustain robust financial results. Though, if a star crashes to uphold its market share, it may degrade into a "dog" necessitating a reassessment of strategies and resource allocation. The fate of a star is intricately tied to its ability to adapt and sustain its market dominance in a rapidly evolving business environment.

"**Cash cows**" are divisions with a commanding market share in markets that are not experiencing significant growth. Market dominance in such situations often correlates with pricing power, leading to substantial profit margins. Additionally, cash cows demand just limited financial investment because of the lower growth in their market, resulting in the generation of substantially greater cash than their expenditures. Strategies for cash cows typically revolve around maintaining support for the division without the need for substantial cash injections.

The surplus cash generated by cash cows can be strategically utilized to invest again in revitalizing struggling divisions ("dogs") or transitioning potential divisions ("question marks") into lucrative growth categories such as "stars". The inherent financial strength of cash cows allows for a balanced allocation of resources within the business portfolio, contributing to overall stability and sustained profitability. The key focus for cash cows is on leveraging their established market position and profitability

to facilitate strategic investments in other parts of the business.

In the BCG matrix, divisions are represented by circles, and the size of each circle typically signifies the comparative importance of each business unit to the organization regarding the cash produced. An alternative approach is to have circles of the same size, with pie slices within each circle. These pie slices would be shaded to depict the relationship between the cash generated by that division (the slice) and the overall cash contribution.

The BCG matrix provides a rapid visual representation of a company's portfolio concerning market share, market growth, the size of cash contribution, and relative strength or weakness of each business unit. It serves as a valuable tool for quickly assessing the strategic positioning of different divisions within the organization.

Moreover, the BCG matrix can be employed to illustrate the position of a target company relative to its competitors. This is achieved by placing the target company on the matrix and appropriately situating its competitors. By doing so, the matrix aids in comparative analysis and strategic planning. As the first analysis tool to go beyond simple examination, the BCG matrix introduces strategic implications, making it a pivotal instrument for businesses to evaluate and plan their portfolio strategies.

The practical use of BCG matrix can be shown in the example represented below. In the market there are 4 companies (we are going to get BCG matrix of the "A" company) producing 5 products.

Table 1

Sales by products 2022-2023

Products		**Sales in 2023 (mln USD)**				**Total Sales in 2022 (mln USD)**
		A	**B**	**C**	**D**	
1	Mobiles	500	250	750	650	2000
2	TV	750	500	400	300	1500
3	Lap-Top	800	400	500	450	1800
4	PC	150	600	500	400	1650
5	Headphones	400	800	600	500	2500

***Source*:** Developed by author.

Based on the data it is possible to estimate "Market Share" and "Market Growth Rate".

Considering the sales of each company, we can calculate the total sales in 2023, and based on it get market share of company "A" (Table 2).

Table 2

Calculation of Market share of "A" company.

Products		**Sales in 2023 (mln USD)**				**Total Sales in 2023 (mln USD)**	**Market share % (A)**	
		A	**B**	**C**	**D**			
1	Mobiles	500	250	750	650	2150	(500/2150)*100%	23
2	TV	750	500	400	300	1950	(750/1950)*100%	38
3	Lap-Top	800	400	500	450	2150	(800/2150)*100%	37
4	PC	150	600	500	400	1650	(150/1650)*100%	9
5	Headphones	400	800	600	500	2300	(400/2300)*100%	17

***Source*:** Developed by author.

Accordingly, considering the statistics of years 2022 and 2023 it is possible to have Market growth rates (Table 3).

Table 3

Market growth rates.

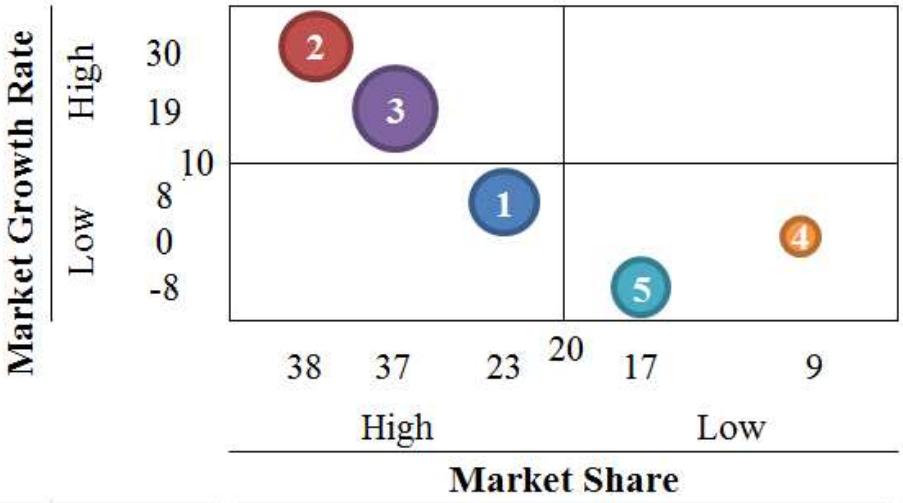
Products		Total Sales in 2023 (mln USD)	Total Sales in 2022 (mln USD)	Market growth rates %	
1	Mobiles	2150	2000	((2150-2000)/2000)100%	8
2	TV	1950	1500	((1950-1500)/1500)100%	30
3	Lap-Top	2150	1800	((2150-1800)/1800)100%	19
4	PC	1650	1650	((1650-1650)/1650)100%	0
5	Headphones	2300	2500	((2300-2500)/2500)100%	-8

Source: Developed by author.

Accordingly, coming from the data of Tables 2 and 3, BCG matrix of "A" company can be shown below (Image 2).

Image 2

BCG matrix of "A" company.



Source: Developed by author.

The BCG Matrix and the Product Lifecycle are inherently connected because both frameworks provide insights into how a product or business unit evolves over time and requires different strategic approaches at each stage. The matrix provides a snapshot of where a product or business unit stands in terms of market growth and relative market share, while the product lifecycle describes the stages a product goes through from its introduction to its decline. By integrating these two models, companies can gain a dynamic understanding of how to make strategic decisions at each phase of a product's life (Parcell, J., 2019, 3-5.).

Growth Stage (PLC) → Stars (BCG Matrix). As the product moves into the growth stage of its lifecycle, it gains market share in a growing market, which places it in the **Stars** quadrant of the BCG Matrix. Referring to the case, we have 2 stars (product 2:TV and product 3: Lap-top). The company must actively invest in these 2 projects to keep the positions as they insure the highest sales of the company too (accordingly 750 and 800 mln USD). **Strategic Insight**: Products in the Stars category require significant

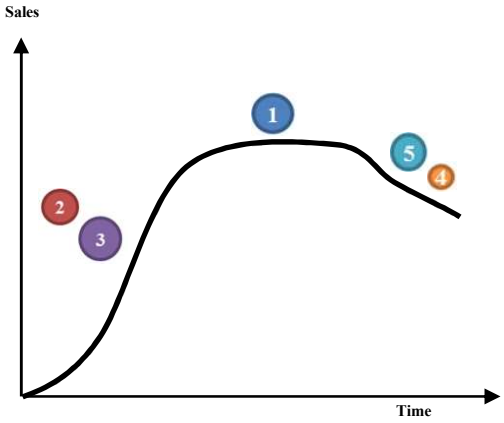
investment to maintain growth and market leadership. Companies should focus on expanding market penetration, product development, and increasing distribution channels (Image 3).

Maturity Stage (PLC) → Cash Cows (BCG Matrix). In the maturity stage, the product has achieved a high market share, but the market growth has slowed, positioning it in the **Cash Cows** quadrant. As for the cash cow, we have just one product (product 1:Mobiles). This product requires only limited investment in order not to lose the position (it is the 3rd portfolio with the highest sales of 500 mln USD). **Strategic Insight**: Cash Cows generate substantial cash flow with minimal investment. Companies should use this cash to fund new investments in Question Marks or Stars. The key strategy here is to maintain market leadership while optimizing operational efficiency (Image 3).

Decline Stage (PLC) → Dogs (BCG Matrix). As the market declines, the product loses its market share and becomes a **Dog** in the BCG Matrix. Product 4:PC and Product 5:Headphones are dogs for the company, possess low market share in markets with minimal or negative growth. At worst, they consume cash and demand considerable management time and attention. Typical strategies for addressing dogs involve quitting the market. **Strategic Insight**: Companies need to decide whether to divest, discontinue, or attempt a niche strategy to sustain the product for a smaller market. At this stage, the product offers limited growth potential and may consume more resources than it generates (Image 3).

Image 3

Products lifecycle of "A" company.



***Source*:** Developed by author.

Conclusion. The BCG matrix helps categorize units, with the higher market growth rate requiring more cash for competitiveness, and higher market share generating more cash. The matrix aids in grouping units strategically into four categories, each with specific characteristics. The BCG matrix provides a rapid overview of the company's portfolio, considering market share, expansion, financial contribution, and competitive strength. It can also be applied to analyze a target company and its competitors. Ultimately, the BCG matrix is a valuable tool suggesting strategies beyond simple analysis. The BCG Matrix helps a company visualize which products are in different stages of their lifecycle and decide how to allocate resources. Understanding both frameworks

allows for more strategic planning:

- **Invest in Stars** to maintain growth.
- **Harvest Cash Cows** to support other areas.
- **Nurture or divest Question Marks** based on potential.
- **Divest or reposition Dogs** to avoid wasted resources.

By integrating the BCG Matrix with the Product Lifecycle concept, businesses can better manage their portfolio of products and services, ensuring they invest wisely at each stage of a product's life while maintaining overall strategic balance.

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Journal of Yerevan University. Economy
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NOISY TRADER BEHAVIOR IN ADAPTIVE MARKETS: DECISION-MAKING BIASES AND MODELING APPROACHES

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Abstract: This paper examines the debate between the Efficient Market Hypothesis (EMH) and the Adaptive Market Hypothesis (AMH), focusing on trader behavior, market dynamics, and decision-making biases. The EMH asserts that markets reflect all available information, making consistent outperformance impossible. However, persistent market anomalies such as mean reversion, price momentum, and excess volatility challenge this view, prompting the development of the AMH.

The AMH frames market efficiency as dynamic, evolving with environmental changes and participant adaptation. Drawing from evolutionary psychology, it explains how diverse market participants - from institutional investors to noise traders - shape outcomes through competition and adaptation. Traders' decisions under uncertainty are influenced by biases like overconfidence, herding, and loss aversion.

Noise traders, acting on perceived but irrelevant information, contribute to inefficiencies while enabling liquidity and trading opportunities for informed investors. Their persistence highlights "limits to arbitrage," where rational traders cannot fully correct price distortions due to market frictions. Portfolio biases such as home bias, familiarity bias, and risk aversion further affect investment decisions. Rational inattention theory explains how cognitive limitations force selective information processing, leading to suboptimal behavior.

To model these processes, we propose advanced machine learning techniques like Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) with Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU). These models capture temporal patterns and evolving biases.

In conclusion, this research bridges EMH and AMH by linking trader behavior, cognitive biases, and market adaptability, offering a novel framework for understanding market dynamics and pricing inefficiencies.

Keywords: *adaptive markets, noisy traders, decision-making biases, neural networks, bias-driven behavior*

Efficient market hypothesis (EMH) versus Adaptive market hypothesis (AMH)

Critics of the Efficient Market Hypothesis (EMH) find strong support in the presence of serial dependencies in stock market data and the success of straightforward investment strategies. If asset prices truly followed a martingale process, such patterns and profitable

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Received: 28.11.2024
Revised: 10.12.2024
Accepted: 27.12.2024

investment rules would not exist. However, their persistence in the data, even long after being publicly recognized, indicates a flaw in the EMH framework. What value does even the weakest form of the EMH hold if strategies like mean reversion and price momentum consistently outperform the market? While it's possible that an unidentified risk explains these returns, such a significant risk should be apparent given the returns observed, yet no such risk has been clearly identified so far. *(Burton, E., & Shah, S., 2013).*

The Efficient Markets Hypothesis (EMH) is one of the most influential concepts in intellectual history, sparking ongoing debates between its supporters and advocates of behavioral economics and finance. At its core, the EMH implies that active portfolio management is unnecessary. Given the success of this journal over three decades, it seems appropriate to revisit this foundational theory. In an informationally efficient market, price changes should be unpredictable if they accurately reflect all relevant information and expectations of market participants. Roberts and Fama formalized this concept with Fama's famous phrase, "prices fully reflect all available information," by defining different levels of information accessible to investors. Today, the EMH framework is often summarized by the "three P's of Total Investment Management": prices, probabilities, and preferences. These principles are rooted in the fundamental economic concept of supply and demand. (Fama, E.F., 1970). Psychologists and experimental economists have identified several behavioral biases that deviate from the Efficient Markets Hypothesis (EMH), highlighting common irrationalities in human decision-making under uncertainty. These biases, such as overconfidence, overreaction, loss aversion, herding, mental accounting, probability miscalibration, hyperbolic discounting, and regret, can negatively impact an individual's economic well-being. Critics of the EMH argue that investors frequently, if not consistently, behave irrationally in predictable and financially harmful ways. Grossman and Stiglitz take this criticism further by asserting that perfectly efficient markets cannot exist. If markets were fully efficient, there would be no incentive to gather information, as no profits could be made, ultimately reducing trading activity and causing market failure. (Grossman, S. J., & Stiglitz, J. E., 1980). The extent of market inefficiency influences how much effort investors are willing to put into gathering and trading on information. A stable market equilibrium can only exist if enough profit opportunities, or inefficiencies, exist to justify the costs of trading and information acquisition. The profits earned by these informed investors can be seen as "economic rents" gained by those who actively pursue such opportunities. But who provides these rents? Black offered an intriguing explanation: "noise traders" - individuals who trade based on what they mistakenly believe to be valuable information, but which is actually just random noise. (Black, F. (1986).

The sociological context surrounding the Efficient Markets Hypothesis (EMH) debate suggests that a shift from the traditional deductive framework of neoclassical economics may be needed. One promising direction, proposed by Farmer and Lo, involves applying evolutionary principles to financial markets. This approach draws on the emerging field of evolutionary psychology, influenced by Wilson's work on applying competition, reproduction, and natural selection to social behavior. It provides compelling explanations for various human behaviors, including altruism, fairness, kin selection, and moral reasoning.

By integrating these principles, the EMH can be reconciled with behavioral finance,

forming a new framework: the Adaptive Markets Hypothesis (AMH). The AMH reinterprets market efficiency through an evolutionary lens, where prices reflect available information based on environmental conditions and the diversity and behavior of market participants, referred to as "species" in an economic ecosystem. Each species represents a distinct group of investors with similar behavior, such as pension funds, retail investors, market makers, or hedge fund managers.

When multiple species, or a dominant species, compete for limited resources within a market, that market becomes highly efficient. Thus, market efficiency is not static but context-dependent and dynamic, evolving like ecological systems, where populations rise and fall in response to environmental changes, competition, and adaptation. (Lo, A.W. 2004).

According to AMH, markets can be efficient at times, but this efficiency is not permanent. It depends on the behavior and adaptability of market participants, who are constantly learning and adjusting to new information and changing conditions. Unlike the EMH, which assumes markets always reflect all available information, AMH suggests that markets evolve and can become more or less efficient depending on external conditions. Behavioral biases, like overconfidence or loss aversion, may influence prices, but these effects may diminish as participants adjust. The success of investment strategies depends on the current market context. A strategy that works well in one environment (bull market, high liquidity, low volatility) may fail in another (bear market, economic crisis). As market conditions shift, investors must continually adapt their strategies to survive, leading to an ever-changing landscape of market dynamics. This adaptability contrasts with the static assumptions of the EMH, where a single strategy can work consistently. The AMH suggests that there are periods of relative stability when market conditions allow for more efficient functioning, but also periods of instability where markets are more inefficient due to shocks, crises, or other external factors. During times of instability, market inefficiencies become more pronounced, but as participants learn and adapt, markets gradually regain efficiency. Just as species evolve through natural selection, market participants evolve through a process of financial selection. Those who can adapt to changing market environments survive and succeed, while others are driven out of the market. This evolutionary process means that market participants' behaviors, investment styles, and strategies are constantly evolving, leading to shifts in market efficiency over time. AMH bridges the gap between two previously conflicting theories: the Efficient Market Hypothesis and Behavioral Finance.

- **No single strategy works all the time**: Investors must continuously adapt their strategies to align with the current market environment.
- **Behavioral finance is important**: Investors should be aware of their own biases and the biases of others, as they can create opportunities in inefficient markets.
- **Risk management** is essential: Since markets evolve and may become inefficient, strategies need to be flexible, and investors must manage risk, especially in periods of instability.
- **Opportunities arise from inefficiencies**: While the EMH suggests it's hard to consistently outperform the market, AMH implies that adaptive investors can find opportunities during periods of inefficiency Lo, A. W., (2005).

We can summarize all above mentioned approaches in Table 1.

Table 1

The aspects of the Efficient Market and Adaptive Market Hypothesis'.

Aspect	Efficient Market Hypothesis (EMH)	Adaptive Market Hypothesis (AMH)
Core Concept	Markets are always efficient, reflecting all available information instantly.	Markets evolve and adapt due to changing environments and agent behaviors.
Market Behavior	Prices follow a random walk and cannot be predicted.	Prices change based on market participants' adaptation and learning.
Information Processing	All relevant information is immediately reflected in prices.	Market efficiency varies; information processing depends on experience, learning, and adaptation.
Assumptions About Agents	Investors are rational and maximize utility.	Investors are boundedly rational with behavioral biases that adapt over time.
Market Conditions	Constant market efficiency regardless of external changes.	Efficiency depends on environmental conditions like competition, regulation, and market shocks.
Trading Strategies	Active trading cannot consistently outperform the market.	Adaptive strategies can be profitable depending on evolving market conditions.
Market Anomalies	Anomalies like bubbles and crashes should not exist.	Anomalies are expected due to changing behaviors and learning processes.
Mathematical Framework	Based on models like the Capital Asset Pricing Model (CAPM) and Random Walk Theory.	Incorporates elements from evolutionary economics, behavioral finance, and complexity theory.
Practical Implications	Passive index investing is recommended due to efficiency.	Adaptive strategies, active management, and market-timing can be effective.
Long-Term View	Markets remain efficient in the long run.	Markets continuously evolve; efficiency is context-dependent.
Criticism	Overly idealistic, ignoring real-world complexities.	Hard to quantify and apply consistently due to adaptive nature and complex feedback loops.

Source: Developed by authors.

For us the main interesting aspect of this hypothesis is how traders (noisy and informed) perceive information, evaluate the informativeness of the information, and make biased or non-biased decisions.

Noise and Noisy Traders

Noise plays a dual role in financial markets: it enables trading but also introduces imperfections. Without noise trading, trading in individual assets would be minimal. Jaffe and Winkler propose a model where speculative markets are stabilized by traders who adjust their risk exposure, overestimate their forecasting skills, or trade for reasons unrelated to maximizing expected returns for a given level of risk. Similarly, Figlewski's model identifies two types of traders with different forecasting abilities. Since neither type fully considers the other's information, both end up trading based partly on noise.

Noise trading occurs when traders act on perceived information that is actually irrelevant. These traders engage in the market despite being objectively better off staying out, possibly because they mistakenly believe the noise they act on is valuable information — or simply because they enjoy trading. This activity fills a crucial gap in the

market, sustaining liquidity and enabling price discovery, even if it leads to market inefficiencies. (Jaffe, J. F., & Winkler, R. L. 1976).

One reason traders engage in noise trading is simply that they enjoy it. Another reason is the abundance of noise in the market, making it difficult to distinguish real information from irrelevant signals. Many traders believe they are acting on valid information when, in fact, they are responding to noise.

Kahneman and Tversky provide a more advanced explanation through their behavioral decision-making model, which explores why people often make seemingly irrational choices. Their framework could help explain the motivations behind noise traders' behavior. For applications of their theory in economics and finance, see works by Russell and Thaler. Meanwhile, stock prices and returns are directly observable. Historical return volatility can be measured, and using daily return data, the current volatility of a stock's returns can be estimated with reasonable accuracy. Similarly, the correlations among returns on different stocks can be closely monitored and analyzed. Russell, T., & Thaler, R. (1985).

Noise or uncertainty has its effects in economic markets because there are costs in shifting physical and human resources within and between sectors. If skills and capital can be shifted without cost after tastes and technology become known, mismatches between what we can do and what we want to do will not occur. (Black, F.1986)

Rational Expectations Equilibrium (REE) models assume that traders act rationally, maximizing expected utility based on beliefs consistent with the model itself. While these models acknowledge the presence of "noise," it is typically considered a random error in the aggregate excess demand function rather than the result of incorrect beliefs. The precise origin of noise is not deeply explored within the REE framework, as traders are assumed not to act strategically, and learning from prices occurs within equilibrium rather than in real time. Trading activity is simplified, with agents submitting demand functions to a theoretical auctioneer.

For noise traders to persist, there must be barriers that prevent them from being eliminated by more informed traders, commonly referred to as "smart money." This concept relates to the "limits to arbitrage." One such barrier could be a limited trading horizon for smart money investors. With a restricted time frame, noise traders might push prices further from their fundamental values, causing losses for rational traders. This idea is explored in works by DeLong, Shleifer, Summers, Waldman, Dow, Gorton, and Shleifer and Vishny, who argue that such limits to arbitrage explain the continued existence of noise trading in financial markets. (Dow, J., & Gorton, G., 2006)

Noise traders mistakenly believe they possess unique information about future prices of risky assets. In response, sophisticated investors adopt strategies to profit from these misperceptions. They buy when noise traders drive prices below fundamental values and sell when prices are pushed too high. While these contrarian strategies help correct mispriced assets, they do not fully restore prices to their true values.

This partial correction gives rise to various financial market anomalies explained by noise trader risk. Examples include excessive volatility and mean reversion in stock prices, the breakdown of the expectations hypothesis in the term structure of interest rates, the Mehra-Prescott equity premium puzzle, the undervaluation of closed-end mutual funds, and other persistent market irregularities. (De Long, J. B., Shleifer, A., Summers, L. H., & Waldmann, R. J., 1990).

The question of market equilibrium in the presence of agents who do not update their expectations according to Bayes' rule has been explored by Russell and Thaler. They conclude that having some rational agents in the market does not ensure a rational expectations equilibrium if quasi-rational agents are also present. Jarrow extends this analysis by examining market equilibria with agents holding diverse expectations.

Supporting the overreaction hypothesis, empirical evidence shows that portfolios of previously underperforming stocks ("losers") tend to outperform portfolios of past high-performing stocks ("winners"). Thirty-six months after portfolio formation, the losing stocks generate returns approximately 25% higher than the winners, despite the winners being notably riskier. This suggests that market overreaction creates profit opportunities, challenging the assumption of fully rational markets. (De Bondt, W. F. M., & Thaler, R. 1985)

Casual observation suggests the content of financial news about the stock market could be linked to investor psychology and sociology. However, it is unclear whether the financial news media induces, amplifies or simply reflects investors' interpretations of stock market performance.

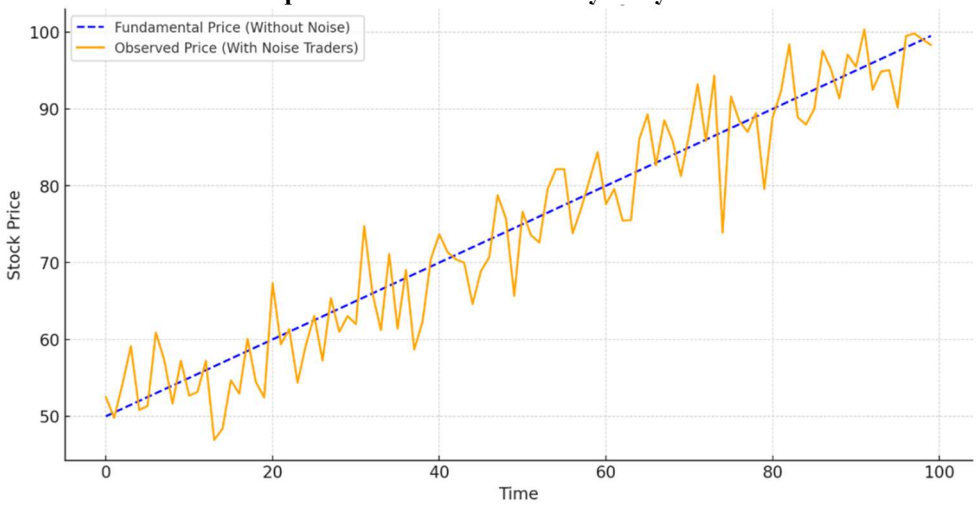
1. **Focus on Salient Information Over Fundamentals**: Noise traders often react more to salient information than to underlying fundamentals. For example, they may make investment decisions based on recent price trends, media hype, or market sentiment without considering the intrinsic value of the asset. This leads to volatility and irrational market movements, as noise traders buy or sell based on what seems most attention-grabbing at the moment.
2. **Overreaction and Mispricing**: Salient information can trigger overreactions in noise traders. For instance, during market bubbles, noise traders may overvalue stocks based on rapidly increasing prices, ignoring warnings of overvaluation. Similarly, during market downturns, they may panic and sell off assets due to overly salient negative news, even if the fundamental outlook hasn't changed.
3. **Herding Behavior**: Salient information can also fuel herding behavior, where noise traders follow the crowd rather than relying on independent analysis. For example, when media outlets repeatedly emphasize a market trend, such as a rapidly growing sector, noise traders may jump on the bandwagon, causing further price distortions. This behavior is common in asset bubbles and can be reinforced by the attention-grabbing nature of the information.
4. **Market Volatility and Inefficiencies**: Because noise traders react to salient but potentially irrelevant information, their actions can increase market volatility and lead to mispricing. Rational investors (or informed traders) may not always be able to correct these price distortions, as the actions of noise traders can dominate market movements, creating bubbles or crashes.

Measuring noise in financial information flow is critical to understanding the quality and reliability of data used in financial decision-making. Noise refers to random, irrelevant, or misleading information that can obscure the true signals within financial data. Here are some approaches that already exist to measure or quantify noise in financial information flow.

For modeling stock price fluctuations caused by noisy traders in Python we used the numpy and matplotlib pyplot libraries and we set a random seed for reproducibility, generated time points, generated a fundamental stock price trend (e.g., a steady upward trend) and added noisy trader effects (random fluctuations)(see pic. 1).

Graph 1

Stock price fluctuations caused by noisy traders.



Source: Developed by authors.

Biases in a trader's decision-making process

The last factor is the representation of biases in trader's decisions. We are considering only one group which is named Portfolio biases.

Portfolio biases refer to systematic deviations from optimal diversification in investors' portfolios. These biases can take many forms, such as:

- **Home bias:** The tendency for investors to hold a disproportionately large share of domestic assets.
- **Familiarity bias:** Preference for familiar assets, often from companies or sectors investors know well.
- **Risk aversion bias:** Overinvestment in safer, less volatile assets, even when riskier assets might provide higher returns.
- **Overconfidence Bias:** Overconfidence bias occurs when traders overestimate their knowledge, skills, or ability to predict market movements.
- **Herding Behavior:** Herding occurs when investors follow the actions of others rather than making independent decisions based on their own information or analysis.

Rational inattention can help explain why portfolio biases occur. Since investors have limited cognitive resources, they may rationally choose to focus only on certain types of information when making investment decisions. Here are a few ways they interrelate:

1. **Home Bias and Information Costs:** Investors might exhibit *home bias* because they find it easier or less costly to gather information about domestic markets than foreign ones. As a result, they are more "attentive" to local market conditions and allocate a larger share of their portfolio to domestic assets. From the perspective of rational inattention, focusing on local markets minimizes the cognitive and informational cost.
2. **Familiarity Bias and Simplified Decision-Making:** Investors might prefer familiar companies or sectors because these require less cognitive effort to evaluate. For example, someone who works in the tech sector may pay more attention to tech stocks because the cost of processing information about them is lower. Rational inattention explains this as an efficient way of managing limited information-processing capacity.

3. Risk Aversion and Information Avoidance: Risk-averse investors might avoid paying attention to complex or uncertain financial information (e.g., about emerging markets or speculative assets), leading to biases toward safer assets. This avoidance can be rational if the cost of processing uncertain information outweighs the perceived benefits of diversification.

4. Overconfidence Bias Overconfident noise traders often make excessive trades, underestimating the risks involved and overestimating their ability to time the market. They are more likely to act on "noisy" or irrelevant information, believing they can capitalize on it, leading to increased market volatility. Their actions are often driven by recent price movements or media hype rather than careful analysis of fundamentals. Overconfident noise traders can inflate bubbles or worsen crashes as they aggressively buy or sell assets, ignoring the underlying risks or overreacting to superficial signals.

5. Herding Behavior Noise traders are particularly prone to herding because they are often swayed by the actions of the majority or by salient information in the media. When many traders act in the same direction (e.g., buying during a bull market or selling during a crash), noise traders amplify these trends by jumping on the bandwagon. Herding can lead to bubbles or crashes, as large groups of traders move in the same direction, pushing prices far beyond their fundamental values.

According to the above-presented models and theories we propose an experimental model of trader's behavior under uncertainty in the system of portfolio biases and time perspective.

The collective impact of individual trader biases, combined with varying levels of market news informativity, can significantly affect broader market dynamics:

- **Market Overreaction or Underreaction:** Overreaction occurs when traders respond too aggressively to new information, causing asset prices to overshoot their true value. This is often driven by **overconfidence** and **herding**. Conversely, underreaction occurs when traders fail to adjust their portfolios sufficiently in response to news, which can happen due to **anchoring** or **confirmation bias**.
- **Increased Volatility:** When news is rapidly disseminated, traders with different biases interpret and act on it in varying ways. This asynchronous processing of news can increase market volatility, especially in the short term.
- **Inefficient Markets:** Behavioral biases and the misinterpretation of market news can lead to price distortions and inefficiencies, challenging the assumption of efficient markets (as posited by the Efficient Market Hypothesis). Prices might deviate from their intrinsic value for extended periods due to traders' psychological tendencies.

Bias Modeling

Bias modeling in decision-making process of noisy traders can significantly enhance the general understanding of the Adaptive Market Hypothesis (AMH). Advanced models can describe the historic impact of all the above-mentioned biases on market state while the predictive power of some models provides valuable feedback to market participants, not limited to noisy traders, i.e., funds utilizing hedging strategies.

In this research, the observed modeling approaches are the Statistical approach and Machine Learning (ML) approach. The statistical approach mainly employs simple regressive models often requiring careful selection of describing features of the objective – in this case the type of the bias. The ML approach often referred to as a "black box" model,

due to the complexity of the interpretation of the underlying mechanisms by the practitioners, is far more powerful (Arrieta et al., 2020). Machine Learning is a subfield of Artificial Intelligence (AI) which utilizes advanced algorithms and statistical techniques to capture relations and recognize complex patterns in data. The rapid growth of the adoption of ML models for various financial market-related tasks sets an incentive to further explore the approach for behavioral finance (Henrique, Sobreiro, & Kimura, 2019).

In their research, Silva, Tabak, and Ferreira (2019), compare the performance of both the Statistical and Machine Learning approaches for the prediction of stock returns depending on the sentiment of the investors. The research concludes a superior performance by Machine Learning approach. However, the research explores only the traditional decision tree-based Machine Learning techniques such as Random Forest, Adaboost, XGBoost, and LightGMB, the benchmark being Logistic regression. While the decision tree-based models are powerful and established tools for financial tasks, they still require some degree of feature engineering to yield the best results and avoid overfitting (Abdelouahed, Abla, Asmae, & Abdellah, 2024).

The research aims to reveal new insights from the decision-making processes of noisy traders considering their portfolio biases; hence further and more sophisticated Machine Learning approach is proposed. Deep Learning (DL) approach extends Machine Learning approach by adding more data processing layers - resulting in complex model architectures - each capable of capturing and learning features without the necessity of profound initial feature engineering.

Given the research object the main two model architectures worth exploring are Convolutional Neural Networks (CNN), notable in the field of image processing for pattern recognition, and Recurrent Neural Networks (RNN), initially created for text processing tasks and later recognized and adopted for time series analyses with a noteworthy architecture modification - Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU). These two model architectures can be used for in-depth analyses of behavioral patterns (biases) and their changes and adaptations over time and uncertainty (Fazzari, Romano, Falchi, & Stefanini, 2024).

Conclusion

The research introduces a new perspective on analyzing trader behavior by integrating a model that combines portfolio biases with time perspective to simulate trader responses under uncertainty. This approach goes beyond traditional views by emphasizing how individual biases and market news informativity jointly shape market dynamics, contributing to phenomena like market overreaction, underreaction, and increased volatility. The study's proposed experimental model thus offers an innovative framework for observing how noisy traders' biases influence market efficiency and pricing. This model highlights the role of psychological and behavioral factors in adaptive markets, suggesting that market inefficiencies and price distortions arise not only from information gaps but also from complex bias-driven behaviors that amplify volatility and impact market equilibrium over time. We propose to examine Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) as architectures worth exploring for in-depth analyses of behavioral patterns (biases) and their changes and adaptations over time and uncertainty.

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Journal of Yerevan University. Economy
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GREEN INVESTMENTS AND THEIR INFLUENCE ON GREEN GROWTH IN RA: INTEGRATING ECONOMIC GROWTH WITH SUSTAINABILITY

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Abstract: The importance of green investments in the developing economies is in the potential of reducing the emissions and creating alternative funds to effectively contribute to economic growth and sustainable development. The main objective of this research is to explore the macroeconomic implications of green investment in the transformation to a green economy, while defining main sectoral priorities for investment allocation and underlining the short- and long-term macroeconomic effects of the "green" investment on the basis of which we can build possible scenarios for green transformation in the RA. For this purpose, we have examined the features of the new taxonomy of investments proposed in the "LowGrow SFC" model, which was developed based on the Canadian economy. We propose to classify green investments in Armenia as "productive" or "non-productive", "additional" or "non-additional". Within the framework of the above-mentioned logic of presenting investments according to their macroeconomic impacts, the main directions of the RA economy that can contribute to the growth of the green economy have been highlighted. In the article it is suggested that there are two possible scenarios for Armenia's green transformation, each of which takes into account different levels of investment, policy actions, and technological deployment. Which scenario is most effective for Armenia depends on the ability of the Armenian economy to attract green investments.

Keywords: ***green investment, sustainability, green growth,*** *productive or non-productive investments, additional and non-additional investments*

Introduction

The "Green Wave" has covered almost the entire economic and financial system. The global movement towards sustainability and eco-growth is rapidly transforming the investment landscape. As the global economy continues its transition to sustainability, green investments are becoming a critical driver of economic growth, social impact, and environmental protection. Investors and businesses that align their strategies with these global sustainability trends will not only contribute to addressing climate change and environmental degradation but will also position themselves to thrive in an increasingly green-focused economy.

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Received: 30.11.2024
Revised: 08.12.2024
Accepted: 27.12.2024

In every nation's "Green Growth Strategy", green investment plays a vital role in sustainable development. Transitioning to a circular economy, where the waste is minimized, and the resources are maximized, is crucial for a more sustainable future. Investors may make well-informed decisions that not only benefit their portfolios but also work towards a greener future. Within the framework of the socio-economic transition of RA from a phase of rapid and poor-quality economic growth to one of high-quality development, it becomes crucial to focus on advancing the green economy to sustain economic progress. This research identifies some factors influencing green investments' allocation, investigates challenges and solutions' directions for promoting green finance in RA.

Research methodology

For the implementation of the research, our analysis has been done on the basis of legislative acts in RA and the data from the websites of various sectoral authorized bodies, including statistics, sectoral reports available on them. Within the framework of the research the general scientific methods have been applied such as comparison and historical analysis, induction and deduction synthesis, also qualitative and quantitative assessment methods, similarity, dynamic and structural observations approaches were used.

Legislative framework and Government programs on green investments in Armenia (2004-2024). Over the past quarter century, Armenia has made significant progress in reforming its legislative framework and government programs to ensure the transition to a green economy and promote green investments, paying special attention to the issues of financial stability and building an energy-efficient economy, while also emphasizing the issues of environmental protection and climate change mitigation.

The overview of the main legislative and policy developments in the framework and government initiatives supporting green investments.in Armenia have shown, that almost all the governments of the RA, since 2000, have tried to a greater or lesser extent to show some initiatives towards the formation of a "green economy". According to the analysis of Armenia's governmental programs, the economic category of "sustainable development" was first mentioned in the programs of the RA Government in 2007 (RA Government Program, 2007) and the concept of "green economy" was used for the first time in 2013. In the RA Government programs of 2013 and 2014, the importance of transitioning towards a "green economy" as part of their strategic vision for sustainable development (RA Government Program, 2014, point 2.4.4.) was highlighted. The concept of sustainable development has been addressed within the framework of sectoral programs (RA Government Program (2013), point 3.4.4). The concept of the "green economy", with a focus on sustainable development, for the first time since 2013, has not been included in the 2018 RA Government Program, and only in the 2019 RA Government Program were these two concepts combined: "green economy" and "sustainable development", as a single system, mentioning the need to develop and implement a separate policy to ensure them (RA Government Program, 2019 point 4.8). Finally, in 2021, the Government of Armenia renewed its commitment to green recovery and growth by introducing green economy and sustainable development policy priorities in its new five-year (2021 – 2026) program (RA Government Program 2021-2026, point 2.2). The primary goal of the Government of the RA in forming a "Green Economy" is to ensure the readiness of the economy for a new, low-carbon energy reality, and the second goal is to create the prerequisites for the longer preservation of natural resources in the economic cycle. The legislative

framework contributing to the transition to a "green economy" in Armenia is not only supported by national legislation and policies, strategies, action plans and roadmaps, but also by its participation in global, regional, and bilateral agreements. But none of them contains provisions directly attributable to the process of forming a "green economy", they are predominantly attributable to environmental protection, which, naturally, is one of the pillars of the "green economy". In other words, we are in a situation where the RA is a member of a number of international agreements, has ratified a number of legal acts which are related to the formation of a "green economy", but doesn't completely close the field of action, moreover, they are not coordinated around a single common idea and policy, the development and implementation of which should be the responsibility of the Government of the RA.

For about a decade, the strategy and policy of forming and gradually implementing a "Green economy" have remained on the agenda. The RA has already developed a document (draft) "Strategy for Green and Sustainable Economic Development", which is another important step on the path to ensuring sustainable macroeconomic development. The main tools of the strategy, in addition to reforms in the legislative and regulatory framework and a number of other important directions, also include the promotion of investments in green infrastructure, such as sustainable construction, energy, transport, etc. One of the targets for implementing the strategy is to increase the volume of green investments, in particular in the fields of green energy, transport and ecotourism, which will stimulate the creation of new and green jobs. In outlining the action plan, the RA policy envisages implementing a sustainable finance strategy policy, which will be based on a green taxonomy, will set appropriate criteria for green and sustainable investments, encouraging banks and financial institutions to invest in green projects, and in the long term, will create a basis for offering tax incentives for green investments ("Green and sustainable economic development strategy" draft - decision of the government of the Republic of Armenia).

So, the main task of the policy involves three key elements, which must be carefully aligned:

- To choose the right and expedient investment target,
- To select the appropriate financing option for maintaining financial stability,
- To assess the expected macroeconomic impact.

The EU's "Green Taxonomy" on Sustainable Finance (Regulation 2020/852) clarifies the scope and meaning of the green investment. According to this taxonomy "environmentally sustainable investment" (understood here as green investment): 1) must make a substantial contribution to one of six environmental objectives (climate change mitigation; climate change adaptation; sustainable use and protection of water and marine resources; transition to a circular economy; pollution prevention and control; and protection and restoration of biodiversity and ecosystems), 2) does no significant harm to the other five, and 3) must meet minimum safeguards such as the UN guiding principles on business and human rights (Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment). Therefore, we can say, that the EU taxonomy defines what the meaning of green investment is.

We have analyzed the "**LowGrow SFC model"** (which can be seen as a low-growth scenario) that was developed based on the Canadian economy (Jackson T. and Peter A. Victor, 2020), and refers to a type of economic modeling approach that simulates low-growth scenarios in an economy through a Stock-Flow Consistent (SFC) framework. This model is typically used to analyze how economic variables such as income, **investment**, consumption, and savings interact under different growth conditions and how they

affect overall economic stability. We have examined the features of the new taxonomy of investments proposed in the model, and the possibilities of its application in the RA.

For defining the main sectoral priorities for investment allocation and underlining the short- and long-term macroeconomic implications of the "green" investment, it should be mentioned that the investments taxonomy has been based on their macroeconomic impact on stability and "green" growth. We propose to classify investments in Armenia according to the above approach: "productive" or "non-productive", "additional" and "non-additional".

Productive **investment supports the expansion of an economy's productive capacity while promoting decarbonization and preserving our planet's natural assets, also** promoting macro**economic sustainability**. These investments focus on developing and expanding sectors that contribute to **green growth** by reducing negative environmental impacts and supporting sustainable development. Green productive investments are a critical component of the transition to a green economy.

Non-productive **investments** may not directly increase the productive capacity of the economy in terms of output but contribute significantly to environmental protection, climate resilience, and long-term sustainability. These types of investments focus more on environmental and social benefits rather than immediate economic returns. Their purpose is to help protect other productive capital, not to add to it (Policy Framework for Investment - Pocket Edition, 2015).

Both types are essential for transitioning to a *green* economy, but they have different roles and impacts on economic growth and macroeconomic sustainability.

In the context of the macroeconomic impact, above-mentioned criterion of **additionality** versus **non-additionality** is a key concept in evaluating the effectiveness of green investments. It helps to determine whether the funds allocated to green investments result in a net increase in overall investment in the economy or if they merely replace or displace other forms of investment without adding to the total economic activity. This distinction is critical for understanding the true impact of green investments on economic growth and sustainability. This has much to do with how the green investment is financed.

Additionality refers to the extent to which a green investment leads to **new** or **additional** spending that would not have occurred otherwise. In other words, it means that the green investment leads to a net increase in overall investment in the economy and does not simply replace or crowd out other types of investments.

Non-additionality refers to situations where the green investment **displaces** other types of investments, meaning that the overall level of investment in the economy remains the same or does not increase. This occurs when green investments are financed by diverting funds from other existing investments, rather than creating new sources of funding or stimulating new economic activity.

So, the way in which green investments are financed plays a crucial role in determining whether they are additional or non-additional. Several financing options can influence this outcome:

By combining the two criteria of macro**economic impact** (productive vs. non-productive) and **additionality** (additional vs. non-additional), we can derive a cross-cutting classification of green investment. These categories help better understand the potential effects of green investments on the economy, considering both their contribution to macroeconomic output and whether they increase or displace overall investment in the economy.

Table 1

Summary of the investments' macroeconomic impact.

	Productive investments	Non - Productive investment
Additional investments	• Contributes to GDP growth by increasing productive capacity • Net increase in overall investment	• No direct contribution to GDP but helps long-term sustainability • Net increase in overall investment
Non – additional investments	• Contributes to GDP growth but displaces other investments • No net increase in total investment	• No direct contribution to GDP and displaces other investments • No net increase in total investment

Source: Composed by the authors based on the analyses.

Short- and long-term macroeconomic effects depend on the extent to which green investment is additional or productive. If the finances injected into the RA economy are situational, unregulated, not allocated and targeted according to the above-mentioned principles, can put the economy at risk of economic instability. Misunderstanding or mismanaging the strategic direction of green investments can indeed put the economy at risk of macroeconomic instability.

An analysis of the structure of Armenia's economy will allow us to identify the main sectoral priorities that will ensure the maximum macroeconomic results of the investments. The economy of the RA, like all other national economies, has its own unique starting macroeconomic structural features, faces unique challenges and opportunities in transitioning to a green economy, and understanding the existing economic structure is crucial for the effective implementation of green investments.

Highlighting the main structural features of the Armenian economy can help to understand how green investments can impact the country's macroeconomic stability**.**

Armenia's economy overview

During 1990-2023, Armenia's economy has undergone a profound transformation. Thus, in 1990 the industrial sector accounted for 29.7% of GDP, in 2000 - 25.2%, while in 2023 this indicator was 16.5%. In **1990**, the industrial sector accounted for **29.7%** of Armenia's GDP. This was a time when Armenia's economy was heavily reliant on industries such as mining, energy production, and manufacturing, all of which were major contributors to the economy during the Soviet era. This creates both challenges and opportunities for green investment, which needed to be carefully balanced.

Similarly, agriculture, being one of the main sectors of the economy, has been declining since 2000, and reached 8.5% of GDP in 2023. Instead, the share of trade and services continuously expanded from 28.2% in 1990 to 59.4% in 2023.

By **2023**, the share of the industrial sector had further dropped to **16.5%** of GDP, indicating a shift toward a more service-oriented economy, with industries like IT, finance, and tourism becoming more prominent.

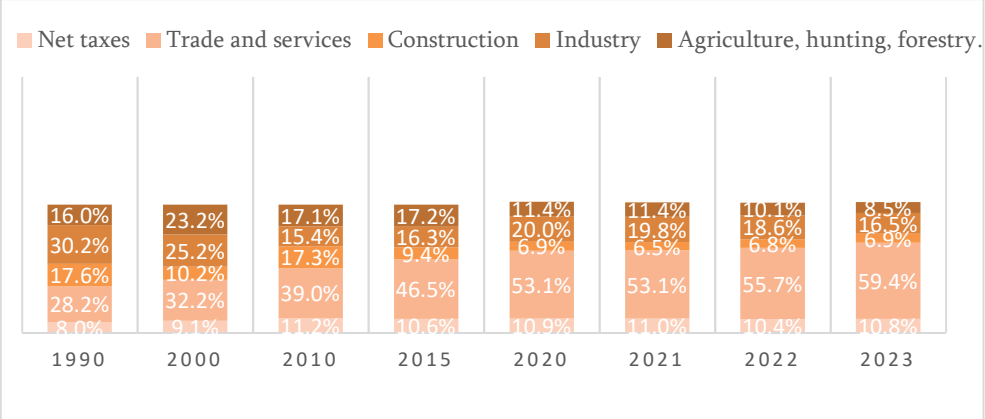
The transformation of Armenia's economy from a heavily industrial base in 1990 to a more service-oriented economy by 2023 reflects broader global trends of deindustrialization, as well as Armenia's specific historical and geopolitical challenges. The shrinking industrial sector has been offset by growth in other areas such as services and technology, which have become the main drivers of economic growth. However, the challenge for Armenia moving forward will be to diversify its industrial base and ensure that the growth in services and technology continues to be sustainable, inclusive, and well-

integrated into the global green economy (see Figure 1).

Truly appreciate the significant impact that the service sector can have on the environment by adhering to green practices; it is first important to recognize the wide array of concerns that comprise this segment of the economy. The service economy is indeed a multi-faceted entity spanning many diverse industries. There are researches, illustrating the various ways in which the industries comprising the service sector might embrace a green orientation: The greening of services matrix (Grove et al., 1996**)**.

Figure 1

GDP composition during 1990-2023, in %.



Source: Developed by the authors based on the reports of the Statistical Committee of RA, (25.09.2024) https://www.armstat.am/am/?nid=82.

Armenia produced 0.79 million toe of electricity in 2022, of which 31.0% was from nuclear power plant 42.2% from natural gas-fired thermal power plants, 21.1% from hydropower plants, and 5.7% from wind and solar plants. In 2022, the total primary energy supply in Armenia was 4.0 million tons of oil equivalent (toe), of which hydropower (4.2%) and wind, solar PV, and solar thermal (1.5%) were included. Armenia's energy intensity has decreased steadily in recent decades (-21% in 2000-2020). This is due to GDP growing over three-fold during that period, whereas energy consumption (measured by TFC) "only" doubled. The direct, positive correlation between economic growth and energy consumption weakened after 2012 but strengthened in 2019 (Energy Policy Review, Armenia 2022). The 12.7% decrease in energy intensity from 2021 to 2022 indicates a return to improving energy efficiency after the 2020 disruption. The trend suggests that Armenia's energy intensity improvements are part of a longer-term effort to modernize the energy system and reduce the environmental footprint of economic growth (Armenia energy factsheet 2022, Energy balance of the RA 2022). According to the **RA Energy Sector Development Strategic Program (2021–2040)**, the government has set targets to significantly increase the share of **solar energy** in the country's energy mix. Specifically, the program outlines the goal of achieving **at least 15%** of total energy generation from **solar energy** by **2030**, which is expected to amount to **1.8 billion kWh** of electricity.

The roadmap for energy-efficient buildings in Armenia (2020-2040) represents a comprehensive and multi-faceted approach to improving the country's building stock,

reducing energy consumption, and contributing to sustainability and climate change mitigation. By setting ambitious goals, promoting green construction practices, retrofitting existing buildings, and fostering public-private partnerships, Armenia can create a more energy-efficient and sustainable built environment that benefits its economy, environment, and citizens (Energy-Efficient Buildings in Armenia: A Roadmap Insights and pathways for better buildings 2020-2040).

In order to reduce environmental pollution, reduce the amount of exhaust gases and stimulate the use of environmentally friendly vehicles, the RA is pursuing a policy aimed at the development of electric vehicles, including in terms of infrastructure necessary for operation. In 2022, 2,663 vehicles were imported into our country; in 2021, 1,898 vehicles; yet in 2024, it has been already almost 8000[1].

By 2040, Armenia aims to transition to a low-carbon, sustainable transport system that includes a predominantly electric public transport fleet in urban centers, extensive bike-sharing programs in all major cities and a seamless, multi-modal transport network integrating electric buses, trams, bicycles, and walking (Armenia: Transport and Trade Facilitation Strategy, 2020–2040).

Energy and agriculture are two key sectors in Armenia that contribute significantly to greenhouse gas (GHG) emissions, with a combined share of 85.2% (66.7% from energy and 18.5% from agriculture). These sectors present substantial opportunities for climate mitigation and emission reductions. By focusing on these areas, Armenia can make significant progress toward achieving its climate goals and contribute to the global effort to combat climate change. International programs have significantly contributed to the restructuring and modernization of Armenia's agricultural sector. The support from programs like ENPARD**,** FAO**,** the World Bank**,** USAID and others has focused on improving agricultural productivity, promoting sustainability, and addressing environmental challenges such as water scarcity and soil degradation. These programs help farmers adopt climate-resilient practices**,** improve access to markets**,** and modernize farming systems to ensure long-term food security, economic growth, and environmental sustainability in Armenia.

Green investments in the RA economy

The principles of sustainable economic growth, social development, and environmental protection are enshrined in the RA 2014-2025 Strategic Program of Prospective Development, and in "The Strategy of the Main Directions Ensuring Economic Development in Agricultural Sector of the RA for 2020-2030". Here, is the classification of the green investments:

1. PRODUCTIVE AND ADDITIONAL GREEN INVESTMENTS

Short-term economic implications for Armenia's economy:

- **Capital and GDP growth**: they can increase the capital expenditures and employment, which in turn can affect other expenditure components of GDP, leading to growth with a double effect.
- **Increased economic activity**: They can stimulate new productions in sectors like renewable energy, green transport, construction, ecotourism, leading to new markets and increasing green GDP.

Long-term economic implications** for **Armenia's economy:

[1] State Revenue Committee of RA. Online at: https://src.am/en/getNews/705, seen 20.10.2024, seen 01.09.2024.

- **Sustainable growth**: This type of investment will build new infrastructure and structure of economy, and Armenia can transition to a more sustainable growth model.
- **Energy independence**: Investments in the renewable energy sector (solar and wind) will reduce Armenia's dependence on imported fossil fuels, improving energy security and reducing trade deficits, also ensuring macroeconomic stability and creating new development opportunities
- **Strengthening competitive positions**: By embracing green technologies and industries, Armenia can become a strong economy in the region in **sustainable development** and **green technology innovation**, attracting additional international investments and becoming more competitive in the green capital market globally.

In the context of Armenia's green transition, it is important to ensure that green investments, both productive and additional, should maximize their economic and environmental benefits:

- Renewable energy and energy efficiency (solar energy, wind farms, etc.)
- Sustainable agriculture and water management (climate-resilient farming, water conservation technologies, etc.)
- Green infrastructure development (sustainable cities, green buildings, eco-transportation systems)

So, by focusing on both productive and additional green investments, Armenia can drive a sustainable economic transition that promotes growth, resilience, and environmental sustainability over the long term.

2. PRODUCTIVE AND NON-ADDITIONAL GREEN INVESTMENTS

The combination of **productive** and **non-additional** investments plays a unique role in shaping the economy's transition to a more sustainable and green future. These are investments that contribute to the economy's productive capacity (productive) but **do not** lead to a net increase in overall investment in the economy (non-additional). Instead, they displace or reallocate investment from other sectors.

Short-term implications for Armenia's economy:

- **Limited economic stimulus**: Non-additional green investments in Armenia, such as transitioning to renewable energy or upgrading infrastructure, may not create immediate growth in total investment or GDP. However, they reduce costs and help **improve energy efficiency**, which can enhance long-term competitiveness, especially for energy-intensive sectors like manufacturing.
- **Increased economic activity**: Investments can generate jobs in new industries and help diversify Armenia's economy.

Long-term implications for Armenia's economy:

- **Sustainable growth from productive investments**: They will help the economy to enhance its **industrial productivity** while promoting **environmentally sustainable growth**. Over time, Armenia could benefit from a **greener, more resilient economy** that is better able to withstand environmental shocks.
- **Economic diversification**: Both productive and non-additional green investments are important for diversifying Armenia's economy away from **energy-intensive and polluting sectors**. Investing in green technologies, sustainable agriculture, **water-**

efficient farming technologies, and renewable energy could open up new industries and reduce Armenia's reliance on its **mining** and **energy extraction** industries.

- **Environmental resilience and competitiveness**: Non-additional investments contribute to Armenia's **environmental resilience** by reducing emissions, improving waste management, and enhancing the efficiency of existing systems. Over time, these investments will make Armenia more competitive in global markets that are increasingly focused on sustainability.
- **Green infrastructure**: Expand investments in **green public transportation** (electric vehicles, public transit systems), **smart cities**, and **energy-efficient buildings** to create sustainable urban growth and reduce environmental degradation.

3. NON-PRODUCTIVE AND ADDITIONAL GREEN INVESTMENTS

These investments do not directly contribute to economic output in terms of goods and services (non-productive) but result in a net increase in investment in the economy (additional). They primarily focus on environmental sustainability, resilience, and ecosystem protection.

Short-term economic implications for Armenia:

- **Environmental health**: These investments can't contribute directly to short-term GDP growth, but they improve environmental quality, which can lead to a higher quality of life.
- **Government spending**: Government expenditure on non-productive but essential green investments, such as **public awareness campaigns** or **environmental monitoring programs**, may result in higher fiscal outlays in the short term but will contribute to the long-term sustainability of the economy.

Long-term economic implications for Armenia's economy:

- **Increased resilience**: Over time, these investments will enhance Armenia's resilience to climate change, environmental degradation, and resource depletion. The direct macroeconomic benefits of these investments may not be immediately apparent, but avoiding future costs related to environmental damage or climate impacts will be significant.
- **Sustainable growth**: As the economy adapts to environmental challenges and benefits from cleaner air, water, and ecosystems, long-term **economic growth** will be supported by these investments, leading to a more sustainable future.
- **Global competitiveness**: Armenia's efforts in environmental protection and sustainability could position it as a regional strong leader in **green innovation** and attract international financing and partnerships for future green projects.

In Armenia, **non-productive and additional green investments** are essential for addressing environmental challenges and supporting the country's long-term sustainability goals, focusing attention on improving environmental conditions, addressing climate change, and reducing environmental degradation. Such investments are very important for Armenia as it seeks to transition towards a **greener, more sustainable economy** while managing the impacts of environmental challenges. Below we define some directions, which are crucial in Armenia.

- Green energy projects
- Pollution control and environmental clean-up
- Reforestation and forest conservation
- Waste management and recycling initiatives
- Ecotourism infrastructure
- Urban green spaces and sustainable infrastructure
- Biodiversity protection and nature reserves
- Green finance and investment mechanisms
- Environmental education and research

4. NON-PRODUCTIVE AND NON-ADDITIONAL GREEN INVESTMENTS

These are investments that do not contribute directly to economic output (non-productive) and do not lead to an increase in the total amount of investment in the economy (non-additional). They often represent a **shift in resources** rather than new investments.

While non-productive and non-additional green investments can't directly contribute to real GDP growth, they can contribute to green GDP growth. They play an important role in maintaining the health of a country's environment. The macroeconomic importance of these investments lies in their ability to maintain the health of ecosystems and avoid long-term damage, rather than in contributing to new productive capacity.

*Short-term economic **implications for Armenia's economy:***

- **Minimal impact on GDP Growth**: As these investments do not lead to increased production or the creation of new productive capacities, they will likely have little to no immediate impact on the economy's GDP.
- **Government expenditure**: These investments might represent an **ongoing government expenditure** on environmental upkeep, which could increase public spending in the short term without resulting in an immediate economic return. However, the latter's impact on green GDP growth will definitely be positive.

Long-term economic implications for Armenia's economy:

- **Environmental stability (upkeep): T**hese investments can contribute to maintaining environmental sustainability, **avoiding future environmental damage** and preventing future environmental crises, which in turn can harm the economy by undermining macroeconomic stability.
- **Public health improvements**: This type of investment can contribute to better public health outcomes, reducing long-term healthcare costs, and improving peoples' productivity. For instance, maintaining clean air and water standards prevents costly diseases and conditions caused by pollution.
- **Sustainability**: Keeping Armenia's ecosystems, pollution control systems, and natural resources healthy and functional ensures that the country can avoid large-scale environmental disasters, which would be far more costly to manage if left unaddressed.

So, this type of investments in Armenia is critical for addressing environmental issues, ensuring regulatory compliance, and mitigating the impacts of **environmental degradation**. While these investments may not contribute directly to short-term economic growth or GDP, they are essential for **long-term sustainability** and **public health**. By making

necessary investments in **pollution control**, **remediation**, and **environmental infrastructure**, Armenia can avoid future economic risks, enhance its reputation in the global green economy, and maintain a healthier environment for future generations.

- Compliance with environmental regulations
- Maintenance of existing environmental infrastructure (waste management, water purification, or sewage treatment services)
- Fixing environmental damage
- Carbon offsetting programs

Results

Within the framework of the above-mentioned logic of presenting investments according to their macroeconomic impacts, here are highlighted the main directions of the RA economy that can contribute to the growth of the green economy.

1. Energy transition (green productive investments)

Armenia highly depends on energy imports, particularly **natural gas**. However, it also has great potential for **renewable energy** sources like **solar**, **wind**, and **hydropower**. Green energy investments are critical for diversifying the energy mix and reducing dependency on fossil fuels.

- ✓ **Impact on short-term Economy**: **Investments in renewable energy** (e.g., solar or wind power plants) can stimulate economic growth by creating jobs, increasing energy security, and potentially reducing energy costs in the long term. However, these are **productive investments** that require a longer horizon to deliver substantial returns.
- ✓ **Impact on long-term economy**: These investments can significantly increase **economic productivity** in the energy sector and support **sustainable growth**. If the transition to clean energy is not additional (e.g., financed by reallocation from other sectors), it may not increase total investment levels but still can provide long-term benefits, such as reducing the costs of energy imports and improving energy efficiency across other sectors.

2. Agricultural sustainability and innovation (green non-productive investments)

Agriculture is a major part of the Armenian economy, but it faces challenges such as **water scarcity** and **soil degradation**. Investments in sustainable farming practices, such as **drip irrigation**, **organic farming**, or **water conservation technologies**, are essential for ensuring the long-term viability of agriculture.

- ✓ **Impact on short-term economy**: These types of investments might not immediately lead to a large increase in overall GDP or industrial output because they are often **non-productive** investments (focused on preserving resources rather than generating new goods). However, they **stabilize the agricultural sector**, ensuring future food security and agricultural productivity.
- ✓ **Impact on long-term economy**: In the long term, investments in **agricultural sustainability** will contribute to greater **productivity** by maintaining and improving **soil health** and **water resources**. Such investments can prevent significant losses in the agricultural sector caused by environmental degradation, helping to maintain a stable supply of food and agricultural exports.

3. Green infrastructure and urban development (mixed impact)

As Armenia's urban population grows, there is increasing demand for **sustainable urban development**, including **green buildings**, **eco- transportation**, and **waste management** systems. These are **non-productive but additional** investments that focus on enhancing quality of life and environmental sustainability.

✓ **Impact on short-term economy**: **Green infrastructure investments** (such as public transit systems, energy-efficient buildings, and waste-to-energy projects) may **displace investments** in other sectors. If funded by reallocating funds from other projects, it may not contribute to **net economic growth** in the short term. However, they can still have positive effects, such as improving public health and reducing long-term infrastructure costs.

✓ **Impact on long-term economy**: In the long term, **green urban development** can significantly improve productivity by making cities more **livable**, reducing **energy consumption**, and **lowering costs** for households and businesses. Investments in **green infrastructure** can also **attract foreign investment** and contribute to the country's competitiveness.

4. Industrial transition and circular economy (productive and additional investments)

Armenia's manufacturing sector, particularly in the areas of **metallurgy**, **construction materials**, and **textiles**, can benefit from **green industrial practices** like **circular economy models** (e.g., waste recycling, sustainable materials, and low-emission technologies).

✓ **Impact on short-term economy**: In the short term, Investments in transitioning industries to more **sustainable practices** can stimulate economic activity and create jobs, especially if these investments are **additional** and not simply a shift of resources from one sector to another.

✓ **Impact on long-term economy**: In the long term, **green industrial investments** can increase **productivity**, reduce the environmental footprint of the manufacturing sector, and support **economic diversification**. As the global market increasingly shifts toward sustainability, **greening industries** will allow Armenia to remain competitive, attracting green trade and investment.

5. Environmental protection and tourism (non-productive but additional investments)

Tourism is a growing sector in Armenia. The tourism sector, has attracted significant investments, driven by the strong focus on economic modernization and infrastructure development. Investments in **environmental protection** (**national parks**, **forests**, and **biodiversity)**, can enhance the tourism sector.

✓ **Impact on short-term economy**: **Non-productive green investments** in tourism, such as the preservation of natural areas, may not generate immediate economic output. However, there may be **additional investments**, funded by new sources (e.g., international aid or climate funds), thus contributing to the economy in the form of long-term tourism growth.

✓ **Impact on long-term economy**: In the long term, preserving the environment ensures the sustainability of the **tourism sector**, which is a significant contributor to GDP. These investments can improve **tourism revenues**, **foreign exchange inflows**, and **employment** in tourism-related industries.

The green transformation of Armenia's economy will require significant changes and massive investments in various sectors of the economy to achieve sustainable growth while also reducing environmental degradation. Below are highlighted two possible scenarios for Armenia's green transformation, each of which takes into account different levels of investment, policy actions, and technological deployment. The effectiveness of Armenia's transition to a green economy largely depends on the country's economic capacity, resources, institutional framework, and the existing challenges it faces in implementing sustainable development. Here's an analysis of the most effective scenarios for Armenia, considering these factors (see Table 2).

Table 2

Scenarios for green transformation of Armenia's economy

SCENARIO 1: AMBITIOUS GREEN TRANSFORMATION (ACCELERATED GREEN GROWTH)	**SCENARIO 2: GRADUAL GREEN TRANSFORMATION (SLOW BUT SUSTAINABLE TRANSITION)**
Overview: Armenia undertakes an aggressive green transformation with strong policy support, substantial green investment, and the adoption of innovative technologies. The government, private sector, and international donors collaborate to significantly reduce carbon emissions, enhance environmental sustainability, and foster green economic growth. The scenario can be applied in the sector, which currently plays a modest role in the process of ensuring economic growth, but also is a key sector in building a green economy: *agriculture, energy, service /transport, tourism/.*	***Overview**: Slow and steady transformation of key sectors: the economy develops gradually, based on certain predictability and longer-term plans, where green investments are implemented more cautiously and gradually. This approach avoids rapid changes, such as deep technological or systemic transformations, and seeks to preserve current economic structures.* The scenario can be applied in the sector, which currently plays a key role in the process of ensuring economic growth: i*ndustry and manufacturing, food systems, financial services and green finance, construction and buildings.*
✓ Renewable energy expansion**:** Rapid investment in solar**,** wind**,** and hydropower energy production, potentially transforming Armenia into a regional leader in renewable energy. Armenia harnesses its solar potential in regions like the Ararat Valley and expands wind energy in the Sevan and Gavar regions, Aragatsotn and Vayots Dzor, which have favorable conditions for wind power generation. ✓ Energy efficiency: Large-scale retrofitting of energy-efficient buildings, smart grids, and electric vehicle infrastructure across cities like Yerevan and Gyumri**.** ✓ Green transport: Implementation of electric public transport systems, bike-sharing programs**,** and sustainable urban mobility solutions to reduce air pollution and greenhouse gas emissions in urban centers. ✓ Sustainable Agriculture: Broad adoption of organic farming**,** drip irrigation, and sustainable water use techniques. The government incentivizes farmers to transition to eco-friendly practices, supported by green financing. ✓ Circular economy and waste management:	✓ **Renewable energy development**: Support for the development of renewable energy and the creation of energy storage infrastructure. ✓ **Energy efficiency and green buildings**: Implementation of **energy-efficient building codes** and gradual retrofitting of buildings. However, the shift is not widespread in the short term, and incentives for energy-efficient appliances and home improvements remain limited. ✓ **Sustainable agriculture**: Transition to **eco-friendly farming** practices proceeds gradually, with subsidies and incentives targeting small-scale farmers. However, traditional agriculture still dominates, and green technologies are adopted at a slower pace. ✓ **Transport and mobility**: The gradual introduction of **electric vehicles (EVs)**, expansion of **public transport**, and **bike lanes** in larger cities like **Yerevan**. However, **private car ownership** remains dominant. ✓ **Waste management**: Waste management practices are improved, but the transition to a fully **circular economy** is slower. The changes

The introduction of circular economy principles where waste is minimized, and materials are reused or recycled. Investment in waste-to-energy projects and eco-friendly waste management infrastructure in cities.	being implemented are more cautious and gradual, based on bilateral co-chairs and conservative strategies. The modest scenario emphasizes efficiency and resource conservation without major systemic changes.
Economic and environmental implications on Armenia's economy:	***Economic and environmental implications on Armenia's economy:***
✓ **Economic growth:** Economic growth is achievable, but it requires a comprehensive strategy that balances rapid development with effective risk management. Growth must be pursued in a way that ensures stability and sustainability in the long term. ✓ **Job creation:** The green transition has enormous potential for job creation in a range of sectors. But addressing the challenges of job mobility and skills gaps is essential to securing the benefits of this transformation. ✓ **Environmental impact:** Achieving near carbon neutrality is an ambitious but achievable goal for Armenia. By focusing on renewable energy, sustainable transportation, energy efficiency, carbon capture, waste reduction, and green investments, Armenia can significantly reduce its greenhouse gas emissions while positioning itself as a regional leader in sustainability. ✓ **Sustainability:** This development scenario will enable Armenia to move to a new level of sustainability. By harnessing its natural resources, developing green technologies and promoting green growth, Armenia can improve its sustainability outcomes. The green transition will require significant investments and policy reforms.	✓ **Economic growth**: The role of the green sector in the structure of economic growth is certainly highlighted, but it is not yet tangible. The structure of the economy is gradually changing in favor of green sectors. ✓ **Job creation**: Steady growth in green jobs, although the growth rate lags behind the changes recorded in the ambitious scenario. Workers who choose to participate in the green economy must have new skills related to environmental regulations, new technologies, or sustainable systems. ✓ **Environmental impact**: The slow growth model will ensure slow but steady economic growth, quality jobs, while reducing environmental risks (slower progress towards **carbon neutrality)**, promoting the adoption of new economic relations and sustainable practices by all, taking into account the limited nature of resources, and creating an environment and outcomes that promote macroeconomic stability. ✓ **Sustainability**: The economy is transitioning to a more sustainable growth model, but it faces challenges in fully transitioning to a green economy in the short-to-medium term. Modest growth does not imply quick results, but it can ensure a more stable and gradually developing economy, taking into account certain challenges and opportunities.

In the modest green transformation scenario, we can move to the green transition at a slow pace, given the limited amount of investment. In the modest green transformation scenario, a small part of all investments is diverted to green investment, but the main part of this green investment is assumed to be productive. This scenario we can apply in such sectors, which provide GDP growth now, because, a sharp outflow of investments from non-green sectors may put the Armenian economy in front of a sharp decline.

These scenarios are intended to provide an analytical assessment of the green transformation in Armenia. Here we have to make a choice about how much we are willing to replace the current growth for the sake of building a green economy. This transformation must be achieved over time but also in time. Long-term planning is particularly important in the case of long-lived infrastructure. We must take particular care in our investment decisions regarding power plants, buildings and transportation infrastructure, which may not be easily replaced or retrofitted. Urban development is one of those areas where today's choices will have consequences on emissions for decades to come. The emissions from these investments could be locked in for decades, as premature removal of such infrastructure would be costly (Long-term climate strategies, 2018).

The agriculture sector faces challenges like capital undernourishment, low productivity and limited modernization, environmental degradation, and the intensity of *Scenario 1*, focused on rapid transformation and maximizing efficiency, can be essential for the sector's growth and sustainability. But the service sector faces other challenges such as digital transformation, adaptation to technological changes, cybersecurity and data privacy, quality control, and social responsibility, which require a special approach to transformation. *Scenario 2,* which prioritizes a slow transformation, can be more effective in ensuring that changes are sustainable, inclusive, and aligned with the sector's long-term growth. Thus, the choice of scenario depends on the economic situation, sectoral development strategy, and capital volumes. A combination of scenarios can also be applied for both rapid and gradual changes at the same time, using a combination of advantages depending on the situation and resources. The combination can be achieved by integrating two different approaches (an initial rapid change and a careful, gradual transition), where rapid changes are implemented in some areas, and later and more careful changes in others.

Thus, the ***most effective scenario for Armenia*** *will likely be a* ***hybrid approach*** *combining elements of both of them.*

The draft version of the "Green and sustainable economic development strategy" and the Government programs contain defined indicator targets that can be realistic in both the short and long term if investments are allocated to economic sectors in a targeted manner, as a regular step in the ongoing strategic plan, rather than being situational and implemented within the framework of a separate local project that is not part of the process ((Republic of Armenia Government Program (2021-2026)). Fostering international partnerships, public-private collaboration, and a strong policy framework is key to ensuring that economic growth, and environmental and economic sustainability go hand in hand.

Conclusions

The Green Economy not only does not limit or slow down the possibility of ensuring economic growth in the current period, but also, as a result of the application of a balanced policy and incentive system, can guarantee the expansion of the potential for economic development, while ensuring the minimum possible risks to the environment and social security as a result of economic activity (Green and sustainable economic development strategy" draft - decision of the government of the Republic of Armenia).

While the progress has been significant, more remains to be done to ensure that green investments become a central pillar of Armenia's economic growth strategy. Continued investment in infrastructure, policy reforms, and green finance mechanisms will be necessary to fully capitalize on Armenia's green potential. Basing on its priorities and characteristics, Armenia forms its own green growth agenda, for the implementation of which the following main directions are distinguished: productivity and competitiveness, income growth and job creation, innovative development, mastering new markets and new sectors, more balanced macroeconomic environment and stability.

The formulation of a green economy can lead to the fundamental principles of sustainable development. Summarizing the analyses some assessments of the macroeconomic impact of green investments on the RA economy can be highlighted:

- ✓ **Short-term growth and stabilization**: In the short term, **additional** green investments in sectors of the economy targeted by the RA government, such as **renewable**

energy and **green infrastructure** could stimulate demand and economic activity. However, if these investments are **not additional** and are funded by reallocating resources, the short-term economic impact may be muted, and other sectors could experience a slowdown.

- ✓ **Long-term sustainability and productivity**: In the long term, **productive** green investments in sectors of the economy targeted by the RA Government, such as in **energy (efficiency)**, **agriculture**, transport, ecotourism and **green industries, will stimulate the creation of new and green jobs,** boost **economic productivity** and reduce environmental risks, leading to sustainable economic growth. However, **non-productive** investments, while important for environmental sustainability, may not have immediate positive effects on GDP unless they are complemented by productive projects.
- ✓ **Innovation:** Financing the **green innovative sectors** can help move the economy away from resource extraction toward more sustainable, knowledge-based industries. The transition to a green economy can create new opportunities for development and growth for the RA by stimulating innovation and investments in more sustainable sectors of activity, shaping and expanding practices that contribute to sustainable development, creating new green jobs, creating new sectors of activity, and also achieving social and environmental goals. The high-tech sector is one of the priorities of the RA government, based on the motives of the RA economy and security. The results recorded in the sector are a valuable resource for the development of other sectors of strategic importance for the economy.
- ✓ **Economic diversification**: Armenia has the opportunity to leverage **green investments** to **diversify its economy**. Effective and balanced allocation of investments across all sectors of the economy will allow for the formation of a new structure that will be more diversified, conducive to stability, and ensuring balanced growth
- ✓ **Environmental resilience and sustainability**: With a focus on **green investment** and **environmental protection**, Armenia can ensure that its natural resources continue to support economic activities. Promoting green investments will help improve public health as a result of reducing the level of environmental pollution, which will be possible due to green and clean technologies, sustainable transport, healthy food production and consumption, and promotion of a healthy lifestyle. And fiscal and legislative levers will help ensure the rational and integrated use of subsoil in the industrial sector, exclude the overexploitation of natural resources, promote the targeted and economical and efficient use of land resources in the agricultural sector, and reduce the rates of deforestation, land degradation, and waste volumes in the construction sector.

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CHALLENGES AND OPPORTUNITIES OF SECURITIZATION IN ARMENIA'S BANKING SYSTEM

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Abstract: Securitization is an integral part of modern finance, providing liquidity and risk-sharing mechanisms. The driving force behind securitization is the need for banks to realize the value of assets on their balance sheets. Typically, these assets are residential mortgages, corporate loans, and retail loans, such as credit card debt. The article examines the quality of banking system assets, paying special attention to the growing volumes of mortgage lending and the overheating of the real estate market. It examines modern approaches to regulating the mechanisms of risk transfer from the banking system to the market, as well as the possible negative consequences of the application of Basel II and III on the pace of market development.

Keywords: *NPLs, Mortgage Loans, Securitization, Bazel II and III, Banking system*

Introduction

Since the Global Financial Crisis there has been a significant downturn in global securitisation market activity. As an alternative source of funding for the banking sector, securitisation markets can play a role in supporting economic growth. However, the revival of confidence in these markets depends on a range of complex factors, and both securities and prudential regulators must continue to address the issues with securitisation that came to light through the experiences of the Crisis. Risk retention has been a focus of regulatory attention since the Crisis, and is seen as a way to address misaligned incentives arising in certain structures and practices that were prevalent in some markets prior to the Crisis. The EU has implemented risk retention requirements for EU credit institutions through the Capital Requirements Directive (CRD) .The securitisation markets can play a role in supporting economic growth. Securitisation offers financial institutions a market-based alternative to existing sources of funding.

Securitisation markets create opportunities for issuers to raise finance through alternative funding and by diversifying funding sources, potentially making bank lending less sensitive to abrupt changes to the cost of funds, ultimately affecting the availability of finance to economic growth. For that reason, access to these funding sources may be important to those economies experiencing slow growth. The relationship between asset securitization and GDP is complex, and the effects can be both positive and negative. When

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Received: 25.11.2024
Revised: 09.12.2024
Accepted: 27.12.2024

managed properly, securitization can stimulate economic activity by increasing credit availability and lowering borrowing costs, which can contribute to GDP growth. However, poorly structured or excessive securitization can lead to financial instability and crises, which can harm economic growth. Therefore, while there can be a positive correlation between asset securitization and GDP in stable periods, the overall impact depends on the quality of the securitization process and the broader economic context.

Securitization by its nature is endowed with the function of redistributing and transforming long-term funds. It, in turn, transfers the existing risks of the banking system to the market and investors, making them more marketable. And from this perspective, the policy approaches of regulatory bodies in the field of risk management are important. How to regulate and at the same time not hinder the development of the securitization market. Securitisation represents a viable alternative source of funding for the banking sector at a time when funding diversification is needed. The sustainability of securitisation and its adequate regulation depend on a range of complex factors. Increasingly critical factors include the capital requirements imposed on investors through various regulatory initiatives such as Solvency 2 in Europe and liquidity coverage ratios and new risk weights for securitised products under Basel 2.5 and Basel 3.

Economic Theory

The process of securitisation creates asset-backed bonds. These are debt instruments that have been created from a package of loan assets on which interest is payable, usually on a floating basis. The asset-backed market was developed in the United States and is a large, diverse market containing a wide range of instruments. Techniques employed by investment banks today enable an entity to create a bond structure from any type of cash flow; assets that have been securitised include loans such as residential mortgages, car loans, and credit card loans. The loans form assets on a bank or finance house balance sheet, which are packaged together and used as backing for an issue of bonds. The interest payments on the original loans form the cash flows used to service the new bond issue. Traditionally mortgage-backed bonds are grouped in their own right as mortgage-backed securities (MBS) while all other securitisation issues are known as asset-backed bonds or ABS.

Consider the Reasons for Undertaking Securitization. The driving force behind securitization has been the need for banks to realize value from the assets on their balance sheets. Typically, these assets are residential mortgages, corporate loans, and retail loans such as credit card debt. Let's consider the factors that might lead a financial institution to securitize a portion of its balance sheet. A bank may want to reduce the size of its balance sheet for the following reasons (Anuk Teasdale, *The Process of Securitisation* 2003,17-3):

- ✓ *If the returns on assets remain roughly constant but the size of the assets has been reduced, this will lead to an increase in the return on equity ratio.*
- ✓ *The level of capital needed to support the balance sheet will be reduced, which again may lead to cost savings or allow the institution to allocate capital to other, potentially more profitable, businesses.*
- ✓ *To obtain cheaper financing. Often, the interest rates payable on ABS securities are significantly lower than the rates payable on the underlying loans. This creates a cash surplus for the original entity.*

Studying the historical developments of the securitization market, it becomes clear that the driving force of securitization is the banking system. Of course, strict regulations

of the banking system have a positive effect on reducing risks in the system, but they can also negatively affect the quality of banks' loan portfolios and creditworthiness in the economy. Consider the distribution of the loan portfolio of the banking sector of Armenia for the last two decades. Loan Portfolio Trends in Armenia.

Looking at Non-Performing Loans (NPLs) in the Armenian banking system from 2013 to 2024, we see that the share of NPLs in Armenia's total loan portfolio has fluctuated significantly (see figure 1). In 2015, NPLs peaked at 7.95%, reflecting economic challenges. However, due to improved risk management and economic recovery, NPLs have decreased to 2.4% by 2022. A slight increase to 4.5% in 2024, according to the latest data, highlights the potential emerging risks. As for the share of Mortgage loans, we can see that Mortgage lending has grown significantly, from accounting for 18% of total loans in 2013 to an estimated 41% by 2024. This growth demonstrates a robust demand for housing finance, spurred by favorable interest rates, government initiatives, and increased consumer confidence. Finally, as the chart shows the ratio of bank loans to GDP has remained steady at around 50% over the past decade (see: https://www.cba.am/EN/pperiodicals/Stability_Report_2023.pdf). This balance underscores the importance of credit in supporting Armenia's economic activity while raising questions about potential over-leveraging.

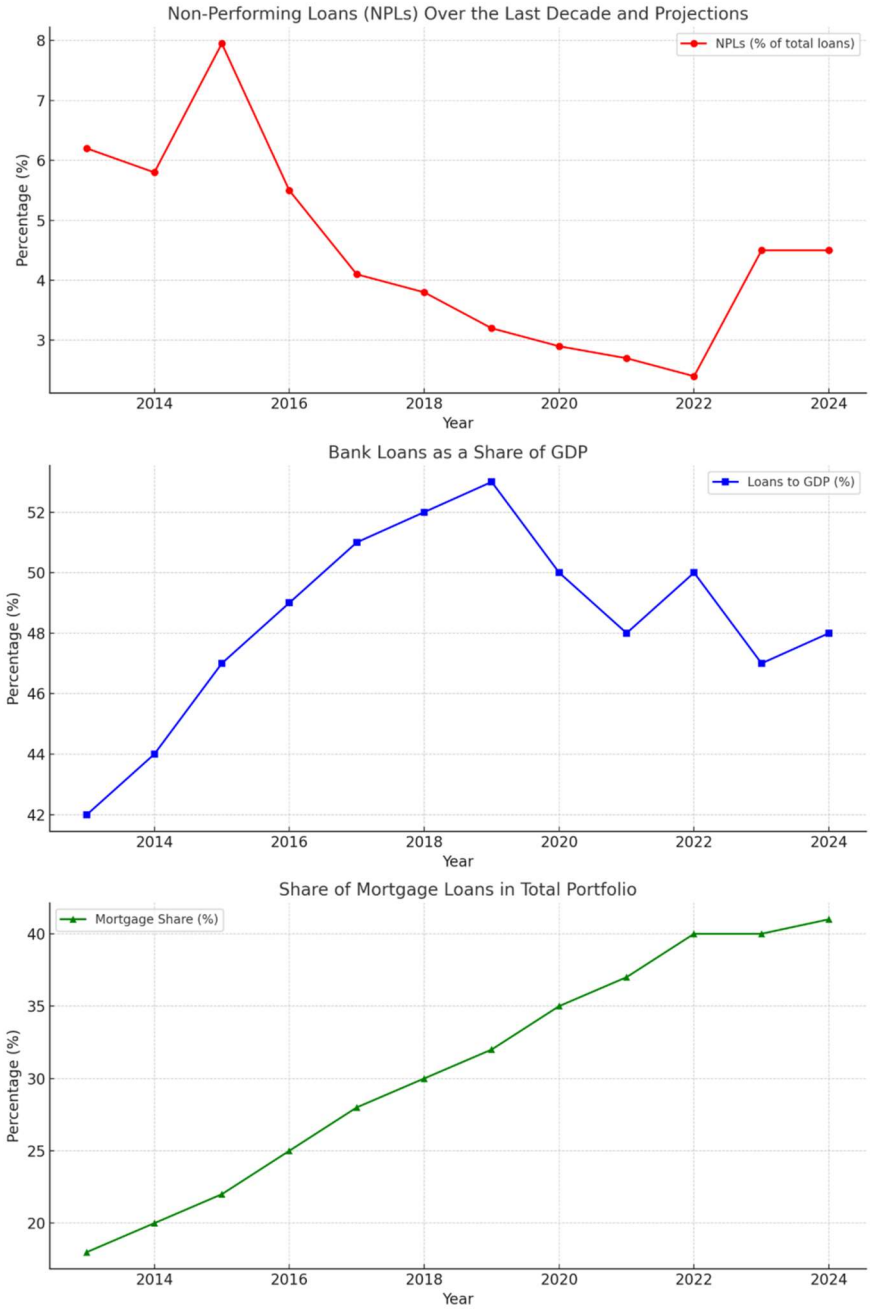
International regulatory standards have been introduced in the banking system of the Republic of Armenia, the primary goal of which is the prevention and detection of existing and uncertain risks. From this perspective, the financial system of the Republic of Armenia is no exception with its market regulation and behavioral requirements. Asset securitization essentially intersects two poles that are different from the point of view of financial regulation. The need for securitization regulation was more deeply understood especially after the crisis, where the need for a systemic approach and a common approach to risk recognition became clear.

For this purpose, the Basel Committee, which The Basel Framework is the full set of standards of the Banking Supervision (BCBS), which is the primary global standard setter for the prudential regulation of banks. The membership of the BCBS has agreed to fully implement these standards and apply them to the internationally active banks in their jurisdictions. Let us consider the standards for the application of the Basel international standards for the Republic of Armenia and the consequences of their possible effects on the activities of issuers.

There is a wealth of research on this topic, particularly on how Basel III encourages banks to use securitization to remove assets from their balance sheets and reduce capital requirements. (See: Acharya, V., Schnabl, P., & Suarez, G. (2013). "Securitization without Risk Transfer.") or the impact of securitization on securitization, where the authors examine how regulations aimed at ensuring transparency and risk assessment contribute to increasing investor confidence, ensuring stable market growth, while pointing out that excessive bureaucracy can also hinder development. (see: Keys, B. J., Mukherjee, T., Seru, A., & Vig, V. (2010). "Did Securitization Lead to Lax Screening? Evidence from Subprime Loans."). At the same time, international comparative analyses show that the development of the securitization market has been most stimulated in countries with balanced regulatory approaches. This study examines how different regulations in the US and Europe have affected the volume of securitization and the distribution of risks. At the same time, the growth of securitization volumes and their impact on the financial crisis have been analyzed, indicating that securitization has contributed to the increase in market liquidity, but also contributed to the accumulation of risks. (Gorton, G., & Metrick, A. (2012). "Securitization.").

Figure 1

NPLs, Bank loans as share of GDP and Share of Mortgage loans in total portfolio.



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Referring to the regulation of the banking system of the Republic of Armenia, as well as securitization as an object of regulation, we note that, the banking system of Armenia has prudential regulatory approaches towards financial institutions and especially banks, which were introduced taking into account the Basel regulations and methodology. Considering the specific frameworks of Basel II and Basel III regulations, let us present their limitations, especially in the securitization sector. Thus the Basel Committee on Banking Supervision (BCBS) plays a crucial role in regulating the global banking sector, including the securitization process. The committee's regulations are designed to ensure that banks manage the risks associated with securitization and maintain financial stability. Basel II and Basel III introduced specific frameworks for addressing the risks inherent in securitization activities, focusing on improving risk management, capital adequacy, and transparency. So, can these regulations still be an obstacle for the emerging market and slow down the development trends of the market? Let us consider the nuances of the RA regulation. Basel II, introduced in 2004, set out a more comprehensive framework for capital adequacy, risk management, and disclosure, with a particular focus on the following key aspects of securitization:

- *Risk-Weighted Assets (RWA) Calculation for Securitization Exposures:*
- *Capital Requirements for Securitization Tranches:*
- *Disclosure and Transparency:*
- *Securitization Risks:*

At the same time, Basel II also acknowledged the importance of managing specific risks inherent in securitization, such as:

- ✓ Credit Risk: The risk of default on the underlying assets in a securitization pool.
- ✓ Liquidity Risk: The risk that the securitized assets might be difficult to trade in secondary markets.
- ✓ Operational Risk: The risk of failures in the processes associated with securitization, such as inaccurate asset valuations or failures in servicing and managing the assets.

The global financial crisis of 2007–2008 led to a need for stricter economic standards and regulation in all areas. In response, Basel III, which came into force in 2013, introduced stricter requirements to address risks and deficiencies that had been highlighted during the crisis. The main changes in Basel III related to securitization were aimed at strengthening capital buffers, increasing liquidity requirements, and improving risk management practices. The Basel III approach to securitization can be seen in the following areas: These strictures concerned several aspects.

1. Increased the capital requirements for banks, particularly for the riskier exposures, including securitization. The framework required higher-quality capital (Tier 1 capital) and larger capital buffers to absorb potential losses in times of financial stress. This meant that banks engaged in securitization had to hold more capital against their securitized assets, especially for lower-rated tranches or more complex securitization structures.

2. Introduced the leverage ratio to limit excessive risk-taking by banks. The leverage ratio acts as a backstop to the risk-weighted capital ratio, ensuring that banks do not become over-leveraged. For banks with significant securitization activities, this was an important factor to ensure that they held adequate capital in relation to their overall size and leverage.

3. Introduced liquidity requirements to ensure that banks have sufficient liquidity to meet their short-term and long-term obligations. These requirements have

implications for securitization:

4. Basel III revises the treatment of securitization exposures under the risk-based capital framework. For example, it applies a more conservative approach to the risk-weighting of certain securitized products.

- Revised Internal Ratings-Based (IRB) Approach, includes modifications to the IRB approach to account for the complexity and risks associated with securitization. Banks using internal models to assess the risk of securitized assets must apply more stringent assumptions about credit quality and risk correlations.
- Supervisory Approach for Securitizations: also emphasized more robust supervision of securitization activities. Regulators are required to ensure that banks adequately capture the risks associated with securitization, particularly with regard to off-balance-sheet exposures (e.g., special purpose vehicles or conduits) and hidden risks in complex structured products.

5. Higher Transparency and Disclosure**:** Basel III continued the push for enhanced transparency, especially concerning complex and opaque securitization structures. Banks are required to provide more detailed disclosures on the composition of their securitization portfolios, including the risk characteristics of underlying assets and the capital set aside to cover potential losses. This improves market discipline and ensures that investors and regulators are better informed about the risks banks are exposed to.

6. Risk Retention and "Skin in the Game": Along with related regulations (e.g., the Dodd-Frank Act in the U.S.), it emphasized the need for banks and other originators of securitizations to retain a portion of the risk. This is known as the risk retention rule, which requires that banks retain at least 5% of the credit risk on the securitized assets they originate. The rationale is to align the interests of the originator with those of investors, reducing the likelihood of reckless lending and securitization practices that contributed to the 2008 crisis.

So, to summarize, Basel II focused on capital adequacy, risk weighting of securitized assets, and transparency. It allowed for both standardized and internal ratings-based approaches to risk assessment. Basel III was introduced to impose higher capital requirements, stricter leverage ratios, liquidity requirements (LCR and NSFR), and stronger supervision of securitization activities. It emphasized risk retention by originators (risk retention) and more detailed disclosures to ensure better transparency in the securitization process. Both Basel II and Basel III aim to regulate the securitization process to ensure that banks properly manage the risks associated with these financial instruments. While Basel II laid the foundation for capital requirements and risk management in securitization, Basel III introduced stricter rules to enhance stability, liquidity, and transparency, especially after the financial crisis of 2007-2008. In terms of securitization, the main evolution from Basel II to Basel III is the focus on greater flexibility through higher capital buffers, liquidity requirements and risk containment mechanisms to prevent excessive risk. By introducing both approaches and defining the more stringent Basel approaches within its regulation, Armenia has attempted to contain possible scenarios of risks emerging in the system from a financial stability perspective. However, rather strict approaches lead to increased costs and, in essence, from a financial perspective, do not contribute to banks resorting to securitization due to its inherently low benefits. Thus, strict regulatory requirements or compliance burdens can lead to market passivity, as

compliance costs and additional capital requirements can reduce the profitability of securitization and as a result, financial institutions will prefer to keep the assets on their balance sheets rather than incur these costs. Valuable research has also been done on the barriers to market development and regulation. In particular, how regulations, often aimed at reducing market risks, limit the entry of new participants into the market. And how regulatory transparency has contributed to the liquidity of the securitization market. (Pagano, M., & Volpin, P. (2012). "Securitization, Transparency, and Liquidity." 210-217). With all this, in Armenia, we see essentially the same picture. At the same time, the low level of securitization or the fact that financial institutions do not seek to participate in the securitization process, is due to a combination of practical, regulatory, and economic reasons. At the same time, considering the rapid growth rates of loans in the Republic of Armenia, particularly in the mortgage sector, the regulatory body is faced with a dilemma: whether to develop the market by relaxing some regulatory norms or pursue a risk containment policy by increasing regulatory requirements.

Summary

In conditions of high activity and profitability, avoiding securitization, financial institutions, in particular banks, reduce risks and optimize their financial strategies in line with economic principles and market realities. From the point of view of financial stability, such regulatory approaches curb the likelihood of risks, but at the same time inadvertently become an obstacle to the emergence of alternative instruments in the market due to their economic and financial “uselessness”. At the same time, the growth of the mortgage market in recent years, as well as its impact on GDP, has been gradually increasing, which in turn may lead to risks, the regulation and prioritization of which are considered of paramount importance. A slight increase in NPLs to 4.5% in 2023 may indicate an increase in credit risk. The growing reliance on mortgage lending may expose banks to risks related to the sector, especially if, according to the 2023 Financial Stability Report of the Central Bank of Armenia, the real estate market experiences a decline or a significant depreciation of property values. Proving that the securitization process, due to its structural peculiarity of financial engineering, acts as a "bridge" connecting participants in the banking and financial markets. From this perspective, there is also a need to introduce a new regulatory policy by both regulatory bodies and market participants. Financial system regulation has a significant impact on the development of the securitization market, shaping the level of market transparency, risk distribution and investor confidence. The "successful" development of securitization requires balanced regulations that will simultaneously contribute to ensuring transparency, real risk transfer and market liquidity. In this regard, regulators are encouraged to use “regulatory sandboxes” as a method of “testing” the regulatory easing scenarios under consideration as a possible policy change. The regulator should launch a “regulatory sandbox” that allows banks to test innovative securitisation mechanisms without the full burden of regulation. “Sandboxes” allow regulators to base their regulatory response to innovation on the results of real experiments. This helps regulators make faster and more informed decisions about how to properly regulate (and supervise) new services and providers entering the market.

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MULTI-FACETED ANALYSIS OF MTPL PRICE LIBERALIZATION IN THE RA: STRATEGIES AND MARKET DYNAMICS

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Abstract: The Mandatory Third Party Liability (MTPL) insurance in Armenia is pivotal in covering damages caused to third parties by insured vehicles, encompassing both material prejudice and bodily injury compensation. Over its thirteen-year implementation, the system has evolved, with significant changes such as the introduction of bonus-malus (BM) components aimed at fairer risk distribution. However, disparities in the BM system have led to considerable uncollected premiums, exacerbating industry losses. To address this, insurers and regulatory bodies have agreed to liberalize premium calculation models, allowing companies to adopt individualized approaches. With the help of quantitative, comparative and financial statement analysis, this study analyzes the effectiveness of these models, assessing market positions, online sales, and premium trends. Results indicate varying strategies among insurers, with implications for risk assessment and portfolio management.

The study underscores the importance of adaptable pricing models in optimizing risk management and profitability in the evolving MTPL landscape. With a firm grasp of the complex interplay between regulatory changes, insurer strategies, and market dynamics, stakeholders can make informed decisions to optimize their competitive positioning and ensure long-term viability in the CMTPL market of Armenia.

Keywords: *insurance pricing, CMTPL, loss ratio, risk factors, bonus-malus*

Introduction:

The Compulsory Motor Third Party Liability (CMTPL) system was introduced in Armenia in 2011 as a unified system, with all six non-state non-life insurance companies operating at that time joining the system. Initially, insurance premium pricing in the system, until April 1, 2023, was unified, with the profit component being almost absent.

However, the absence of a profit component and the unified pricing system led to a decrease in insurance companies' interest in the system. Consequently, insurance companies sought to conclude contracts only with low-risk policyholders, often by offering high commissions to their agency networks.

This practice resulted in unhealthy competition between insurance companies. To address these issues and promote price-quality competition in the system, pricing in the CMTPL system was liberalized on April 1, 2023. Under the new system, each company has the right to develop its own pricing model, subject to approval by the CMTPL Bureau of RA.

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Received: 07.05.2024
Revised: 18.05.2024
Accepted: 27.12.2024

The purpose of this work is to analyze the net loss ratio and other key indicators of insurance companies during the period of pricing liberalization in the insurance system.

The research was conducted using quantitative analysis, comparative analysis and financial statement analysis methods. Quantitative analysis implies gathering numerical data on CMTPL liberalization outcomes in Armenia over the past two years. The collected data included factors such as the number of insurance claims, written premiums, written payouts made, etc. This data was used to calculate the net losses of insurance companies during the liberalization period and a year before the liberalization, which indicates the compliance of the company's liberal model with the actual risk of policyholders. The risk level of policyholders is characterized by many factors, such as the policyholder's age, driving experience, place of residence, permanent or historical driving area, purpose of vehicle use, engine power, etc. These factors can affect the probability of having an accident and the severity of the damage caused. Through the analysis of financial reports, the costs of each company on CMTPL were identified and assessed. This analysis also estimated the combined losses of the companies. The components of combined losses provide insights into the company's policy, such as whether the company prefers to sell through an agency network or online, and whether it offers lower tariffs by reducing system costs. Comparative analysis was used to compare the models of different companies. The aim was to determine whether the simplicity or complexity of the models affects the net loss of the company.

This analysis aims to compare and explain these indicators from the perspective of the new pricing models developed by the insurance companies.

International Experience of CMTPL Free Pricing:

The CMTPL insurance business holds a significant part of the market portfolio in all countries of the Central and Eastern Europe (CEE) region. Even in the most developed ones, CMTPL provides for at least a quarter of the non-life insurance business.

Overall, there has been an increasing trend in CMTPL tariffs in recent years. However, the markets remain very competitive and price-sensitive. This competitive nature is the number one risk factor in liberalizing tariffs, as demonstrated by recent examples in Albania and Croatia. These examples show that insurers tend to capitalize on the freedom to set tariffs to capture a larger market share.

In the CEE region, the status of CMTPL tariffs is as follows:

- Croatia and Albania are two CEE markets that have recently experienced the process of CMTPL market's deregulation.
- In Montenegro, although the change should have been introduced at the end of 2017, the process has been postponed for 4 years, as both the market authority and insurers considered that the local market is not ready to implement the free tariffs.
- In the other countries in the Western Balkans region, outside the EU – Serbia, Bosnia & Herzegovina, Macedonia, Montenegro, Kosovo – CMTPL tariffs are still state controlled; in cooperation with the World Bank, these countries are currently undergoing different stages of the preparations for the MTPL liberalization.
- In the CEE EU member states – except for Croatia, the CMTPL markets were liberalized decades ago, before the year 2000.

Although mandatory in all European countries, CMTPL insurance registers major

differences in both rates and coverage across the CEE and CIS markets. Thus, if in countries such as Russia and the Republic of Moldova the CMTPL price is a standard one, regulated through the local legislation, in the member states of the European Union (EU) the price liberalization transformed the CMTPL into one of the main score points of the insurance markets (Doronceanu, 2014).

MTPL in the European Union (EU) has been deregulated fairly recently (mainly over the period 1968–94) and, for this reason, illustrates the steps that are necessary when introducing a free market in the insurance sector. The EU directive regarding the "freedom to provide services and right of establishment" (1988 and following modifications in 1990 and 1992) affirms the principle of freedom to set tariffs in all EU countries. Yet different countries have pursued liberalization at different times and in different ways.

In France, for instance, a very limited regime of control was in place for the approval of MTPL tariffs after the end of World War II. A pure regime of liberalized tariffs has been applied since 1986 (that is, many years before the official date for liberalization imposed by the European directive). In Spain, the freedom to set prices in the insurance sector was established in August 1984 (again, many years before the official date for liberalization). In the United Kingdom, tariffs have not been subject to any type of control for several decades. In Germany, before 1994, tariffs were approved on the basis of the previous year's technical results of marginal companies, with the objective of avoiding their exit from the market. Complete liberalization was achieved, however, only in 1994. Italy was the last major Western European country to move toward a liberalized regime following the EU directive in 1994. Before then, prices were administered by a ministerial committee, and the tariff structure was identical for all companies. The only differentiation between potential buyers was derived by the application of three rating factors: the power of the car's engine, the area of residence, and the application of a bonus-malus scale. The level of loadings on the pure premium that different companies could apply was limited according to the historical trends registered by each company regarding their total general expenses. (Gonulal, 2009).

Where the procedure of introducing the free definition of tariffs for CMTPL insurance premiums was not well designed, the insurance companies and the entire insurance market faced the real perils. In some European countries, in the first phase of liberalization of CMTPL tariffs, there was an actual war of prices and a struggle to attract new policyholders, through too low insurance premiums. Even the most developed European countries, such as Germany, were not immune to such events, partly because the experience and possible consequences of the introduction of free definition of tariffs for CMTPL insurance premiums at that time were modest. The example of Greece is often cited as the worst example of the procedure of introducing the free definition of CMTPL tariffs. In a short period, Greece regulated the CMTPL system in accordance with the guidelines of the former European Community and quickly switched from the government-stipulated tariffs for CMTPL insurance premiums to tariffs completely freely defined by insurance companies. However, in the Greek system, the main problem was not short time allowed to apply the freely defined CMTPL tariffs, but the lack of market discipline and the unwillingness of the supervisory body to react promptly. As a result, during the process of applying the free setting of CMTPL tariffs in Greece, 30 insurance companies went bankrupt, leaving their clients without insurance coverage. Romania also suffered major disruptions in the insurance sector after liberalizing motor liability

insurance premiums. After joining the EU, in 2008, the country was allowed to freely form motor liability insurance tariffs. Following the initial growth of insurance premiums in the period 2008-2010, accompanied by high costs of insurance, with a constant very unfavorable combined ratio (up to 135%) (Doganjić, 2020).

Some markets, in the early introduction of liberalization are faced with the problem of invalid low

prices for MTPL, which reduces the solvency of insurers and in such cases; it is necessary to involve the regulator. For example, in Bulgaria when the Commission for Financial Supervision and regulation changed the regulation and lifted the minimum prices, of 60-70€, prices for MTPL fell by 30-40€ (Tomevski, 2012).

An example of the successfully implemented liberalization of motor liability insurance premiums is the liberalization implemented in Hungary. Prior to starting the CMTPL insurance system reform, only one state-owned insurer dealt with this insurance in Hungary and the insurance premium was collected through the price of the purchased fuel. From that period until today, numerous changes have taken place. These changes are reflected in the privatization of insurance, competition strengthening, premium differentiation and selection of insured persons through the bonus-malus system. The system of free definition of premiums has been gradually introduced since 1998. The application of free definition in motor liability insurance tariffs led to the privatization of insurers, setting premiums according to the degree of insured risk but also to the reduction of premiums in the initial phase. However, this system can be attributed to a relatively sluggish implementation, which is understandable because the system with only one state-owned insurer that provided CMTPL insurance services suddenly moved to a market with a large number of insurers competing with each other (Doganjić, 2020).

Analysis:

MTPL is intended to cover damages caused to third parties due to the use of an insured vehicle. The policy covers material prejudice produced to third parties, as well as expenses for the compensation of bodily injury or death.

As a mandatory system in RA, MTPL has promoted the development of other types of non-compulsory insurance, particularly CASCO insurance (Insurebusiness.am, 2024). However, the CMTPL system itself has also evolved during the thirteen years of its implementation. Two years after its introduction, the bonus-malus component was added to the system to ensure a fairer distribution of risks between policyholders who had accidents due to their fault and those who did not.

Initially, the insurance premium for any vehicle in the CMTPL system "depends" on the information about the driver and the vehicle. However, to simplify some factors and avoid fraud in the system, the policyholder eventually replaced the driver in determining the premium. Then the bonus-malus classes were changed in the system, because even at the end of the 2nd year of its operation, the BM system built on the Belgian model, provided more bonuses than malus under CMTPL contracts. For one private company, the uncollected insurance premium due to the BM system was more than 2% (Chitchyan, 2016), and by the end of 2021, according to the representatives of the insurance market participants, the uncollected premium due to the BM disparity in the whole market exceeded 5%. In addition to this circumstance, in December 2021 the net loss of the insurance system was 79% (Armenian Motor Insurers Bureau, 2022) with losses ranging from

69% to 81% for individual companies. In addition to this, insurance companies bear additional expenses, including[1]:

- an average of 10% of the expenses directed to the insurance system (the money allocated to the Bureau's guarantee fund (Armenian Motor Insurers Bureau, 2022) and the ASWA system (ASWA, 2024)),
- an average of 20% insurance operating costs of the company
- 10-15% commission to insurance intermediaries

These factors indicate that insurance companies are experiencing significant losses from the insurance system, with a combined loss exceeding 120%.

This system aims to distribute risks more fairly among policyholders and reduce the uncollected share of insurance premiums. In 2022, there were significant changes to the BM classes and the transition rules between them, which differed significantly from previous systems (Armenian Motor Insurers Bureau, 2022). Under the new rules, transitions between classes depend on the amount of compensation provided due to accidents caused by the policyholder's fault before signing the contract. This system aims to distribute risks more fairly among policyholders and reduce the uncollected share of insurance premiums.

According to decision No. 5-L of January 26 of the Council of the Bureau of Auto Insurers of Armenia, the insurance companies, CMTPL Bureau, and the Central Bank of RA have agreed to liberalize premium calculation models within a year. In this case, each company will build its own model based on its expectations for the system, particularly risk appetite, expected profit, etc. Thus, according to that decision starting from April 1, 2023, all insurance companies signed contracts based on their own pricing models. These models range from simple factor models to those using advanced techniques like machine learning and artificial intelligence. Table 1 provides a brief description of the models offered by insurance companies.

Table 1

Brief description of liberalization models

	Policyholder					**Vehicle**				
Insurance Company Name[2]	Registration Place	Entity Type	Age	Citizenship	Personal Risk	Type	Brand	Power	Sesonality	Other
"NAIRI INSURANCE" LLC (4 risk factors)	■	■				■		■		
"INGO ARMENIA" CJSC (ML model with 11 risk factors)	■	■	■	■	■	■	■	■		**+2**
"SIL INSURANCE" CJSC (7 risk factors)	■	■	■			■	■	■		**+1**
"ARMENIA INSURANCE" LLC (6 risk factors)	■	■				■	■	■		**+1**
"LIGA INSURANCE" CJSC (AI model with 132 risk factors)	■	■	■	■		■	■	■	■	**+124**
"REGO INSURANCE" CJSC (6 risk factors)	■	■	■			■	■	■		

Source: web pages of insurance companies (21.05.2024), constructed by authors

[1] The expenses are evaluated from financial statements of insurance companies

[2] In the subsequent Figures the abbreviated names of the insurance companies are used

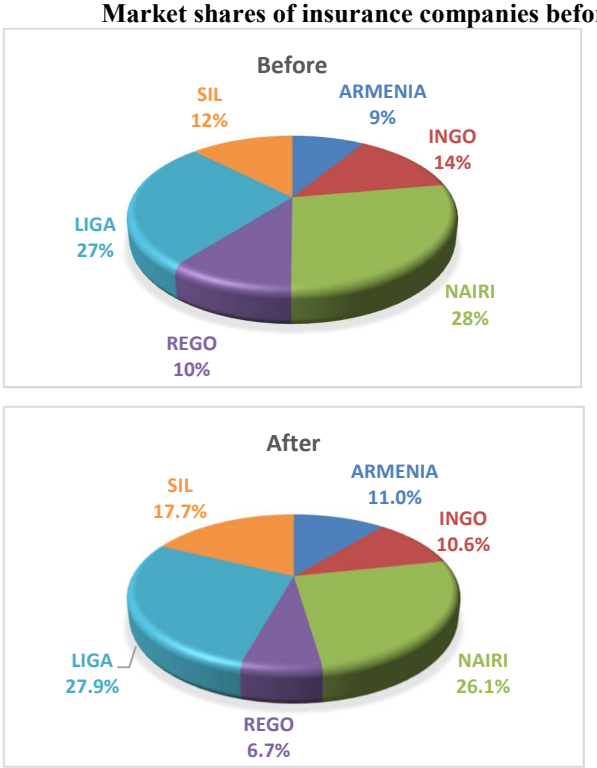
To assess the effectiveness of the models proposed by insurance companies, we analyze the net loss ratios for one year of price liberalization (01.04.2023-31.03.2024) and the preceding year (01.04.2022-31.03.2023). The choice of the analyzed period is due to the fact, that before the liberalization, the insurance premium was consentaneous and all companies offered the same price to policyholders with the same risk. In other words, the firms did not compete on price, and therefore the earlier information would not provide additional information or results for the price liberalization analysis.

To form an opinion on the policies of insurance companies during the period of price liberalization, we compare their market position, level of online sales, and average annual insurance premiums per contract.

Figure 1 shows that before liberalization, the leading insurance companies in the market were "NAIRI INSURANCE" (Nairi Insurance, 2024) and "LIGA INSURANCE" (Liga Insurance, 2024), which maintained their positions even after liberalization. "SIL INSURANCE" (Sil Insurance, 2024) and "ARMENIA INSURANCE" (Armenia Insurance, 2024) each increased their portfolios by 24% and improved their market positions after liberalization, ranking third and fourth, respectively.

Figure 1

Market shares of insurance companies before and after liberalization



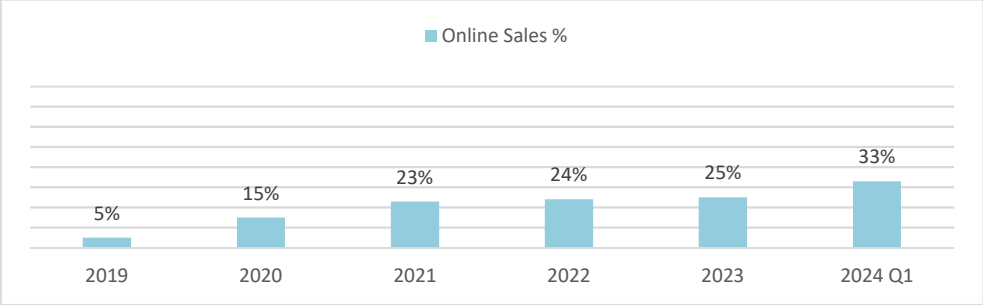
Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), constructed by authors***

The liberalization of insurance premiums also led to a significant increase in online sales, as insurance companies promoted online sales with lower premiums. However, as shown in Figure 2, the results did not meet expectations, with online sales accounting

for only 25% of the market in 2023, an increase of just 1 percentage point from the previous year. Nevertheless, the sharp 8-percentage-point increase in online sales in the first quarter of 2024 suggests that the public is increasingly preferring online purchase of contracts. This shift is likely due to the ability to obtain the same contract at a lower price, up to 15%.

Figure 2

Share of online sales in the market

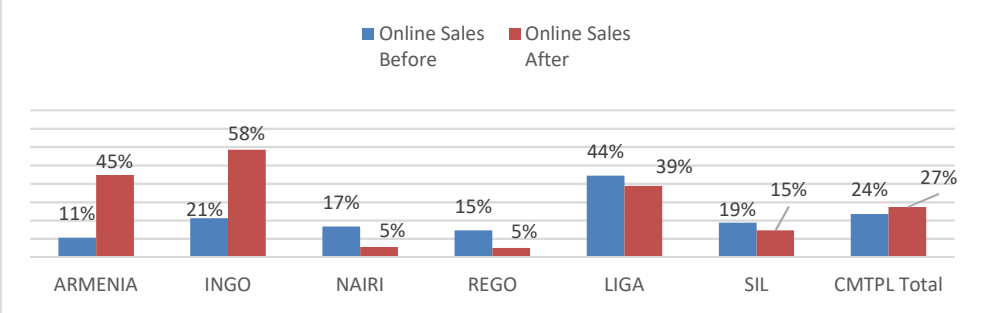


Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), constructed by authors***

However, based on Figure 3, it can be inferred that various companies have adopted different strategies for online sales. The offerings from "INGO ARMENIA" (Ingo Armenia, 2024) and "ARMENIA INSURANCE" were more favorable compared to those of other companies for policyholders with similar risks.

Figure 3

Share of online sales by companies before and after liberalization



Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), constructed by authors***

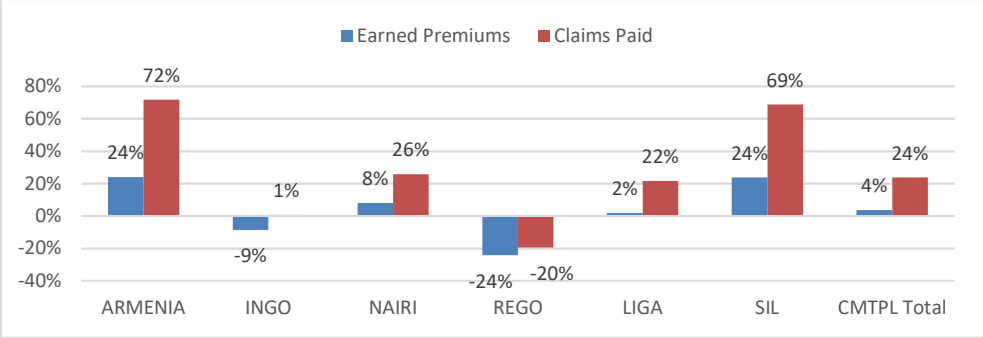
Although Figure 4 shows a 4% increase in premiums earned in the overall market, the average premium per contract in the market decreased by 1.5% (see Figure 5), and the increase in premiums earned is due to the increase in the number of cars in the market. At the same time, while the average compensation per claim increased by 12%, the total claim amount increased by 24%, driven by a nearly 9% increase in the number of claims, relatively more expensive vehicles entering the market and sector inflation.

By comparing the changes in premiums earned and claims paid by companies before and after the liberalization, it becomes apparent that "SIL INSURANCE" and "ARMENIA INSURANCE" have made relatively large claim payments in proportion to the growth of their portfolios (see Figure 4). Additionally, "ARMENIA INSURANCE" has a high level of online sales, indicating that the portfolio may consist of riskier clients.

The company also has the highest average annual premium per contract in the market (Figure 4), further suggesting a riskier portfolio. Therefore, it can be concluded that customers with a high number of malus points are more likely to be insured by these companies.

Figure 4

Changes in Earned Premiums and Paid Claims

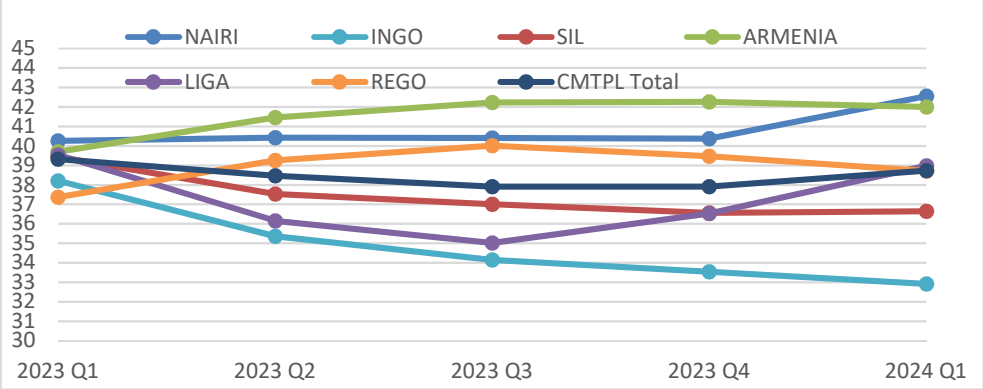


Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), constructed by authors***

For "SIL INSURANCE," its below-market-average level of online sales and portfolio growth suggest the accumulation of a low-risk portfolio. This is also evident from its position in the market based on the average annual premium per contract (Figure 5). The substantial growth in paid claims (69%) can be attributed to the company's strategy of creating more attractive conditions for its clients, thereby fostering portfolio growth.

Figure 5

Average Annual Premium per Contract (thousands AMD)



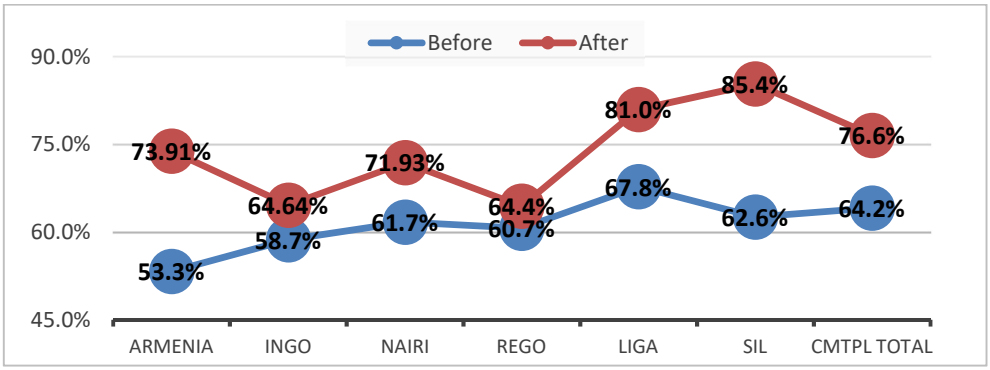
Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), constructed by authors***

It's worth noting that the models of "NAIR INSURANCE" and "LIGA INSURANCE" companies are extreme in terms of risk factors (Table 1). However, the overall increase in paid claims in these companies is close to the market growth rate. This suggests that their leading position in the market, rather than the models and/or the level of risks they include, played a significant role.

To complete the analysis of liberalization, we also study the loss ratios of insurance companies before and after the pricing liberalization.

Figure 6

Loss ratios before and after liberalization



Source: https://appa.am/index.php?al=appa_statistics ***(21.05.2024), calculated and constructed by authors***

Considering that the pricing models of "SIL INSURANCE," "ARMENIA INSURANCE," and "REGO INSURANCE" (Rego Insurance, 2024) are based on almost the same factors, the loss ratios indicate that "REGO INSURANCE" evaluates risks more appropriately in its model compared to "SIL INSURANCE" and "ARMENIA INSURANCE."

On the other hand, the low level of online sales at "REGO INSURANCE" prevented the inclusion of many random risks in its portfolio, contributing to its low loss ratio. In contrast, "INGO ARMENIA" had the highest online underwriting rate but a similar loss ratio to "REGO INSURANCE." Additionally, "INGO ARMENIA" has the lowest average annual insurance premium per contract, suggesting that it has been able to attract a low-risk portfolio, with policyholders with high bonuses choosing "INGO ARMENIA" during online contract purchases.

From Figure 5, it's evident that there was a policy change in "NAIRI INSURANCE" and "LIGA INSURANCE" regarding insurance premiums, resulting in a 5.4% and 6.7% increase, respectively, in the average annual premium per contract. While the growth of claims in these companies corresponds to the overall market trend, the average annual premium per policy of "LIGA INSURANCE" has consistently been lower than that of "NAIRI INSURANCE" throughout the liberalization period. This difference has contributed to a greater increase in the loss ratio of "LIGA INSURANCE.

Conclusions:

The decision to liberalize premium calculation models represents a significant paradigm shift in the Armenian insurance sector, empowering insurers to adopt individualized approaches tailored to their risk appetites and profitability objectives. However, the analysis highlights that even models based on artificial intelligence do not guarantee the most accurate assessment of risks. This underscores the importance of ongoing refinement and validation of pricing models to ensure effective risk management.

Moreover, the findings emphasize that a high percentage of online signings does not necessarily hinder achieving a low level of loss ratio, provided that risk factors are well-estimated. This underscores the importance of accurate risk assessment in optimizing portfolio performance and profitability.

Companies can follow trends and take a more rigorous approach when building models. The choice of risk factors and the evaluation of their impact should be made in more detail, in

accordance with the real risks, using international experience. We suggest companies analyze the indicators obtained after liberalization based on the most detailed information available to them, make appropriate conclusions, introduce new statistically significant factors or remove from the model those factors that do not have a significant impact on the insurance premium.

With proper risk assessment, insurance companies can promote online sales by reducing commission costs. Along with the growth of online sales, some other administrative costs will also decrease, which can provide companies with profits and contribute to lower insurance premiums in the long run.

Moving forward, regulatory bodies and insurers must collaborate closely to monitor market dynamics, address emerging challenges, and foster a conducive environment for sustainable growth. Initiatives aimed at promoting transparency, consumer education, and market integrity will be instrumental in building trust and confidence among stakeholders.

Overall, the analysis offers valuable insights for insurers, regulatory authorities, and other industry stakeholders seeking to navigate the complexities of the CMTPL market in Armenia. By understanding the underlying trends and dynamics shaping the market, stakeholders can make informed decisions and contribute to the advancement of the insurance sector in Armenia.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 102-111
https://doi.org/10.46991/BYSU.G/2024.15.2.102

ASSESSMENT OF THE LONG-TERM RELATIONSHIP BETWEEN RA PERSONAL TRANSFERS-ECONOMIC GROWTH USING THE VEC MODEL

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Abstract: The article evaluates the macroeconomic impact of personal transfers from abroad in Armenia. The analysis utilizes quarterly data on macroeconomic indicators spanning the period from 1996 to 2024.The data sources are the databases of the Central Bank of Armenia and the Statistical Committee of Armenia. Hypotheses have been proposed, and to test them, ARDL class and Vector Error Correction (VEC) models were constructed. The Granger causality test indicated unidirectional causality, where personal transfers from abroad drive changes in economic growth, but not vice versa. Meanwhile, the Johansen cointegration test confirmed the existence of a long-term relationship between personal transfers from abroad and economic growth in Armenia. The results of the VEC model indicate that a 1% increase in personal transfers from abroad leads to a 0.42% rise in Armenia's real GDP in the long run, whereas a 1% increase in the export of goods and services results in a 0.35% growth. An increase in the rate of economic growth in Armenia leads to a reduction in personal transfers from abroad. A 1% increase in real GDP leads to a reduction in external personal transfers by 1.08% after 4 quarters, 1.05% after 5 quarters, and 1.22% after 6 quarters. The findings from the regression and VEC models indicate that personal transfers from abroad do not have a significant short-term effect on Armenia's economic growth. The results of the research can be useful in the development of Armenia's macroeconomic policy.

Keywords: *personal transfers from abroad, economic growth, regression model, Vector Error Correction model, cointegration relationship*

Introduction

Personal transfers from abroad play an important social and economic role in Armenia's economy. For many households, these transfers provide a source of income and create opportunities for building and enhancing physical and human capital. At the national level, they serve as a source of foreign currency, boosting aggregate demand and ultimately contributing to GDP growth. From 2013 to 2019, our country's dependence on foreign remittances decreased: in 2013, the net inflow of transfers to individuals through Armenian banks constituted 13.0% of GDP, while in 2019, it dropped to 3.7%. However, during 2020-2022, this indicator increased from 4.5% to 12.8%, and in 2023, it amounted to 6.9%

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Received: 16.11.2024
Revised: 01.12.2024
Accepted: 27.12.2024

(CB of RA, 2024). Notably, starting from 2016, the amounts transferred from Armenia abroad have been increasing year by year. In 2018-2019, this was mainly due to the large import of vehicles from abroad, while in 2022-2023, it was linked to the Russia-Ukraine conflict. The decrease in the ratio of net transfers/GDP is evidence of the country's reduced economic dependence on foreign monetary transfers.

According to Armenia's Balance of Payments, the inflow of personal remittances from abroad amounted to $18.4 million in 1995. Due to the devaluation of the Russian ruble, the volume of transfers sharply decreased in 1997 from $101.6 million to $84.3 million in 1998. From 2000 to 2008, transfers increased from $104.0 million to $837.3 million, contributing to the growth of both consumption and construction in the country. As a result of the 2008-2009 financial crisis, the flow of remittances decreased, but it began to recover at an average rate of 4%. Between 2017 and 2022, the inflow of external personal transfers increased from $680.5 million to $1,150.6 million, while in 2023, it decreased to $845 million (CB of RA, 2024). In 2023, the top five countries in terms of volume of remittances were Russia, the USA, Germany, the UAE, and France. In the first quarter of 2024, external personal transfers amounted to $170 million, and $149 million in the second quarter.

The primary aim of this study is to evaluate the interaction between economic growth and external personal transfers in Armenia. The proposed hypotheses include:

- **Hypothesis 1:** There is a long-term positive relationship between personal transfers from abroad and economic growth in Armenia.
- **Hypothesis 2:** An increase in Armenia's economic growth rate leads to a reduction in personal transfers from abroad.

Literature review

The economic literature includes numerous empirical studies examining the impact of remittances from abroad on various macroeconomic indicators. Cazachevici et al. (2020, pp. 1–14) highlight the lack of consensus on the impact of remittances on economic growth. Analyzing 538 estimates from 95 studies, they observe that around 40% of the studies report a positive effect, another 40% report no effect, and 20% indicate a negative effect. They conclude that, while the average impact of remittances on growth remains positive, it is economically modest. Ahmed and Uddin (2009, pp. 79–92) demonstrated that in Bangladesh, imports, exports, and remittances influence economic growth in the short term; however, their long-term impact is insignificant. Similarly, Paul et al. (2012, pp. 164–192) investigated the long-term effects of remittances on the living standards of poor rural households in Mexico over the long term and concluded that these remittances could lead to sustained income growth if part of them is invested in productive activities. Abdelhadi and Bashayreh (2017, pp. 98–102) utilized the VEC model to analyze Jordan and found a significant positive relationship between foreign remittances and economic growth in both the short and long term.

Bucevska (2022, pp. 79–94) employed panel regression with a fixed-effects model to examine the role of remittances as a driver of economic growth in six South-East European (SEE) countries and found that remittances significantly and positively influence economic growth across the SEE region. Kumar et al. (2018, pp. 95–126) examined the impact of remittances on the economies of Kyrgyzstan and North Macedonia, highlighting the role of banks and pension funds. In both countries, remittances are considered a source of income that promotes socio-economic development and contributes to economic growth. Adela and Meyer (2013, pp. 3–19) examined data from 21 developing countries to assess

the influence of remittances on different dimensions of economic development and revealed that significant economic growth was recorded in countries with substantial inflows of remittances compared to others. Olofsdotter and Abdullaev (2011, pp. 16–31) explored the effect of remittances on economic growth in countries across Asia and the former Soviet Union. Using regression analysis, they found that remittances have a positive effect on per capita income growth in the 10 countries studied. Comes et al. (2018, pp. 1–16) analyzed seven Central and Eastern European countries with a GDP per capita of $25,000 and found that foreign direct investments have a greater impact on GDP than remittances.

Data and Methodology

The analysis considers quarterly data on the following variables for the Republic of Armenia (RA) from 1996 to 2024: nominal GDP[1] (GDP), real GDP (GDPR), personal remittances from abroad (TRANS), exports (EX), imports (IM), private consumption expenditures (CC), and gross investments (INV). The data sources are the databases of the Central Bank of Armenia and the Statistical Committee of the RA. The research was conducted using the ARDL class model and Vector error correction models.

In addition to the personal remittances from abroad and real GDP variables, the research also considered the expenditure components of GDP, which affect economic growth and help improve the model as macroeconomic variables. Later, the personal consumption expenditure variable was removed from the models.

Stationary time series were considered in the regression model. To test the stationarity of the series, the Augmented Dickey-Fuller (ADF) unit root test was applied, which estimates the following equation:

$$\Delta X_t = \beta_1 + \gamma X_{t-1} + \beta_2 t + \sum_{i=1}^{k} c_i \Delta X_{t-i} + \varepsilon_t \quad (1)$$

In (1), $\beta_1, \beta_2, \gamma, c_i$ are coefficients, t is the time or trend variable, and ε_t is the random error, which represents a White Noise process. The ADF tests the null hypothesis $\gamma = 0$. If this hypothesis is accepted, the time series has a unit root and is therefore non-stationary. To achieve stationarity, the differencing operator is applied.

If there is no cointegration, the ARDL class model for two explanatory variables is presented by the following formula:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta Y_{t-1} + \cdots + \alpha_P \Delta Y_{t-P} + \beta_0 \Delta X_{1,t} + \beta_1 \Delta X_{1,t-1} + \cdots + \beta_q \Delta X_{1,t-q} + \gamma_0 \Delta X_{2,t} + \gamma_1 \Delta X_{2,t-1} + \cdots + \gamma_k \Delta X_{2,t-k} + \varepsilon_t, \quad (2)$$

where y_t is the dependent variable, X_{jt} is the j-th explanatory variable, β_j is the j-th parameter, and ε_t is the random error.

Using the VEC model, a long-run relationship between Armenia's economic growth and personal remittances from abroad has been identified. For the application of the VEC model, the variables must represent a first-order integration process, I(1). According to Engle and Granger (Engle & Granger, 1987, 251-276), if the linear combination ε_t of the I(1) processes X_t and Y_t is an I(0) process, then the variables X_t and Y_t are cointegrated. This means that there is a long-run interdependence between these variables.

If ε_t is an I(0) process, then the equilibrium error for the previous period is represented by the following formula:

$$\varepsilon_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1} = Y_{t-1} - \widehat{Y_{t-1}}, \quad (3)$$

where Y_{t-1} is the actual value of Y_t in the previous period, and $\widehat{Y_{t-1}}$ is the equilibrium

[1] All indicators are measured in million drams.

value. The change in Y_t over time is represented by the following equation:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 \varepsilon_{t-1} + u_t, \quad (4)$$

where ε_{t-1} is the error correction component of the model. The logic of error correction is as follows: if $\varepsilon_{t-1} \neq 0$, there is no equilibrium, and ε_{t-1} is used to correct the imbalance. $|\alpha_2|$ represents the speed of equilibrium restoration. If $\alpha_2 < 0$, the imbalance is corrected, indicating cointegration and a long-term interdependence.

To identify cointegration among the variables under study, several Vector Autoregression (VAR) models satisfying the stability condition were constructed. The best model was chosen based on the minimum value of the Akaike Information Criterion (AIC). For the selected VAR model, the Johansen cointegration test (Johansen, 1988, pp. 231–254) was applied to examine long-term stable relationships between the variables. For cointegration analysis, the Trace and Maximum Eigenvalue tests were used.

The homoscedasticity, non-autocorrelation, and normal distribution of the residuals of the models were tested using the Breusch-Pagan-Godfrey, Breusch-Godfrey LM, and Jarque-Bera tests, respectively. In the ARDL class model the accuracy of the model specification was confirmed by Ramsey's test.

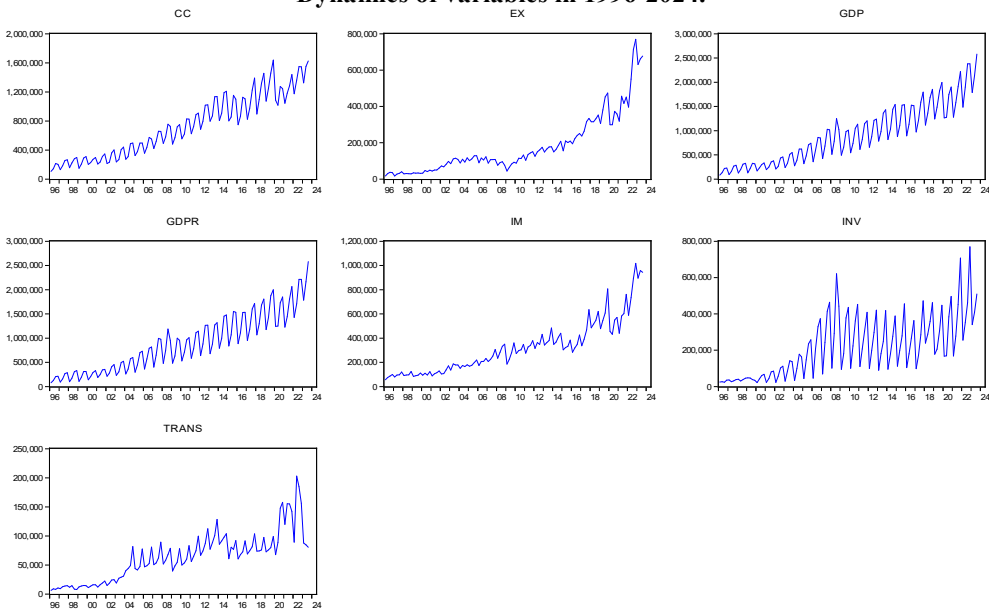
To assess the quality of the models, the adjusted coefficient of determination $(Adj.R_{sq})$ was used, while the statistical significance of the estimated parameters and hypothesis testing were evaluated using the $t, F, and\ Chi\_sq$ statistics.

Research Results

All variables included in the analysis exhibit seasonality (Figure 1); therefore, smoothing was performed using the Moving Average method.

Figure 1

Dynamics of variables in 1996-2024.



The variables in the model have been used in logarithmic values and made stationary (Figure 2). The stationarity of the variables was tested with the Dickey-Fuller unit root test, which indicated that all variables are I(1) processes (Table 1).

Table 1

Results of the Dickey-Fuller Unit Root Test

Variables	Test Equation	ADF test stat	5% level	I(d)
d(lcc)	Trend and intercept	-5.6617	-3.4528	I(1)
d(lex)	Trend and intercept	-12.1867	-3.4516	I(1)
d(lgdp)	Trend and intercept	-5.4102	-3,4528	I(1)
d(lgdpr)	Trend and intercept	-5,7192	-3.4528	I(1)
d(linv)	Trend and intercept	-5,9591	-3,4528	I(1)
d(lim)	Intercept	-9,782	-2,8884	I(1)
d(ltrans)	Trend and intercept	-11,5928	-3,451959	I(1)

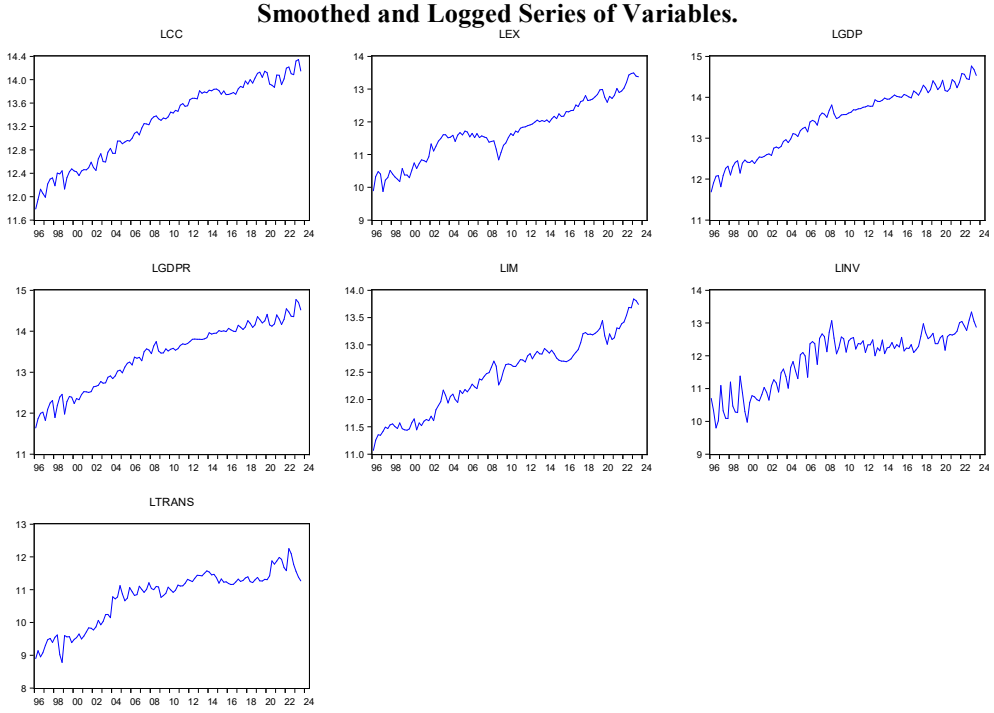
d indicates first-order differences and l is the natural logarithm

An ARDL (3,2,1,4) model has been constructed to assess the impact of personal remittances from abroad, exports of goods and services, and gross investments on economic growth. The estimated ARDL (3,2,1,4) model is represented by the following equation:

$$\mathrm{d(lgdpr)}_t = 0.062 - 0.617 * \mathrm{d(lgdpr)}_{t-1} - 0.705 * \mathrm{d(lgdpr)}_{t-2} - 0.625 * \mathrm{d(lgdpr)}_{t-3} + 0.084 * \mathrm{d(ltrans)}_{t-2} + 0.051 * \mathrm{d(linv)}_{t-1} + 0.145 * \mathrm{d(lex)}_{t-4} + e_t \quad (5)$$

Figure 2

Smoothed and Logged Series of Variables.



According to the results of the Breusch-Pagan-Godfrey Heteroskedasticity Test, the residuals of the model are homoscedastic (Obs*R-squared=6.181835, Prob. Chi-Square = 0.5187). The Breusch-Godfrey Serial Correlation LM Test results show that the residuals

are not autocorrelated (Obs*R-squared=5.361750, Prob. Chi-Square = 0.0685). The results of the Jarque-Bera Normality Test indicate that the residuals follow a normal distribution (Prob. JB = 0.304724). According to the Ramsey Reset Test, the model specification is correct (Prob. F-stat = 0.1949) (Table 2). There is no multicollinearity in the model, as the VIF for all explanatory variables is less than 5.

Table 2

Estimated Coefficients of the Regression Model and Residual Tests

	Dependent Variable: D(LGDPR)		
Variables	**Coefficient**	**Variables**	**Coefficient**
C	0.061684*[6.637949]		
D(LTRANS(-2))	0.083710***[1.867219]	D(LGDPR(-1))	-0.617452*[-8.611452]
D(LINV(-1))	0.051404**[2.400609]	D(LGDPR(-2))	-0.704968*[-10.18915]
D(LEX(-4))	0.144950*[2.895828]	D(LGDPR(-3))	-0.624819*[-8.497375]
Adjusted R-sq.	0.650075		
F-statistic	28.86632		
Prob(F-statistic)	0.000000		
Heteroskedasticity Test: Breusch-Pagan-Godfrey		**Breusch-Godfrey Serial Correlation LM Test**	
Obs*R-squared	6.181835	Obs*R-squared	5.361750
Prob. Chi-Square(7)	0.5187	Prob. Chi-Square(2)	0.0685
Jarque-Bera Normality Test		**Ramsey RESET Test**	
Jarque-Bera	2.376696	F-statistic	1.703432
prob(JB)	0.304724	Probability	0.1949

*1% **significance** level, **5% level, ***10% level, and t-statistics in [ ]

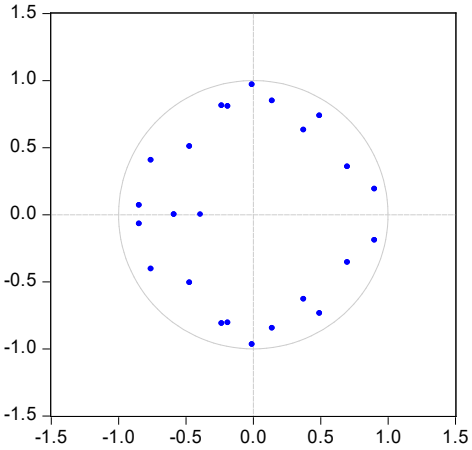
The estimates obtained using the method of Least Squares provide the basis to conclude that a 1% increase in gross investments leads to a 0.05% increase in economic growth in the following quarter, while a 1% increase in exports contributes to a 0.15% increase in economic growth four quarters later, ceteris paribus. In the short run, personal remittances from abroad do not have a statistically significant effect on economic growth at the 5% level, but they have a significant effect at the 10% level (a 1% increase in external personal remittances leads to a 0.08% increase in economic growth two quarters later at the 10% significance level).

To examine the long-run relationship between personal remittances from abroad and economic growth, a Vector Autoregression (VAR) model was initially constructed, including real GDP, personal remittances from abroad, exports (endogenous variables), and imports (exogenous variable). Based on LR, FPE, AIC, SC, and HQ criteria, models with lags of 3, 4, 7, and 8 were suggested. VAR models with these lags were constructed, and based on minAIC, the model with 8 lags was selected as the best model. The characteristic polynomial of the VAR model shows that all roots have absolute values smaller than one, thus satisfying the stability condition (Figure 3).

The results of the Granger causality test were used to examine the presence of causality between the variables. The test revealed unidirectional causality between personal remittances from abroad and economic growth, with remittances driving changes in economic growth (Chi-sq = 15.85299, Prob(Chi-sq) = 0.0445). However, economic growth does not lead to changes in remittances (Chi-sq = 10.77362, Prob(Chi-sq) = 0.2149). Additionally, there is bidirectional causality between economic growth and exports (Table 3).

Figure 3

Roots of the Characteristic Polynomial of the VAR Model



Source: calculations of authors.

Table 3

Granger Causality Test

Dependent variable: D(LGDPR)				**Dependent variable: D(LTRANS)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
D(LTRANS)	15.85299	8	0.0445	D(LGDPR)	10.77362	8	0.2149
D(LEX)	16.28726	8	0.0384	D(LEX)	27.61006	8	0.0006
All	29.20345	16	0.0226	All	38.57280	16	**0.0013**
Dependent variable: D(LEX)							
Excluded	Chi-sq	df	Prob.				
D(LGDPR)	15.66155	8	0.0475				
D(LTRANS)	14.01428	8	0.0475				
All	26.82112	16	**0.0435**				

To assess the existence of a long-run relationship between the variables, the Johansen cointegration test was applied. Both the Trace and Max-eigenvalue tests indicate the presence of cointegration (Table 4).

Table 4

Johansen Cointegration Test

Hypothesized No. of CE(s)	**Trace Statistic**	**0.05 Critical Value**	**Max-Eigen Statistic**	**0.05 Critical Value**
None *	52.59072	29.79707	24.51845	21.13162
At most 1 *	28.07227	15.49471	21.81159	14.26460
At most 2 *	6.260675	3.841466	6.260675	3.841466
	Trace and Max-eigenvalue tests indicate 3 cointegrating eqn(s) at the 0.05 level			

* denotes rejection of the hypothesis at the 0.05 level

Based on the results of the cointegration test, a VEC model was constructed (Table 5).

Table 5

VEC model

Vector Error Correction Estimates			
Cointegrating Eq:	CointEq1		
LGDPR(-1)	1.000000		
LTRANS(-1)	-0.418906		
	(0.07760)		
	[-5.39803]		
LEX(-1)	-0.354128		
	(0.07227)		
	[-4.90023]		
C	-4.762229		
Error Correction:	**D(LGDPR)**	**D(LTRANS)**	**D(LEX)**
CointEq1	-0.159231	-0.421186	-0.247055
	(0.06808)	(0.17208)	(0.11090)
	[-2.33894]	[-2.44766]	[-2.22772]
D(LGDPR(-1))	-0.417769	0.306542	0.062690
	(0.10809)	(0.27322)	(0.17608)
	[-3.86491]	[1.12196]	[0.35602]

Standard errors in ( ) and t-statistics in [ ]

The residuals of the VEC model are homoscedastic (Chi-sq = 353.6423, Prob(Chi-sq) = 0.0521), not autocorrelated (Prob(LM-Statistic) > 0.05), and normally distributed (Jarque-Bera = 11.37375, Prob(Jarque-Bera) = 0.0775). The Error Correction component for real GDP has a negative sign (-0.159) and is statistically significant (t-statistic = -2.33894), indicating that exports and remittances from abroad have a long-run impact on real GDP. The speed of equilibrium restoration is 15.9%. The Error Correction components for remittances and exports are also statistically significant, and there are 3 cointegrating equations.

The objective of our research is to assess the macroeconomic impact of personal remittances from abroad on economic growth; therefore, real GDP is considered as the variable of interest in the cointegration equation. The cointegration equation is:

$$\ln(GDPR)_t = 4.762 - 0.419\ln(Trans)_t - 0.354\ln(Ex)_t \quad (6)$$

In the long run, a 1% increase in remittances from abroad results in a 0.42% rise in economic growth in Armenia, while a 1% increase in the export leads to a 0.35% increase in economic growth.

Based on the VEC model, the following results were obtained for the short run:

- A 1% increase in exports leads to a 0.15% rise in economic growth three quarters later;
- Personal remittances from abroad do not have a significant short-term impact on economic growth;
- A 1% increase in real GDP leads to a 1.08% decrease in remittances from abroad four quarters later, 1.05% decrease five quarters later, and a 1.22% decrease six quarters later.
- The effect of exports on remittances is not straightforward. A 1% increase in exports leads to a 0.52% decrease in remittances one quarter later, a 0.54% decrease three quarters later, and an increase of 0.48% six quarters later and 0.35% seven quarters later.
- Imports do not have a statistically significant impact on remittances from abroad,

whereas an increase in imports by 1% is associated with a 0.6% increase in exports in the current quarter.

Conclusions

Historically, personal remittances from abroad have been a crucial factor in Armenia's economy. To assess the interaction between remittances from abroad and economic growth, ARDL and VEC models were constructed, and the following results were obtained:

- According to the Granger causality test, there is unidirectional causality between remittances from abroad and economic growth. Remittances are the cause of changes in economic growth, while economic growth is not the cause of changes in remittances.
- According to the ARDL and VEC models, in the short term, personal remittances from abroad do not have a significant impact on economic growth in Armenia.
- ***According to the cointegration equation of the VEC model, in the long term, a 1% increase in foreign transfers contributes to a 0.42% increase in Armenia's real GDP, confirming the initial hypothesis.***
- ***The results of the VEC model also confirm the second hypothesis that an increase in the rate of Economic growth reduces the volume of personal remittances from abroad.***
- According to the ARDL model, an increase in gross investment contributes to economic growth.
- According to the Granger causality test, there is bidirectional causality between economic growth and exports. Both the ARDL and VEC models indicate that an increase in exports contributes to economic growth.
- The impact of exports on foreign remittances is not unambiguous: at first it contributes to a decrease in the volume of remittances, but after 6 quarters it increases them. The growth of export rates indicates an increase in production, which, under conditions of a fixed level of technological progress, is accompanied by an increase in employment, thus leading to higher incomes and a reduction in foreign remittances. The further growth of exports means an increase in total demand due to the rise in the living standards of the population, which, in turn, results in an increase in the prices of goods and services. Inflation causes the volume of remittances to start increasing for needy households.

The findings of the research can serve as a foundation for formulating effective macroeconomic policies in Armenia.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 112-119
https://doi.org/10.46991/BYSU.G/2024.15.2.112

COMPARISON OF MARKOWITZ AND HELLINGER-NORMAL PORTFOLIOS

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Abstract: In this paper we compare the performances of Markowitz portfolio and the portfolio closest to normal in distribution. The latter is obtained by fixing the same desired level of expected returns and optimizing the Hellinger distance to Gaussian distribution with parameters obtained from Markowitz portfolio optimization for the same expected return. We confine ourselves to a long-position portfolio only. We found that in contrast to the expectations, the Hellinger-Normal portfolio does not smooth enough the extreme losses, but it does not do worse in that regard than Markowitz portfolio. We also found that overall in non-long-run passively managed portfolios, the Hellinger-Normal portfolio had better overall realized Sharpe and Kelly ratios.

Keywords: *Portfolio analysis, performance measurement, Hellinger's distance*

JEL codes: G11

1. Introduction

Papers exploring and expanding ways of portfolio construction other than Markowitz mean-variance portfolio (MP), are numerous. While some of them directly incorporate other components in the objective function optimized (like adding skewness (Lai, Lean Yu, Shouyang, 2006; De Athayde, Gustavo, Renato, 2003) or smoothing with entropy (Mercurio, Yuehua, Hong, 2020), or incorporating tail risk instead of variance (Yao, Zhongfei, Yongzeng, 2013)), others take different approaches based on newer ideologies (like in the risk-budgeting approach (Roncalli, 2013)).

The uses of Statistical distances in portfolio theories were primarily motivated by tracking problems (Svetlozar et. al. 2013), (i.e., the desire to keep closer to chosen maybe not-fully-known portfolios).

However, some emerging literature still managed to incorporate a statistical distance approach in portfolio optimization problems, arguing to capture better outcomes (Kim et. al., 2022). For a more thorough analysis of distance-based models, see (Svetlozar et. al. 2008).

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Received: 27.11.2024
Revised: 09.12.2024
Accepted: 27.12.2024

In this paper we continue our long-lasting research of the portfolio closest to Gaussian in distribution, which was proposed and thoroughly studied in (Mesropyan, Mkrtchyan, 2021; Bardakhchyan, Mesropyan, 2023; Mesropyan, Bardakhchyan, 2023). The distance used was taken to be Hellinger's one, based on purely theoretical and less on practical reasons. Here we call the portfolio thus obtained Hellinger-Normal portfolio (HNP).

Let us first introduce the motivation behind the proposed portfolios.

1.1. Market structure as a motivation

While in most of the literature the proposed alternatives to MP are motivated by the desire to overcome the drawbacks of MP, which we will also elaborate on in this paper, our initial motivation was rather based on a constructive approach to obtain a diagnostic tool for market structure. More precisely we were seeking an indicator the abrupt changes of which will indicate the change of market structure, in a sense of crucially changed correlations between asset returns, or rather a comparable change in vector distribution of asset returns.

According to the central limit theorem (CLT), the more independent random variables are taken into consideration, the closer their rescaled sum is to a Gaussian distribution (Durrett, 2019).

On the other hand, if random variables under consideration are initially normally distributed, this distance is always 0 and does not change. Moreover, in this case non-correlatedness does not play a crucial role, i.e., even the sum of correlated normally distributed random variables is normally distributed.

The converse of this result, Cramer's decomposition theorem, states that if any Gaussian random variable can be decomposed into a sum of two independent ones, then both of the latter's are also Gaussian.

Not contrasting any of the above arguments, still stock markets behave differently in the following more precise sense. While most of the stocks at least in theory have close to normal distribution of their return, or have only slightly heavier tails, the distribution of return of their linear combination is not close to normal, or better to say is rather far from Guassianity (Egan, 2007; Shiryaev, Zuoquan, Xun, 2008; Canan, Meterelliyoz, Tinic. 2016).

One of the reasons behind this is that returns (log-returns) being normal entail the price distribution to be log-normal, and the linear combination of log-normally distributed random variables can substantially deviate from log-normal in tails, being closer at average (Beaulieu, Qiong, 2004).

On the other hand, while dealing with portfolios, one deals with linear combination of returns. Thus the non-Guassianity here cannot be addressed the same way as above. Rather it can be attributed to the combination of two factors: 1) slight deviations from normality in returns of individual stocks and 2) the existing correlation between them.

The first reason solely cannot capture the non-normality of portfolio returns in big enough (meaning having a larger landscape of stocks) portfolios, as thanks to CLT, the return of linear combination would converge in distribution in an absence of correlations.

Thus we argue that the second reason is still more crucial in explanations of the non-Gaussianity of returns, as CLT is not known to hold even in stationary but correlated sequences (Ibragimov, 1975).

While trying to minimize the distance between the normal distribution and the distribution of returns of our portfolio, we found non-negligible and non-vanishing positive distance, indicating the existence of correlations (Mesropyan, Bardakhchyan, 2023). Thus the

positive minimum Hellinger distance is an indicator of the latter. Even more, the changes in the magnitude of this distance will indicate the change of correlational structure.

1.2. The drawbacks of MP as a motivation.

Several drawbacks of MP motivated further investigation into other methods of portfolio construction. Some more or less viable drawbacks that may be deemed to be not entirely rational are the following:

(i) In several cases MP gives 0 weights to most of the assets, even for not close to extremes desired expected returns. This feature would not be regarded as a violation of common sense, if we explore all assets given 0 weight to be dominated by the others. While often this is indeed the case, there are situations where the dropped assets are not dominated. This, together with the insufficiency of historical returns, gave rise to expert-based and more smoothed portfolios like entropy-added and Black-Litterman models.

Cevizci, 2016; Michaud, Tongshu, 2015)

(ii) In some cases, MP is still too sensitive to small changes in perceived expected returns, leading to minor changes in expected return estimates that entail some extreme changes of portfolio weights. This can be even combined with the pervious point, suggesting to get rid of some assets which had not so small weights previously. In a setting where assets have an internal bid-ask spread or are tangible and require transportation costs, this may lead to substantial money outflow. Some portfolios like Black-Litterman still overcome even this drawback. (Becker, Marc, 2010; Qian, Gorman, 2001).

(iii) MP does not incorporate all the information. MP portfolios rely heavily on only two descriptive statistics: expectation and variance. While in all-Gaussian framework, these two are enough, in reality there are at least two other features of interest: skewness and kurtosis/VaR/CVaR (as indicators of extreme events). It has been shown that some of the investors extremely value positive skewness and are very averse to extreme losses. These gave rise to several other portfolio theories (Lai, Lean Yu, Shouyang, 2006; Kraus, Litzenberger. 1976; Post, Vliet, Levy, 2008; Kane, 1982).

HNP can handle some of these drawbacks. We had shown previously that it overcomes the (i), may overcome (ii), in that it is less sensitive. And still in most cases fixes (iii). While one should be cautious, that it does not maximize the skewness or minimize the kurtosis, but rather struggles to keep them fixed.

In addition to the above, HNP also brings some predictability with itself; in contrast to what entropy theory would suggest for normal distributions, the predictability here should be understood in a sense that having chosen HNP one can indeed confine himself to two measurements, estimation of expected return and variance.

More precisely, while MP exploits these two estimates, ignoring others, HNP does drive us to the domain, where the latter are of, indeed, lesser importance (as they would not change substantially).

One other crucial feature of HNP, is that it incorporates correlations in a non-linear manner. While the correlational structure in MP is included through the variance, HNP still enables one to keep (but not to observe directly) the track of changes in correlations.

1.3. Hellinger-Normal portfolios construction

Typical construction of HNP portfolio has been described in our previous works [11]. Here we briefly recall main steps. First, the classical MP problem is solved for a given set of assets that will not change during any step of the problem.

$$\begin{cases} E(X) = \overline{e} \\ Var(X) \to min \\ X = \sum_{i=1}^{n} X_i \\ w_i \geq 0 \\ \sum_{i=1}^{n} w_i = 1 \end{cases} \quad (1)$$

Here X_i-s are returns of each asset. We assume only a finite number of assets. We confine ourselves to the case of logarithmic return. The weights w_i-s represent the percentage of money in each asset. We assume only long positions i.e. $w_i \geq 0$.

After solving (1), we make use of found minimal variances ($\overline{\sigma}^2$) for each level of expected return[1].

$$\begin{cases} E(X) = \overline{e} \\ H^2\left(X, N\left(\overline{e}, \overline{\sigma}^2\right)\right) \to min \\ X = \sum_{i=1}^{n} X_i \\ w_i \geq 0 \\ \sum_{i=1}^{n} w_i = 1 \end{cases} \quad (2)$$

Where $H(X,Y)$ – is Hellinger's distance between X, Y r.v.-s[2].

Here, the parameter $\overline{\sigma}^2$ is just short hand notation for the found minimal variance corresponding to given level of $\overline{e}$.

Let us keep track of the main calculations, by adding the definition of squared Hellinger distance. For a continuous case

$$H^2(f,g) = 1 - \int \sqrt{f(x)g(x)}dx \quad (3)$$

While with one of the random variables being continuous but made constant over bins in histogram construction, we have the following formula

$$H^2(X,Y) = 1 - \sum_{j=0}^{n-1} O_j \int_{a_j}^{a_{j+1}} \sqrt{f_Y(x)}dx \quad (4)$$

Generally O_j-s are any numbers, not bound to be different. We take the interval cut enough fine to have one value for each interval.

Whenever the counterpart's (Y's) distribution is normal each element of (4) will take the following form:

$$\begin{aligned} \int_{a_j}^{a_{j+1}} \sqrt{f_Y(x)} &= \frac{1}{\sigma^{\frac{1}{2}}(2\pi)^{\frac{1}{4}}} \int_{a_j}^{a_{j+1}} e^{-\frac{(x-\mu)^2}{4\sigma^2}} dx \\ &\xrightarrow{\sigma_1 = \sigma\sqrt{2}} \sqrt{2}\sqrt{\sigma}(2\pi)^{\frac{1}{4}}\left(F_N\left(a_{j+1}|\mu,\sigma_1^2\right) - F_N\left(a_j|\mu,\sigma_1^2\right)\right) \end{aligned} \quad (5)$$

Hereafter we are less interested in the values of squared Hellinger distances than in the optimizing portfolio, i.e., the vector of optimal weights. We strive to compare the portfolios obtained by solving (1) and (2) respectively. We denote

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[1] Solving (1) one gets two things for each fixed level of expected return: the weights' vector (i.e. the risk-minimizing portfolio) and the precise value of variance (i.e. some correspondence $\bar{e} \to \overline{\sigma^2}$).

[2] Here we use (X,Y) , $H(F_X, F_Y)$ and in absolutely continuous case $H(f_X, f_Y)$ interchangeably.

the solving vectors by w_{MP} and w_{HN}.

In the next section we describe the empirical procedure and data used, and compare performances of both portfolios in a not active management setting, in a sense made explicit further.

We argue that HN performs better than MP, with a small possible cost of higher variance and, in half of the situations, slightly more extreme loss. We show that by comparing 10 days' performance Sharpe ratio and Kelly ratio. Also we made it explicit that our results are not due to random effects.

2. Empirical analysis

For an illustrative example we have taken 3 years' (the period from 01/2021-01/2024) data of 13 assets (10 of which are included in S&P500 index)[3].

We added three other assets to have negative correlations for at least some period of time (see Table 1). For example, the 12-month log-returns correlation matrix has the following form for the first year.

Table 1

Correlation matrix for assets.

	ADBE	CAT	DIS	FDX	GS	IBM	JNJ	KO	NKE	XOM	SPOT	BRN	FET
ADBE	1.00	-0.04	0.14	0.25	-0.01	-0.09	0.09	0.21	0.33	-0.02	0.41	0.03	0.03
CAT	-0.04	1.00	0.43	0.31	0.67	0.32	0.18	0.19	0.14	0.58	0.08	0.17	0.29
DIS	0.14	0.43	1.00	0.21	0.43	0.17	0.11	0.30	0.24	0.36	0.17	0.23	0.20
FDX	0.25	0.31	0.21	1.00	0.31	0.17	0.14	0.22	0.11	0.29	0.22	0.13	0.12
GS	-0.01	0.67	0.43	0.31	1.00	0.27	0.14	0.17	0.24	0.57	0.16	0.15	0.31
IBM	-0.09	0.32	0.17	0.17	0.27	1.00	0.26	0.29	0.07	0.35	-0.03	0.09	0.10
JNJ	0.09	0.18	0.11	0.14	0.14	0.26	1.00	0.43	0.10	0.14	-0.04	0.18	0.01
KO	0.21	0.19	0.30	0.22	0.17	0.29	0.43	1.00	0.16	0.20	0.04	0.19	0.05
NKE	0.33	0.14	0.24	0.11	0.24	0.07	0.10	0.16	1.00	0.14	0.23	0.09	0.19
XOM	-0.02	0.58	0.36	0.29	0.57	0.35	0.14	0.20	0.14	1.00	0.01	0.23	0.41
SPOT	0.41	0.08	0.17	0.22	0.16	-0.03	-0.04	0.04	0.23	0.01	1.00	0.07	0.09
BRN	0.03	0.17	0.23	0.13	0.15	0.09	0.18	0.19	0.09	0.23	0.07	1.00	0.10
FET	0.03	0.29	0.20	0.12	0.31	0.10	0.01	0.05	0.19	0.41	0.09	0.10	1.00

Source: Authors' calculations.

We took the following procedure when constructing MP and HN. We used 1 year of data before the taken date as a historical input. We then calculated log returns of each of the assets and evaluated the mean returns based on the 1-year historical data.

Next we used the range of feasible expected returns of the portfolio (i.e., the range between the highest expected return out of 13 and the smallest). Then we divided the interval into 10 equal parts, and on the split point of each interval, we solved the MP problem (1) to find both the MP portfolio weights and the minimal variances for each level of expected return. The latter we used in HN portfolio construction according to (2).

To obtain the solution of (2) we employed formulas (4) and (5), for which we used the binning procedure to obtain a histogram of the portfolio return distribution of the vector of weights. We used the optimal number of bins according to Sturges's formula.

After solving and obtaining the optimal portfolios, we keep the weights for another 10 trading days. And after the period we evaluate the performance.

[3] ADBE; CAT; DIS; FDX; GS; IBM; JNJ; KO; NKE; XOM; SPOT; BRN; FET.

After the period we shifted our historical data by these 10 days, or put more simply, we moved to the next date where we are allowed to change the weights. There we did the same procedure again and so forth. Thus we got 43 cumulative descriptive statistics for a period observed.

Based on the observations we obtained the following results.

(1) At an average of 11.6% (5 out of 43) of cases, MP showed better realized performance in all measures. While in all other cases HNP showed better performance on at least 1 of the two measures considered.

(2) As for tail risk, in most of the cases HNP did worse compared to MP. However, the difference still may be considered insignificant, as in many of these cases the extreme losses do not deviate even by 3% compared to each other.

(3) In most of the cases, HNP did significantly better compared to more extreme worst-case losses. More precisely, on average, HNP showed 21.4% better performance [1] (i.e., 1,214 times more average return), while showing, on average, only 4.3% more extreme case losses (so -1.043 times more losses). Cumulatively, if we kept only HNP portfolios most deviant from MP, we would, on average, get up to 5.68% more income, with the risk of losing up to 1.25% more money in each 10 days.

The standard deviation differences are up 0.18% different, so that HNP has on average a 1.018 higher standard deviation than MP. While cumulatively in 3 years it may bring a 7.6% difference in standard deviation.

(4) In periods with explicitly dominant assets HNP showed generally worse performance, than MP.

Some results are given in the following Table 2.

Table 2

Comparison of some realized numerical characteristics of MP and HNP, when adjustments are only allowed biweekly (each 10 market days).

	MP	HNP	Comment
Daily mean realized return	-0.0011	-0.0002	So in each of the cases adjustments to portfolios are made every week
Biweekly mean realized return	0.0015	0.0067	This result differ from the previous ones, most probably due to seasonality
Daily mean realized standard deviation	0.0122 (1.22%)	0.0128 (1.28%)	Note that in average, standard deviation is only slightly higher.
Mean biweekly Sharpe ratio	0.063	0.115	These results are approximated to 3 digits, after the floating point.
Mean biweekly Kelly ratio	18.5	23.04	
Mean Extreme values	-0.0012 (1.2% loss)	-0.0014 (1.4% loss)	In extreme cases losses could be as high as 14%

Discussion and conclusion.

Each of the four main results found has different but not contradictory compelling reasons.

(1) On average HNP showed better realized performance. While for Sharpe ratio it is not obvious why, the Kelly criteria case has more theoretical reasoning.

The Kelly criterion assesses a better fit for dynamic (i.e., long-run) investment choices. As we had chosen somewhat not long, but also not daily management of the portfolio, the Kelly criterion should be the more crucial one. And Kelly criterion favored HNP.

Initially HNP was proposed as a more robust alternative to MP. In that sense it should

have been a better choice for long-run investment.

One more precise reason is that the Kelly criterion is based on maximizing the geometric average of returns, while MP only considers average and variance. It is known that the geometric average can be modeled as the logarithm of the portfolio for non-negative returns, which, when decomposed into Taylor series, includes all initial moments (cumulants), not only the first two. This means that the portfolio that fixes all moments (like taking the portfolio to be close to a normal distribution) will perform better than the portfolio only considering the first few moments.

Things differ for the Sharpe ratio case. The MP is the exact portfolio that maximizes the Sharpe ratio; still, HNP performs approximately twice as good as MP. The reason may lie in the changing environment, i.e., the changing multivariate distribution of returns. While with HNP one tries to "fix" the distribution as close to normal as it is possible, MP works with this more "complex" dynamic and still ignores most of the information.

(2) The reason why HNP showed more extreme losses than MP may be due to the fact that the tails are not entirely close to that of normal distribution. This is the fact that HNP tries to bypass. But it may be the case that thus it confines to the cases that may have "worse" tails (i.e., adjusting to heavier tails) than in MP. In other words, it may be that MP solutions may have less kurtosis than 3 (the kurtosis of normal distribution). So, it is reasonable to use HNP when the normality assumption is countered by the heavy tails hypothesis. Still, this difference is not drastically extreme.

(3) This part is self-obvious and is partly discussed above. We can't explain the magnitude of the difference. One should still be cautious, as extreme losses with percentage differences, though small, are in fact bigger in magnitude (bigger in pure amount). Standard deviation differences still do not mean that HNP cumulatively did lose more than MP. Rather, it means that general fluctuations around the better mean are slightly higher than in MP around its' mean.

(4) It is obvious that the one thing HNP does is try to overcome corner solutions. When one has obvious dominant assets, it is not reasonable to try to forcefully deviate from corner solutions. Thus the HNP procedure becomes redundant. In that case, even uniform weights do better than HNP.

In conclusion, we propose to use HNP only when there are no obviously dominant assets. However, in all other cases, HNP will most probably show better performance. Still, several other comparisons should be made.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 120-130
https://doi.org/10.46991/BYSU.G/2024.15.2.120

THE SIGNIFICANCE OF EXPENDITURE POLICY IN FOSTERING ECONOMIC GROWTH (CASE OF ARMENIA)

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Abstract: Government budget expenditures can significantly influence a nation's economic performance, either positively or negatively. The article refers to the dynamics, structure and interrelationship of economic growth and budget expenditures in Armenia. The impact of Armenia's budget expenditures, as well as individual items of the functional classification of budget expenditures, on economic growth was estimated using the least squares method. For the research, quarterly data during the 2000-2023 period have been used.

The regression analysis results indicate that Armenia's total budget expenditures positively affect economic growth. Specifically, an increase of 1 percent of budget expenditure would tend to increase economic growth by 0.14 percent after two quarters, all other things being equal.

When analyzing the components of budget expenditures, spending on health and general public services also shows a positive impact on economic growth. An increase of 1 percent of health expenditure will increase economic growth by 0.07% after 3 quarters, and an increase of 1 percent of expenditure on general public services will increase economic growth by 0.05% after two quarters, all other things being equal.

In contrast, spending on defense and public order and safety activities will reduce economic growth: a 1% increase in public order and safety spending will reduce economic growth by 0.06% after two quarters, ceteris paribus.

Keywords: *economic growth, budget expenditure, correlation matrix, regression model, evaluation*

Introduction: Understandings of the impact of budget expenditures change over time. According to the laissez-faire approach, the function of the state is only regulatory in nature, but during the years of the Great Depression, the ideas about the functions of the state changed dramatically, in particular emphasizing the role of budgetary expenditures. Economic theory suggests that government spending should generally promote economic growth. However, there is no single approach on the exact nature of the relationship between expenditures and economic growth. In the exogenous growth model (neoclassical) developed by Solow (1956) and Swan (1956), fiscal policy is not seen as a driver of long-term economic growth. Changes in fiscal variables such as taxes and government spending are considered to have only short-term effects on the economy.

In contrast, the endogenous growth theory, proposed by economists like Romer (1986) and Lucas (1988), challenges this view. According to this theory, economic growth is driven by internal factors within the economy rather than external influences. Endogenous growth models suggest that fiscal policy can affect the rate of economic growth. Specifically, the structure of taxes and the allocation of government spending are believed to influence economic growth by impacting savings rates and investment of human capital.

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Received: 09.10.2024
Revised: 28.10.2024
Accepted: 27.12.2024

Many authors in their research have identified a positive relationship between economic growth and budgetary expenditures. Ram analyzed a time series of data from 115 countries spanning the years 1960 to 1980 to evaluate the relationship between government spending and economic growth. In his model, he expanded the standard production function, Y = f(L, K, G), to incorporate government expenditure (G) as a variable. He concluded that the effect of government expenditure on economic growth is positive (Pula and Elshani, 2018). Bose et al., examining a time series spanning the 1970s and 1980s in 30 developing countries, concluded that public sector spending can indirectly generate economic growth driven by higher marginal productivity of both government and private production factors (Bose et al., 2007). Grigoryan et al. (2021), assessing the impact of public capital investments on economic growth, revealed that public investments play a crucial role in boosting Armenia's GDP and other key macroeconomic indicators.

Concurrently, numerous studies show an inverse relationship between these variables. Landau (1983) examining the time series of 96 countries from 1960-1979, concluded that economic growth shows a negative association with both GDP per capita and the proportion of public consumption expenditures in GDP. Apart from the researches that reveal the correlation between economic growth and spending, there is quite a lot of research that does not give an unambiguous answer about such correlations. Thus, Saez et al. (2017), by assessing time series of European countries between 1994 and 2021, found that governments have the ability to modify their spending to impact the economy. However, the relationship between these variables can be either positive or negative, depending on the country sample, the time period under review, and the specific variables considered. Sometimes the interactions between government spending and economic growth are not so clear-cut and have a dual nature, so identifying the correlation of individual spending components with economic growth is also considered an agenda issue. Thus, as a result of combining fifteen studies, Chapanyan (2021) concluded that a clear relationship exists between the components of public expenditure and economic growth. Furthermore, productive expenditures positively influence economic growth, while non-productive expenditures have a negative impact.

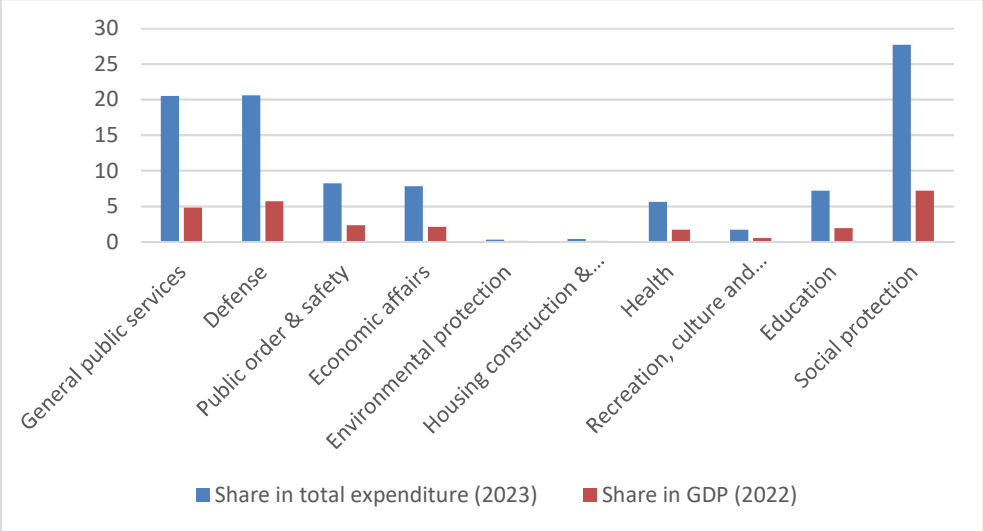
The rate of economic growth, the advancement of social infrastructure, and the modernization of healthcare, education, and social services are influenced by the efficiency of their regulation and the allocation of funds across different sectors. Effective regulation of budget expenditures accelerates the socio-economic development of the state, influences the quality of structural changes in the economy, enhances the effectiveness of fiscal policy, and strengthens the stability of the country's financial system. It can be said that the main condition for the formation of the expenditure part of the budget is the maximum provision of the utility of the state's activities in the conditions of budgetary resource limitations.

Real GDP and budget expenditures. In 2023, the real growth rate of Armenian GDP was 8.7%: increasing the value added in all sectors of the economy (Ministry of Finance of the Republic of Armenia, Report of the state budget of the Republic of Armenia for 2023). Economic growth has been accompanied by growth in domestic and foreign demand. In stimulating domestic demand, the role of budgetary expenditure is significant. An analysis of Armenia's budget indicators reveals that both the revenue and expenditure components of the state budget have steadily risen in absolute terms in recent years. Thus,

in 2023, the revenues of the state budget amounted to 2,358,733.5 million. AMD, or 24.8% of GDP, and expenses: 2 547 624.8 million. AMD or 26.8% of GDP. State budget expenditures rose by 13.6% or 305 billion drams compared to the previous year, primarily driven by increases in capital expenditures, social benefits, pensions, interest payments, and grants. The functional classification of budget expenditures highlights the country's objectives, reflecting the diverse areas and priorities of its socio-economic development.

Figure 1

The structure of Armenian state budget expenditures by functional classification groups .



Source: Report of the state budget of the Republic of Armenia for 2023 and Yearbooks of the Statistical Committee of the Republic of Armenia. https://minfin.am/hy/page/petakan_byujei_hashvetvutyun_2023t_tarekan_, www.armstat.am

Based on the functional classification of Armenia's state budget expenditures the social protection article has the largest proportion of budget expenditures for 2023, making up about 27.7% of the total expenditures. The next largest share of spending is defense and general public services, which are almost equal in share of total spending, around 21%. About 8% of the total expenditure was allocated to public order and safety and economic affairs. Expenditures on education made up 7.2% of total expenses, and health-5.6%. To evaluate the effect of budget expenditures on Armenia's economic growth, we put forward three hypotheses:

***H_0**: Budget expenditures positively influence economic growth,*

***H_1**: Expenditures on defense, public order, and safety negatively impact economic growth,*

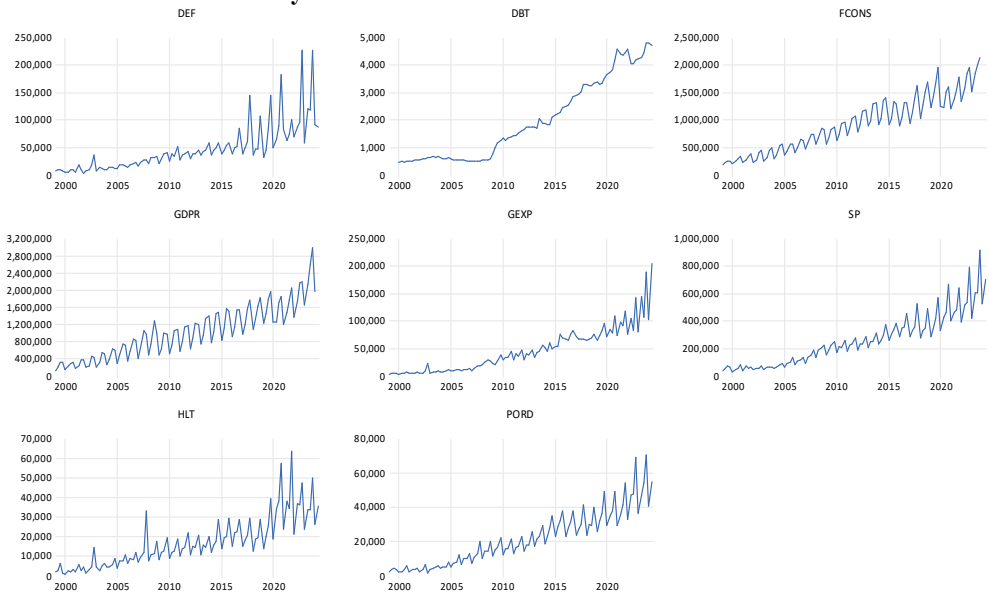
***H_2**: Spending on general public services and healthcare positively affects economic growth.*

In the research, the macroeconomic indicators of Armenia were used on a quarterly basis for the years 2000-2023. The sources of data collection were the reports and annual publications published by the RA Central Bank, the RA Statistical Committee and the RA Ministry of Finance. The regression models include the following indicators: real GDP, mln. AMD (GDPR), final consumption, mln. AMD (FCONS), overoll budget expenses, mln. AMD (SP), general public services, mln. AMD (GEXP), defence, mln. AMD (DEF), health, mln. AMD (HLT), public order and safety, mln. AMD (PORD), public debt, mln. AMD (DBT).

Real GDP is calculated as the ratio of nominal GDP to the CPI. All variables are time series with seasonality (see Figure 2), therefore seasonally adjusted using the Moving average method. Some variables were considered in the models with log values.

Figure 2

Dynamics of the variables in 2000-2023.



Source: Report of the state budget of the Republic of Armenia for 2000-2023 and Yearbooks of the Statistical Committee of the Republic of Armenia, https://minfin.am/hy/page/petakan_byujei_hashvetvutyun_2023t_tarekan_, www.armstat.am

The table of descriptive statistics for the variables indicates that over the period from 2000 to 2023, the average real GDP was 103,696.8 million AMD, the maximum value was registered in the 4th quarter of 2023 and amounted to 2,983,645.0 million AMD, minimum was 164,357.1 million AMD in the 1st quarter of 2000. Overoll spending on average made 261894.9 million AMD, the maximum value was recorded in the 4th quarter of 2023 and amounted to 913689.8 million AMD, the minimum amounting to 32477.9 million AMD in the 1st quarter of 2000. (see Table 1).

Table 1

Descriptive statistics of variables.

	DEF	DBT	FCONS	GDPR	GEXP	SP	HLT	PORD
Mean	47160.63	1916.966	953960.8	1036968.	46230.84	261894.9	17282.43	21819.86
Median	38319.30	1617.460	917870.4	995002.0	39408.35	234834.9	14501.75	19363.10
Maximum	226814.7	4794.900	2136403.	2983645.	189732.4	913689.8	63721.20	70301.40
Minimum	3808.000	479.7000	218585.6	164357.1	3811.800	32477.90	971.9000	1589.200
Std. Dev.	42501.16	1389.126	495565.7	591993.4	37027.77	181484.6	12601.02	15419.21
Skewness	2.229096	0.578275	0.368117	0.637052	1.050147	1.016502	1.282120	0.852097
Kurtosis	8.895028	1.937846	2.218864	3.144862	4.339847	4.039596	4.754864	3.430876
Jarque-Bera	218.5073	9.863110	4.608860	6.577302	24.82571	20.85547	38.61948	12.35974
Probability	0.000000	0.007215	0.099816	0.037304	0.000004	0.000030	0.000000	0.002071
Sum	4527420.	184028.7	91580240	99548911	4438161.	25141908	1659113.	2094706.
Sum Sq. Dev.	1.72E+11	1.83E+08	2.33E+13	3.33E+13	1.30E+11	3.13E+12	1.51E+10	2.26E+10
Observations	96	96	96	96	96	96	96	96

Source: Calculated by author.

The final consumption random variable has a normal distribution (Jarque-Bera= 4.608, Prob(JB)= 0.09>0.05), and the null hypothesis that the other variables have a normal distribution is rejected.

The linear correlation coefficients of the variables prove that the selected variables have a strong positive linear correlation relationship with real GDP. In particular, the correlation coefficient of only budget expenditures and real GDP is Rxy=0.97 (see Table 2).

Table 2

Correlation matrix of variables.

	DEF	DBT	FCONS	GDPR	GEXP	SP	HLT	PORD
DEF	1	0.77843406...	0.85202610...	0.86204990...	0.88466300...	0.93924657...	0.86869115...	0.91421634...
DBT	0.77843406...	1	0.89957481...	0.85517307...	0.92975800...	0.90697457...	0.81836303...	0.89949158...
FCONS	0.85202610...	0.89957481...	1	0.97907493...	0.93005328...	0.95408581...	0.87468862...	0.96469803...
GDPR	0.86204990...	0.85517307...	0.97907493...	1	0.92064015...	0.95047628...	0.87823515...	0.95826805...
GEXP	0.88466300...	0.92975800...	0.93005328...	0.92064015...	1	0.97209161...	0.88136817...	0.96051694...
SP	0.93924657...	0.90697457...	0.95408581...	0.95047628...	0.97209161...	1	0.93194294...	0.99046136...
HLT	0.86869115...	0.81836303...	0.87468862...	0.87823515...	0.88136817...	0.93194294...	1	0.92797015...
PORD	0.91421634...	0.89949158...	0.96469803...	0.95826805...	0.96051694...	0.99046136...	0.92797015...	1

Source: Calculated by author.

The variables included in the regression model are time series, therefore they should be considered stationary. We checked the stationarity of the variables with the Dickey-Fuller unit root test. For total budget expenditures and general public services, we applied the test equation with a constant, and for real GDP, final consumption, defense, health, public order and safety, and public debt, the test equation with a constant and linear trend. All variables are I(1) processes, i.e., they are made stationary by observing first-order differences ` $\Delta Y_t = Y_t - Y_{t-1}$ (see Table 3):

Table 3

The stationarity of the variables.

Variable	equation of the ADF test	ADF statistic	5% critical level	I(d)
LGDPR	Constant, linear trend	-1.954	-3.458	
D(LGDPR)	Constant, linear trend	-3.652	-3.458	I(1)
LSP	Constant, linear trend	-1.809	-3.457	
D(LSP)	Constant	-4.726	-2.891	I(1)
LFCONS	Constant, linear trend	-1.715	-3.457	
D(LFCONS)	Constant, linear trend	-5.363	-3.457	I(1)
LGEXP	Constant, linear trend	-1.895	-3.456	
D(LGEXP)	Constant	-10.108	-2.891	I(1)
DEFSA	Constant, linear trend	2.403	-3.461	
D(DEFSA)	Constant, linear trend	-6.742	-3.460	I(1)
LDBT	Constant, linear trend	-2.000	-3.457	
D(LDBT)	Constant, linear trend	-6.980	-3.457	I(1)
LPORD	Constant, linear trend	-1.373	-3.456	
D(LPORD)	Constant, linear trend	-10.872	-3.456	I(1)

Regression analyses: To assess the impact of expenses on GDP growth, we built three multifactor regression models.

Table 4

Output of the Model 1.

Dependent Variable: D(LGDPR)
Method: Least Squares
Date: 10/09/24 Time: 17:08
Sample (adjusted): 2000Q2 2024Q1
Included observations: 96 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.027164	0.008330	3.260922	0.0016
D(LSP(-2))	0.141544	0.062631	2.259962	0.0262
D(LSP(-4))	-0.172421	0.061092	-2.822329	0.0059
D(LGDPR(-1))	-0.231861	0.066904	-3.465571	0.0008
D(LGDPR(-2))	-0.394424	0.084961	-4.642417	0.0000
D(LGDPR(-4))	0.508826	0.083321	6.106829	0.0000

R-squared	0.665794	Mean dependent var	0.025868
Adjusted R-squared	0.647227	S.D. dependent var	0.114264
S.E. of regression	0.067867	Akaike info criterion	-2.482075
Sum squared resid	0.414533	Schwarz criterion	-2.321803
Log likelihood	125.1396	Hannan-Quinn criter.	-2.417290
F-statistic	35.85894	Durbin-Watson stat	2.305592
Prob(F-statistic)	0.000000		

The first regression model captures the relationship solely between budget expenditures and economic growth. As shown in Table 5, the residuals of the model are homoscedastic (Prob(F statistic)=0.262, Prob(Chi-Square)=0.255) and independent of each other (Prob(F statistic)=0.151 and Prob(Chi-Square)=0.133).

Table 5

Heteroscedasticity and autocorrelation tests of residuals in Model 1.

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.929071	Prob. F(2,88)	0.1514
Obs*R-squared	4.032104	Prob. Chi-Square(2)	0.1332

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.320352	Prob. F(5,90)	0.2626
Obs*R-squared	6.560638	Prob. Chi-Square(5)	0.2554
Scaled explained SS	7.975518	Prob. Chi-Square(5)	0.1576

The model does not exhibit multicollinearity, VIF <5 for all explanatory variables (see Table 6). B parameters estimated by the least squares method are BLUE grades. The Ramsey test indicates that the model specification is correct (Prob(F-statistic)=0.7848>0.05), the null hypothesis is not rejected. According to the results of Model 1, at the 5% significance level, a 1% increase in budget spending increases economic growth by 0.14% after 2 quarters, but slows it by 0.17% after four quarters. The variables included in the model explain 64.72% of the economic growth, and the rest by other factors.

Table 6

Multicollinearity test results for Model 1.

Variance Inflation Factors
Date: 10/09/24 Time: 17:13
Sample: 1999Q1 2024Q3
Included observations: 96

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	6.94E-05	1.446283	NA
D(LSP(-2))	0.003923	1.146698	1.108430
D(LSP(-4))	0.003732	1.161335	1.111882
D(LGDPR(-1))	0.004476	1.239450	1.187811
D(LGDPR(-2))	0.007218	1.965638	1.898179
D(LGDPR(-4))	0.006942	2.009085	1.902701

The second regression model represents the relationship between spending on general public services and defense and final consumption with economic growth.

Table 7

Output of the Model 2.

Dependent Variable: D(LGDPR)
Method: Least Squares
Date: 10/09/24 Time: 17:17
Sample (adjusted): 2000Q2 2023Q4
Included observations: 95 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021876	0.009476	2.308576	0.0233
D(DEFSA)	-8.48E-07	3.42E-07	-2.480389	0.0150
D(LFCONS)	0.637453	0.107507	5.929398	0.0000
D(LGEXP(-2))	0.057463	0.028821	1.993802	0.0493
D(LGDPR(-1))	-0.300062	0.084881	-3.535099	0.0007
D(LGDPR(-2))	-0.348854	0.090068	-3.873250	0.0002
D(LGDPR(-3))	-0.205883	0.089278	-2.306096	0.0235
D(LGDPR(-4))	0.366505	0.084450	4.339894	0.0000

R-squared	0.748716	Mean dependent var	0.024274
Adjusted R-squared	0.728497	S.D. dependent var	0.113791
S.E. of regression	0.059292	Akaike info criterion	-2.732233
Sum squared resid	0.305852	Schwarz criterion	-2.517170
Log likelihood	137.7811	Hannan-Quinn criter.	-2.645332
F-statistic	37.03164	Durbin-Watson stat	2.146769
Prob(F-statistic)	0.000000		

The residuals in Model 2 are homoscedastic (Prob(F)=0.207, Prob(Chi-Square)=0.203), are not autocorrelated (Prob (F)=0.183 և Prob(Chi-Square)=0.155) (see Table 8):

Table 8

Heteroscedasticity and autocorrelation tests of residuals in Model 2.

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.731121	Prob. F(2,85)	0.1833
Obs*R-squared	3.718116	Prob. Chi-Square(2)	0.1558

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.421237	Prob. F(7,87)	0.2071
Obs*R-squared	9.748694	Prob. Chi-Square(7)	0.2033
Scaled explained SS	10.93566	Prob. Chi-Square(7)	0.1415

The model does not suffer from multicollinearity (see Table 9). According to the results of the Ramsey test, the model specification is correct (Prob(F-statistic)=0.6717>0.05).

Table 9

Multicollinearity test results for Model 2.

Variance Inflation Factors
Date: 10/09/24 Time: 17:22
Sample: 1999Q1 2024Q3
Included observations: 95

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	8.98E-05	2.426400	NA
D(DEFSA)	1.17E-13	1.263213	1.254396
D(LFCONS)	0.011558	1.455062	1.330532
D(LGEXP(-2))	0.000831	1.151878	1.127343
D(LGDPR(-1))	0.007205	2.561503	2.466472
D(LGDPR(-2))	0.008112	2.840790	2.724834
D(LGDPR(-3))	0.007971	2.816619	2.690151
D(LGDPR(-4))	0.007132	2.503097	2.391281

Expenditures on general public services are one of the main directions of government spending, the ratio of expenditures on general services to GDP reflects the size of a country's government. These are the costs that are directed to ensuring the normal functioning of the governing bodies. In 2022 expenditures on general public services of Armenia amounted to 4.8% of the GDP, for comparison, let's note that this indicator is 10% and 4.9% in neighboring Georgia and Azerbaijan, respectively, and in developed European countries (France, Germany, Austria, Italy) it averages 6.3% (IMF database). Based on the results of Model 2, a 1% increase in spending on general public services will lead to a 0.05% increase in economic growth after two quarters, ceteris paribus. Defense spending is the second largest share of GDP, accounting for 5.7% of GDP. For comparison, let's note that this indicator is 1.5% and 4.6% in Georgia and Azerbaijan, respectively, and in developed European countries (France, Germany, Austria, Italy) it fluctuates around 1.5%, and from more militarized countries, for example, in Israel, the USA, this indicator is 4.7 and 3.5%, respectively (IMF database). According to model 2, the increase in Armenian defense expenses leads to a decrease in economic growth. A 1%

increase in final consumption expenditures contributes to a 0.55% increase in economic growth in the current quarter, ceteris paribus.

The third regression model illustrates the relationship between spending on health, public order and safety, public debt, final consumption, and economic growth.

Table 10

Output of the Model 3.

Dependent Variable: D(LGDPR)
Method: Least Squares
Date: 10/09/24 Time: 17:26
Sample (adjusted): 2000Q3 2023Q4
Included observations: 94 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036355	0.009652	3.766411	0.0003
D(LHLT(-3))	0.073368	0.016829	4.359635	0.0000
D(LFCONS)	0.549151	0.091237	6.018940	0.0000
D(LDBT)	-0.478269	0.098409	-4.860029	0.0000
D(LPORD(-2))	-0.059692	0.023702	-2.518442	0.0137
D(LGDPR(-1))	-0.463215	0.084526	-5.480130	0.0000
D(LGDPR(-2))	-0.345925	0.083961	-4.120058	0.0001
D(LGDPR(-3))	-0.260343	0.086089	-3.024129	0.0033
D(LGDPR(-4))	0.417378	0.081142	5.143825	0.0000
D(LGDPR(-5))	0.174588	0.078752	2.216929	0.0293

R-squared	0.827160	Mean dependent var	0.023639
Adjusted R-squared	0.808641	S.D. dependent var	0.114232
S.E. of regression	0.049970	Akaike info criterion	-3.054487
Sum squared resid	0.209751	Schwarz criterion	-2.783924
Log likelihood	153.5609	Hannan-Quinn criter.	-2.945199
F-statistic	44.66649	Durbin-Watson stat	2.049262
Prob(F-statistic)	0.000000		

As shown in Table 11, the residuals of the model are homoscedastic (Prob(F)=0.4493, Prob(Chi-Square)=0.43,9) and are independent of each other (Prob (F)=0.4812 և Prob(Chi-Square)=0.4355).

Table 11

Heteroscedasticity and autocorrelation tests of residuals in Model 3.

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.737989	Prob. F(2,82)	0.4812
Obs*R-squared	1.662058	Prob. Chi-Square(2)	0.4356

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.996591	Prob. F(9,84)	0.4493
Obs*R-squared	9.068759	Prob. Chi-Square(9)	0.4310
Scaled explained SS	7.800419	Prob. Chi-Square(9)	0.5544

There is no evidence of multicollinearity in the model. The Ramsey test indicates that the model specification is correct (Prob(F-statistic)=0.6717>0.05).

Table 12

Multicollinearity test results for Model 3.

Variance Inflation Factors
Date: 10/09/24 Time: 17:31
Sample: 1999Q1 2024Q3
Included observations: 94

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	9.32E-05	3.507254	NA
D(LHLT(-3))	0.000283	1.050703	1.047164
D(LFCONS)	0.008324	1.475311	1.348474
D(LDBT)	0.009684	1.437302	1.228203
D(LPORD(-2))	0.000562	1.307019	1.288957
D(LGDPR(-1))	0.007145	3.569810	3.429588
D(LGDPR(-2))	0.007049	3.463270	3.311096
D(LGDPR(-3))	0.007411	3.653602	3.501394
D(LGDPR(-4))	0.006584	3.014433	2.903657
D(LGDPR(-5))	0.006202	3.063689	2.927600

The health sector in Armenia is financed by the state and private sectors, as well as by various international structures. According to the results of the model, in the case of a 1% increase in health costs, economic growth will increase by 0.07% after 3 quarters, and a 1% increase in spending on public order and safety will reduce economic growth by 0.06% after 2 quarters, ceteris paribus. Studies show that health spending in low-income countries is largely financed by private sources- 44%, and external sources- 29%, while in high-income countries, the share of public spending dominates, at 70%. Armenia has a pretty low share of public expenditure financing of the health sector, 1.7% of GDP, while in countries with a high-income (France, Germany, Austria, Italy) it is 8-9%. Funds allocated to public order and safety amounted to 2.3% of GDP, for comparison, this indicator is 1.9% and 2.4% in neighboring Georgia and Azerbaijan, respectively, and in developed European countries (France, Germany, Austria, Italy) this indicator varies around 1.3-1.9% (IMF database).

Conclusion: According to the econometric models built on the basis of quarterly data of 2000-2023, total budget expenditures, as well as separate expenditure items: general public services, health, public order and safety, defense, have a statistically significant impact on economic growth, with their effects being reflected in economic growth after a certain time lag. An increase in total budget expenditures contributes to economic growth, with the effects becoming apparent after a certain time lag; this effect acquires a negative sign, which can be interpreted as this cost multiplier is less than one, which can be interpreted as being less than one of the multiplier of these expenditures, because a part of budget expenses is returned to society in the form of various payments, and a part of it is directed to savings, reducing the impact of spending on economic growth, that is, one unit money spent leads to the formation of less than one additional unit money of income.

And from the articles of functional classification, economic growth is promoted by general public services and health spending. On the other hand, expenditures on public order and safety and defense, inhibit economic growth. The latter two can be considered the purest public goods and services, which in the professional literature are considered together as unproductive expenditure and it is assumed that their effect on economic

growth should be of the opposite sign.

At the same time, the negative relationship between expenditures on public order and safety and economic growth can be interpreted as an artificial overblown of these expenditures: the share of such expenditures in Armenia's GDP exceeds that of high-income countries, and the initial level of these expenditures may already be considered "excessive" for Armenia's economy, and its further growth will become counterproductive.

The obtained results can be the basis for the development of macroeconomic policies, which will be aimed at the formation of a more targeted structure of budget expenditures, however, as obvious as it is that the expenditures directed to national security and defense are unproductive, the choice between military and development expenditures requires a policy-maker to take into consideration the relative values of those costs.

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Journal of Yerevan University. Economy
2024, Vol. 15, No. 2(44), December, 131-146
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THE CONCEPT, GOAL, AND SOLUTIONS OF BUSINESS DIGITAL TOKENISATION IN DEVELOPING COUNTRIES, ON THE EXAMPLES OF ARMENIA

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Abstract: The idea of a business model based on tokenized assets is used in the article to describe and build the concept and main approaches, criteria, tools of business digitalization. For competitiveness, high quality, and inclusive growth of the real sector of the economy, the Republic of Armenia must focus on the paradigm of the digital economy with a matrix of information technology plus an exact industry of the real sector (IT + seprate industries sectors). The benefits and advantages of the token-based business model toolset are outlined in detail in aspects of decentralisation, innovative responsiveness, immutability of entered information, cryptographic security, transparency, the ability to carry out peer-to-peer transactions without the need for verification and regulation by a central authority, and ultimately increasing the level of governance and efficiency, liquidity, and attraction of alternative investment vehicles. The systems of business decentralisation at the organisational and managerial level, various channels for the exchange and sale of tokens are interpreted.

A concept has been put forward to solve the problems of digitalization in Armenia simultaneously: a) in the ICT sector, b) in the real sector of the economy, c) in the financial sector; and, of course, in the educational field. The concept of goal setting is built on the axis of convergent development, which, in turn, will bring a synergetic result — a new quality of competitiveness for the beneficiaries of all the mentioned sectors as well as for consumers.

It is emphasised that, in-depth understanding of the legal regulation of business digitalization is more important for the real sector of the economy, since it is aimed at ensuring: promotion of the generation of innovations; business management efficiency; reducing product and service costs and increasing productivity and efficiency of management; and disclosure of alternative investment channels for businesses.

Keywords: *blockchain, distributed ledger technology (DLT), token, classification of token, tokenomics, digitalization on convergence development*

JEL: O32 Management of Technological Innovation and R&D

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Received: 19.08.2024
Revised: 17.09.2024
Accepted: 27.12.2024

Introduction.

The global digitalization of the 21st century has brought incredible technological developments and solutions, and most importantly, digital philosophy, forming a visual digital environment and ecosystem. This has caused fundamental innovative and tectonic changes in the global economy and in all its sectors. Numerous technological innovations have given rise to digital mechanisms and various online products and services derived from them, which have become an integral part of the lives of businesses and people. Disruptive digital technologies and innovative products are being introduced into the digital virtual environment, which, in turn, leads to novel business models that create new added value; there is no other standard for a business model. Symbolically speaking, the «business genome» is deployed and operates in a virtual digital environment. Moreover, implemented everywhere, without geographical and spatial restrictions (according to the catchphrase "death to distances and space"), this genome is, by its nature, less expensive, simple and easy to implement, and, moreover, inclusive.

In the financial sector, IT is developing fintech solutions, online banking, digital payments, and effective risk management systems. Fintech innovations facilitate real-time transactions, risk assessment, personalised financial services, and fraud detection. This has led to the emergence of digital banking, peer-to-peer lending platforms, robo-advisors, and many other services. The digitalization of businesses, particularly fintech, is transforming all services by making them inclusive, accessible, transparent, and efficient, as well as expanding access to capital for businesses in the real sector, promoting entrepreneurship, quality development, and growth. To remain outside of these digitalization processes is to undermine competitiveness at all levels and for everyone.

Legal framework for regulation of crypto assets in the Republic of Armenia.

It should be noted that the «Armenian Digitalization Strategy for 2021-2025» program has been adopted in the Republic of Armenia (Digitalization Strategy of Armenia 2021-2025). Meanwhile, specifically in the field of business digitalization, very scattered and, in many cases, imitative and/or meaningless measures are often carried out. Our research shows that as of October 2024, Armenia lags behind the countries of the region in terms of business digitalization: Georgia, Azerbaijan, Turkey, Iran, and the EAEU countries: Russia, Belarus, Kazakhstan, and Kyrgyzstan. This, in particular, concerns the use of digital (virtual) business practices, the use of tokenized financial crypto-assets and cryptocurrency, as well as their legislative regulation.

There is practically no legal regulation of digital crypto-assets and cryptocurrencies in the Republic of Armenia. This concerns: a) the legal classification of digital crypto-financial assets and their equivalent legal regulation; b) widely used in international practice, the approval of technological innovations in the experimental regulation regime - sandbox, promoting fintech innovations; c) legislative norms for the implementation of «Open Banking» services. There is no legal regulation of the mining of cryptocurrencies directly from digital platforms (associated with the energy-intensive process of Bitcoin mining), which directly affects taxation and energy consumption[1]. The lack of legal

[1] In general, in international practice, the classification of crypto assets as property or financial assets is the basis for determining taxation regimes for income from transactions with tokenized assets and cryptocurrencies. In this regard, the experience in Kyrgyzstan is interesting, where a special tax has been established, the rate of which is 15 percent of the fee for the energy consumed for bitcoin mining. This approach is associated with a shortage of energy resources, and in this case, crypto miners use approximately half of the electricity

classification and regulation of digital assets and cryptocurrencies in the Republic of Armenia essentially causes uncertainty regarding their taxation regimes. The above-mentioned gaps in legal regulation indicate that in the Republic of Armenia, there is a need for targeted and systemic legal regulation of the digitalization of the business sector with relevant approaches and mechanisms. It should be noted that there is a widespread opinion among the public that the legal regulation of digital assets will regulate the financial sector, whereas this is more important for the real sector of the economy. In this regard, we emphasise that the focus of the article is the digital tokenisation of a real part of the economy that doesn't exist nowadays, and consequently, it is impossible to illustrate this by data. As for such examples in developing countries, these may be separate experimental products in a regulatory sandboxe regime.

Main issues of the real and IT sectors of Armenia.

Disruptive technologies have accelerated the pace of innovation, challenging traditional business models and creating opportunities for new entrants. All this has led to a new option for solving the "Achilles heel" of business, namely, identifying alternative investment resources for the real sector of the economy. The importance of alternative financial and investment channels in the real sector of the economy comes from the fact that the stock market has not fully developed in the Republic of Armenia, and, moreover, investment banks have not been formed, and the business itself in the real sector is not able to generate and provide itself with its own resources and investment grade. The reality is that since independence, the stock market in Armenia, for various objective and subjective reasons, has not met the investment needs of the real sector of the economy. Meanwhile, unexpectedly, the existing regulatory legislation complies with international industry standards. If we subtract government bonds, investments in compulsory pension funds, and bonds issued by banks from the volume of the Armenian stock market, then the stock market doesn't represent any tangible significance for the Armenian economy. The institute of investment banks also failed to take place in Armenia. In the past and now, many are regularly inspired by calculations of possible investment flows from the Armenian diaspora, calculating the imaginary potential in billions of dollars, but do not bother to show the channels and ways of promoting capital, while traditional mechanisms of stock capital in Armenia do not work.

In such circumstances, the implementation of large-scale investment programmes by private businesses in Armenia, as a rule, was associated with government incentive measures, and the presence of institutions and mechanisms directly or indirectly facilitating the influx of FDI. Among the implemented programmes of this practice, one should highlight the long-term lending resources directed to the Armenian economy by the World Bank, the EBRD, the Asian Bank, and other international financial institutions in different years and in different sizes. The addressee of these funds was the government of the Republic of Armenia, and then these funds were addressed to businesses in the real sector of the economy through targeted programmes through the channels of commercial banks (as programme operators).

The mentioned and other examples, typical not only for Armenia but also for other transitional and developing countries, prove the reality of the necessary stimulating patronage of FDI and enterprises' own investment funds from the state, since investment funds are not generated in sufficient quantities within the country, and the stock market

produced in the country, which causes serious problems.

is not capable of providing these needs. Meanwhile, in the modern digital stage, the digital format of business opens up a new option for attracting investment resources from the real sector.

Information technology indicators in Armenia in 2023 had a growing trend, the turnover of the IT sector in 2023 increased by 252 billion drams, or 43% (≈ $638 million in June 2024), (Report of the consulting company "Medex" 2023). According to expert estimates, this may reach up to 7% of GDP. All this is also increased due to the tax preferences established for the IT sector. However, these positive trends will be realised within the IT sector itself, since innovative technological developments and products produced by the IT sector do not penetrate the texture or business matrix of the real sector of Armenia. In most cases, innovative technological developments in the supply chain involve the outsourcing of individual sought-after technological developments (and not the entire set of solutions) supplied from outside the country to technological entities in the Republic of Armenia, and then the transfer of finished developments to the customer outside the country.

This function of the Armenian IT sector is naturally positive, since, under equal conditions for solving IT delegated orders, Armenian IT business entities are competitive. Another large sector in IT is the “iGaming” business. Meanwhile, developments, solutions, or products of Armenia’s IT sector for the real sector are generally presented as “impersonal and neutral” or “without a homeland” in the innovation supply chain. It is not surprising, and it cannot be otherwise; no one will provide such a “present” of ready-made innovative developments to another country. On the other side, innovative solutions can only be implemented in a business format since they must pass through the “market gateway” and have presented new additional value. The latter as a capital, in addition, is focused only on high profits and is not oriented by the “homeland” category.

In addition, innovative supply chains are subject to government protection for several reasons: a) national security (ensure the sustainability and reliability of these supply chains, including through regulation, subsidies, and/or trade policy); b) economic competitiveness (promote innovation for competitiveness in key industries to support economic growth by providing incentives, funding research and development, or implementing trade policies to protect domestic industries from unfair competition or encourage investment in innovation); c) risk mitigation (innovative supply chains may face unique risks, such as disruptions due to technological change, natural disasters, or geopolitical tensions). Governments intervene to mitigate these risks by providing guarantees, creating contingency plans, or investing in modernization infrastructure and technology; d) regulatory compliance (innovative products or technologies require compliance with complex regulatory frameworks related to safety, environmental protection, or intellectual property rights). Governments set and enforce these rules, ensuring that innovative supply chains operate responsibly and ethically; e) disruptions in the market (in some cases, market failures or external factors prevent the development or adoption of innovative supply chain solutions). In general, governments intervene to address these shortcomings through measures such as subsidies, tax incentives, or public-private partnerships to stimulate innovation and overcome barriers to entry. Overall, government protection of innovative supply chains reflects a balance between promoting economic growth, ensuring national security, managing risk, and addressing

market failures to create an environment conducive to innovation and sustainable development.

Setting goals for business tokenization.

For competitiveness, radical, high-quality, and inclusive growth of the real sector of the economy, Armenia must focus on the paradigm of the digital economy with the matrix: «IT + military-industrial complex» , «IT + chip engineering», «IT + precision engineering», «IT + small chemistry», «IT + processing industry», «IT + pharmaceuticals», «IT + construction industry», «IT + biotechnology», «IT + agro-industrial complex», and other strategic or key industries. In this regard, Armenia is already significantly behind. On this basis, not only will GDP growth occur, but inclusive, high-quality development of the RA economy will also be ensured.

Digital business, with its decentralised matrix and financial inclusion, is already transforming the existing centralised business model matrix. In essence, in the history of mankind, a centralised business matrix ushered in the era of industrialization. However, in the millennia-long history of mankind, about 300 years of industrialization are just a minute, but at the same time, it is the period of the most intensive and effective development and flourishing of the business model and practice of business relations, with all its known achievements. Meanwhile, the «post-industrial» or «meta-era» shows that it can transform even this most efficient, centrally controlled pyramid business matrix. By the way, in Latin, the prefixes «post» and «meta» usually mean «after» or «for». Accordingly, both prefixes have the same meaning, indicating the next stage of time. Accordingly, during the incredible development of digitalization, along with artificial intelligence (AI), machine learning (ML), and other achievements, humanity is still in the post-industrial stage and is actively searching for signs of the title of a new digital era, which follows the post-industrial era. Let us only note, in our opinion, that the most important feature among others is the decentralisation of the organisation and management of business, which does not fit into the format of an effective centralised model, including the corporate management system of business. S. Golubev believes that another distinctive feature of the digital era is «a decrease in the overall required level of management and control; tokenomics will reach the level of replacing more than half of the existing management and control functions (in the field of information) (Sergey Golubev, 2019).

In 2024, in the difficult situation of external challenges in the Republic of Armenia[2], it is necessary to ensure the disruptive development of the real sector of the Armenian economy, including the military-industrial complex, by using the potential of digital transformation. Solving the problem requires conceptual justification. Firstly, the goals of such development should be outlined, among which the priorities are promoting innovation, increasing management efficiency, and the ability to attract financial, especially alternative investment resources for business. These goals are consistent with the broader priority goal of promoting economic development and economic competitiveness. The formulation of the problem is aimed at building bridges between decentralised and centralised economic institutions and creating a new arrangement of economic relations. On the other hand, the concept must respond to the issues of identifying opportunities for a technological solution to the problem and, respectively,

[2] The existing unresolved peace process with Azerbaijan and the ongoing blockade of Armenia by Turkey and Azerbaijan.

the implementation of those approaches and standards that will open the way to the implementation of the declared goals. It should be noted that business digitalization is associated with factors such as decentralisation, immutability, security, industry requirements, and others, which pose many obstacles and risks. The benefits of business digitalization are obvious, which dictates the need to develop a digital matrix at the institutional and technological level for all sectors of the economy. By and large, the problem is that until now, throughout the entire transition period and to the present day, the real sector of the economy, the financial and IT sectors of Armenia, have acted quite autonomously and neutrally, each within the framework of its own priorities and problems, without particularly caring about each other about the goals and objectives of other spheres (like the swan, crayfish, and pike in the famous fable).

In this regard, the above-mentioned concept should be aimed at solving the problems of digitalization in Armenia simultaneously: a) in the information and telecommunication technologies (ICT) sector, b) the real sector of the economy, c) the financial sector and, of course, d) the educational sector. The concept of goal setting should be built on the axis of convergent development, that is, solve the problem of convergence of the real, financial and ICT sectors of the economy through digitalization. The emphasis here is on the keyword convergence, which, in turn, will bring the expected synergy result—a new quality of competitiveness for the beneficiaries of all the sectors mentioned as well as for consumers.

The convergent development of the mentioned sectors of the economy implies not only economic growth, but also quality development based on the promotion of innovation, where each sector can contribute to and at the same time benefit from such convergence. In particular, innovations in information technology such as artificial intelligence (AI), machine learning (ML), cloud computing (CC), big data analytics (BD), the Internet of Things (IoT), etc., are transforming the economies of the real and financial sectors and, most importantly, creating essentially new decentralised business models.

In the real sector of innovation, IT promotes process optimisation, cost reduction, improved management quality, and overall efficiency. Real, financial, and IT sector convergence will improve operational efficiency; reduce costs, improve productivity, and drive innovation by enabling the development of new technologies, products, and services to meet changing market needs. In this regard, the Government of Armenia, business, the education sector and other stakeholders should promote the creation of an environment conducive to closer cooperation and innovation between sectors in order to maximize the benefits of convergent development. This means: a) investments in digital infrastructure, b) policies to support innovative research and development, c) the adoption of legal regulations for the digitalization of business that will promote innovation, increase accessibility and inclusiveness of services, while ensuring stability and security.

According to the goals of the proposed concept, it is necessary to highlight the main axes of its implementation. These are: a) development of the necessary structures, standards, and comprehensive projects to ensure legal regulation of the digitalization of the economy and prevent risks for investors and beneficiaries; b) conducting research to identify digitalization problems and their solutions; c) consulting on practical problems of the digitalization of individual units of the real and financial sectors of the economy; d) training and continuous education related to new components, mechanisms, forms, and models of digitalization.

The concept and approach of the proposed solutions require pointing out the importance of adopting a law on digital or virtual assets in Armenia. But this is a separate

subject, and it's not reasonable to include it in this study.

The essence of the proposed concept

The digitalization of business ultimately implies the creation of a digital model for creating added value in business, which is called "Tokenomics". The approach in this paper doesn't have the possibility of giving a full review of tokenomics, which has been explored by many authors (Shermin Voshmgir, 2019 , Alex and Don Tapscott, 2018, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, 2016, Oana Marin, Tudor Cioara , Liana Toderean, Dan Mitrea and Ionut Anghel, 2023, Robert Stevens, 2022, David Tomu, 2018). The conventional birth of Tokenomiks can be considered in 2015, when Ethereum was launched, introducing the concept of smart contracts and allowing developers to create decentralised applications (DApps) and tokens on its blockchain. This event greatly expanded the capabilities of tokenization and laid the foundation for the development of tokenomics as a separate field. Since that time, various ideas and projects have emerged around the potential uses of tokens other than cryptocurrencies, including encouraging online participation, governance mechanisms, and the creation of a decentralised economy. An important milestone can be considered the founding of the World Tokenomics Forum[3] in 2018.

It is worth noting that, in general, tokens build on different tangible or non-tangible assets. Underlying assets may include real estate, precious metals such as gold, silver, or fiat currencies, and/or even other cryptocurrencies. The most important feature of a token built on underlying assets is that a token can typically represent ownership or a claim to an underlying physical or digital asset (Security Token). As a rule, each token is backed by a corresponding reserve of assets held by a custodian or issuer, which provides stability and ensures that the value of the token is linked to the value of the underlying asset. Among the advantages of asset-backed tokens is blockchain technology, which means record immutability, transparency, and security. At the same time, it provides users with public access to a traditional underlying asset in a digital format.

By definition, "Tokenomics" is directly related to a financially workable business model. One should agree with the opinion that "Tokenomics" (at this stage of blockchain development) are the rules for the functioning of a token within an ecosystem (a system of economic relations between project users, token holders, and project tokens) as a means of accessing or receiving certain bonuses, prescribed in the matrix of such an ecosystem created by a crypto project." (Sergey Golubev, 2019). In our amendment, the word bonus in this case should be mainly understood as a benefit since the business model is about receiving benefits in the form of added value.

Construction a business matrix of digital assets is based on building a business platform of tokens—digital assets based on real assets or intangible assets. The platform itself is based on blockchain, or distributed ledger technology (DLT), usually with technological solutions overlaying or embodying "smart contracts" on them. The most universal definition of blockchain boils down to the following: a digital, decentralised, distributed ledger technology in which transactions are recorded across multiple blocks, computers (or nodes) in a manner that ensures immutability, security, and transparency. Each block in the chain contains a cryptographic or encrypted "image"—the hash of the previous block—creating a chain of interconnected blocks. This technology allows for

[3] World Tokenomic Forum, founder Chris Snook, available at: https://www.worldtokenomicforum.com/

the secure and transparent exchange of digital assets and/or information without intermediaries (David Tomu, 2018, Robert Stevens, 2022). This definition highlights the key features of blockchain, including its decentralised nature, immutability of information, cryptographic security, transparency, and the ability to conduct peer-to-peer transactions without the need for review or regulation by a central authority.

In connection with the above, it is necessary to state that historically, the formalisation of business relations implies maintaining an accounting register, for example, debit and credit records, and accounting for assets and liabilities. According to the hypothesis of archaeologists, in ancient times, even money was recorded in the form of entries in registers—in the form of stones or records on them. Accordingly, blockchain and distributed ledger technologies (which are very similar concepts) are essentially electronic digital online registries. Over the millennia, the ability of the human mind (Homo sapiens) has reached the point that in our time, the recording medium of economic relations is no longer a register on stone, clay, or paper, but digital electronic registers - Blockchain, DLT and their varieties.

It should be pointed out here that a very important feature for business is that, depending on the nature of inclusiveness or exclusivity, blockchain technologies are classified as permissionless vs. permissioned blockchains (José M. Garrido, 2023, pages 9-10). Permissionless blockchains are open to anyone to join and participate without any permission, such as Bitcoin (BTC) and Ethereum (ETH). They tend to be inclusive in that anyone can access and use them. This issue is very significant from the point of view of legislative regulation. Permissioned blockchains require clear permission to join and participate. They are often used within groups of individuals or entities where privacy and control are extremely important. Permissioned blockchains are exclusive because access to them is controlled by a central authority (or entity).

In general, blockchain technology design factors such as permission, consensus mechanisms, cryptographic functions, scalability solutions, interoperability, and accessibility can have a significant impact on its inclusiveness or exclusivity. This proves that the blockchain digital asset framework can be inclusive and accessible to a wide range of users, with limitations and/or interim solutions. All this leads to different regulatory approaches, which should also be taken into account when legislatively regulating digital assets and cryptocurrencies in the Republic of Armenia.

Now let's focus on the essential issues. An underlying asset-based token essentially acts as a currency to measure and exchange the value of assets within its native ecosystem, and also serves the function of promoting value growth, while at the same time being an investable asset outside of its ecosystem. for buying and selling. Meanwhile, it is important to emphasise that even in its native ecosystem, a token does not have a fixed value; otherwise, what is the idea of introducing a unit with a fixed value, the role of which could be played by ordinary money? For practical purposes, the last statement should be interpreted in more detail.

1) An asset-backed token, in its native ecosystem (or platform), is typically developed in software to function as a currency or medium of exchange for transactions in the ecosystem or markets operating on blockchain technology.

2) Tokens backed by underlying assets are typically traded on various cryptocurrency exchanges and peer-to-peer (P2P) platforms. This liquidity increases the utility of the token and attracts investors.

3) Tokens may not have a fixed value even in their native ecosystem. The value of

tokens may fluctuate depending on various factors, such as market demand, the value of the underlying asset, and general market conditions. Therefore, it is not a traditional currency. At the same time, fluctuations in the value of a token in its native ecosystem provide an incentive to improve the efficiency of operations.

4) The main issue is the possible fixed value of tokens. If a token had a fixed value, it would essentially function like a traditional currency. Flexibility and the ability to appreciate or depreciate make the token more dynamic and potentially attractive to investors.

Accordingly, the above statements accurately describe the role and characteristics of tokens backed by underlying assets, firstly, in their native ecosystems, emphasising their function as currency, and secondly, as a commercially variable value, especially outside their native ecosystems.

Once again, as a «mantra», let's point out the most important thing: DLT and blockchain allow users to conduct digital transactions without the need for a centralised authority or coordinator. This fundamentally changes the way business is organised and managed (Puja Ohlhaver, E. Glen Weyl, Vitalik Buterin, 2022). Based on the above conceptual framework, a key question to consider is: how will decentralised governance impact or stimulate the investment flows and management efficiencies that businesses seek? In relation to the disclosure of alternative non-traditional investment flows (channels) for business, a real alternative is a digital tokenized business model. Accordingly, it is necessary to identify the functional differences and advantages of traditional and digital business tools—shares and asset-backed tokens.

Essentially, these are different financial instruments that are used in different contexts: tokens in cryptocurrencies, and shares in traditional stock markets. The functional differences between these tools are primarily due to their nature and context. For comparison, it is known that a share is a security that certifies a person’s ownership of a part of the company, with the right to receive part of the company’s profit (as a dividend) and participate in management with voting rights based on the number of shares.

As for tokens, first of all, it should be noted that they are associated with the technological matrix of blockchain, or DLT (in this context, they can be conditionally equated), which is capable of forming an ecosystem. A digital token is a unit of value issued by a programme or organisation. The token provides an exchange of value between stakeholders within the ecosystem as a measure of value and exchange, and can also implement an incentive function to achieve programme objectives (this is not inherent in shares). Tokens are not limited to specific economic functions. In addition, a digital token can act as an investment object outside its native ecosystem. This means that investors can purchase tokens with the intention of making a profit or participating in the potential growth in the value of the token.

Tokens show huge potential in the new digital economy. With the help of smart contracts, a complex package of rights that, for example, a shareholder has can be included in a token. In this way, the entire contractual relationship or the entire shareholder status can be included in the token (José M. Garrido, page 20).

A token can be much more than just a self-referencing virtual asset like Bitcoin. Tokens can provide access to digital services and assets and, ultimately, can also be linked to offline assets and services. In this regard, tokens can perform functions similar to those of commercial instruments, but tokens are more capable because they are not limited by some of the fundamental principles of commercial instruments.Depending on

its purpose and specifications, a token may have various functional properties, including, but not limited to, utility functions, means of payment, value representation, investment opportunities, and managerial functions. As such, tokens can have a variety of functions and properties that go beyond simply representing a virtual asset, and their purpose and meaning can vary significantly depending on the specific project or ecosystem in which they are used. In essence, digital tokens, by their nature and functions, are divided into several types(Euler. T., 2018, Token Taxonomy Framework (TTF) 2022): security tokens (ST), which can certify ownership of an asset, but for this, in addition to the existing unique technological capability, it is also necessary to legislate this. Accordingly, a security token can simply perform the function of a security (stock). Meanwhile, unlike a stock, the token is multifunctional and flexible in terms of functions. On a specific platform, a token can have varieties with different functions, such as: a) tokens that certify the consensus of operations or states—validators (validator token); b) utility tokens that provide access to the platform or services; c) "voting rights tokens" for decision-making ("voting token"); and, as well, d) security tokens with a function of ownership (security token - ST). The cool thing is that different tokens can combine the functions of others, providing a wide range of functions in one token.

This flexibility is one of the key benefits of blockchain-based tokens. For example, there may be security tokens with voting rights. That kind of hybrid tokens allow token holders to participate in corporate governance decisions, such as voting on company policies, elections to the board of directors, or important business decisions. There are also hybrid tokens that combine the characteristics of security tokens and utility tokens. Hybrid tokens often strive to meet regulatory requirements while maintaining utility for token holders. Thus, the functionality of blockchain-based tokens is highly customisable, allowing a wide range of combinations to be created to meet the specific needs of projects, platforms, and token holders. This flexibility allows for innovative use cases and business models in the blockchain and cryptocurrency spaces.

From the point of view of legal compliance with relations, the system of legislative regulation is important in tokenization. The regulatory environment for tokens varies greatly depending on the current legal framework in each jurisdiction.

It is also relevant to present the advantage of asset-backed tokens compared to shares in the plan in their higher liquidity, since tokens can be sold through multiple channels and methods of commercialization. Tokens on blockchain platforms are often easily transferred through cryptocurrency exchanges, where investors can buy and sell them at any time without waiting until the trading session closes. This is because, unlike traditional stock exchanges, cryptocurrency exchanges operate 24/7 and have specific trading hours and trading sessions. As a result, traders can buy and sell tokens whenever they want, regardless of their location or time zone. This continuous access to trading is one of the attractive features of cryptocurrency markets, providing liquidity and allowing traders to quickly respond to market changes and news. Obviously, the fundamental advantage of a trader in any market is to be half a step ahead. Shares are traded on traditional stock markets, where the process is usually more regulated and follows the traditional strict procedures established for buying and selling on stock exchanges.

Tokens have global trading coverage, they are traded around the world 24/7, opening up investment opportunities for a wide range of investors and beneficiaries. Tokens have many exchange tools for buying and selling them on the decentralised exchange market:

over-technological token exchange means, including DEX, peer-to-peer (P2P) platforms, etc. Such exchange platforms operate on the blockchain and allow users to trade tokens without intermediaries, ensuring a high level of confidentiality and security. Their important feature is that they can be integrated into existing websites or applications. Essentially, for the sale or disposal of tokens, it is also applicable for offline transactions. Therefore, the trading of tokens is broader; this is not identical to cryptocurrency exchanges.

Another format is organised sales (IEO, STO). Some programmes allow investors to purchase tokens through organised sales, such as Initial Exchange Offerings (IEO) or Security Token Offerings (STO), which are conducted on specialised platforms in compliance with legal requirements. Thus, tokens, unlike shares, can be actively exchanged or traded in at least several different formats that do not have strict rules.

It should be added that the token is more easily exchanged in its native environment. The modes here are also different, but simpler, depending on the context and features of the platform used. For example, the exchange of tokens in the Ethereum environment can occur through smart contracts or special exchange platforms where tokens can be bought and sold for other cryptocurrencies or tokens.

In the context of an enterprise environment, tokens can be used to represent digital assets, internal resources, or ownership of company shares, and exchanges can be carried out using the token according to the rules defined by the company's or platform's internal system protocol. In terms of liquidity, it can also be stated that asset-based tokens actually offer the greatest opportunities for portfolio diversification due to the fact that their underlying assets can be represented by several assets such as real estate, precious metals, etc., allowing investors to balance the impact of risk fluctuations in their portfolios and level them out.

It should also be emphasised that blockchain or DLT transactions are usually less expensive than traditional stock transactions, largely due to the elimination of various intermediaries and the transfer of their functions, usually to a smart contract. This is the secret to significantly reducing overall costs and increasing the efficiency of digital investments.

From the point of view of comparing shares and tokens, let us once again note the most key concept: decentralisation versus centralization. Tokens are fundamentally linked to decentralised systems; transactions and ownership are recorded on the blockchain and/or DLT, providing transparency and immutability without intermediaries. It’s maximally protected from unauthorised access and transparent for all market participants. Shares are usually part of centralised financial systems, where ownership records are maintained by central authorities and transactions are recorded through centralised stock exchange systems (depositories).

It should be noted that the decentralisation of digital business can be interpreted at two levels: a) organisational decentralization. In 2023, DAOs (Token Taxonomy Framework (TTF), 2022) of the Marshall Islands, USA (Wyoming), Switzerland, Cayman Islands, Liechtenstein, Singapore, Panama, the British Virgin Islands, Gibraltar, and the Bahamas recognised the status of decentralised autonomous organizations. Different jurisdictions have different rules that are worth considering (Aaron Wright. 2021, Nestor Dubnevych, 2024), and b) decentralisation of management decisions.

Organisational decentralisation refers to the distribution of decision-making authority

and operational responsibilities among different nodes or network participants. In the context of Bitcoin (BTC) and similar two-in-one digital currencies, there is no central authority or organisation that can control the entire system. Instead, the network operates in a PtoP format, where each participant (or node) has equal rights and responsibilities (classic blockchain structure). This decentralisation ensures that no single entity can control a given token (currency), making it resistant to censorship, counterfeiting, and/or manipulation. This is the conceptual approach of Satoshi Nakamoto, the godfather of Bitcoin (Wyoming Secretary of State Business Division, 2022).

The second axis is the decentralisation aspect of management decisions, which focuses on the question of how management authority is determined in a decentralised organization. Decentralisation of management decisions means that decisions about protocols, software updates, and network management are made by network participants in a collective decision format, rather than by a centralised body. This decentralised governance model typically includes mechanisms such as consensus mechanisms, in which network participants must agree on proposed changes before they can be implemented.

In terms of comparing shares and tokens, it should be noted that in the event of insolvency or liquidation of a company, the shareholder is the last plaintiff after the claims of all creditors or plaintiffs have been satisfied. In the context of blockchain projects, users of tokens often have different statuses, and their position may vary depending on the nature of the token. Users of tokens may have certain rights to sue or may not be a formal plaintiff at all. The hierarchy of token users is different, the types of tokens are presented above, for example, holders of Utility tokens and Security tokens will have different rights of action in the event of insolvency of a project or business enterprise.

If legally established, users of security tokens can be the owners of a company or project and, therefore, can be equated in hierarchy with traditional shareholders of companies. Thus, among the advantages of asset-backed tokens are the possibility of business decentralisation; the versatility of tokens, liquidity and wide exchange opportunities, global access; 24/7; transparency and immutability of the status of assets and transactions; and low cost.

In the proposed model, disclosure of information about the underlying assets of tokens is very important. However, digital technologies have not yet been comprehensively applied to quantify the components of the underlying assets converted into tokens. Instead of the traditional “Proof-of-Stake” (POS) validation model, an innovative «Proof-of-Stake + Smart Contract + DApps» or «Proof-of-Authority (PoA) + Smart Contract + DApps» transaction validation or verification function is offered, which will confirm that the product was created as it was designed. This mechanism is combined with Internet of Things (IoT) tools, resulting in a continuous technological audit in the online verification mode. This is extremely important in the digitalization of the supply chain. Enterprises are not only classified based on the degree to which supply chain processes have been digitalized (including inventory management, purchasing, logistics, and supply chain analytics), but also on the disclosure of information regarding the identification of the underlying assets underlying the tokens.

Conclusion

Globally, tokenization is being embraced as a forward-looking approach in developing countries such as Kenya and India, where digital assets are unlocking new opportunities for growth. Armenia can position itself at the forefront of this trend by proactively adopting tokenization to boost innovation and economic sustainability. Armenia's economic sustainability is threatened by its geopolitical environment, including regional conflicts and infrastructure blockades. In this context, tokenization isn't just an innovation but a crucial strategy for strengthening resilience. By integrating the financial, real, and ICT sectors through digitalization, Armenia can offset external pressures with stronger internal economic structures and access to alternative investments.

The main problem of the Armenian economy is that its main sectors have been developing separately throughout the years of independence and to this day: the real and financial sectors and the ICT sphere function independently, based on their goals and objective realities. This is an objective statement of facts, and their reasons are different and too multi-layered. This state of affairs can be rebuilt through convergent development, which means digitalisation of business, namely the real sector, based on tokenisation through the convergent fusion of ICT technologies, an alternative system of financial support, and, very importantly, ensuring legal regulation, since the technological solutions themselves without legislative support can sometimes remain just a fiction.

The above justifies the setting of the goal, namely, that an effective basis for the development and growth of the real sector of the economy (including all sectors) should be built on the axis of convergent development of: a) the real sector of the economy, b) the financial sector, c) the ICT sector, or convergence of three sectors through digitalization. Such convergence, in turn, will lead to a favourable multiplier or synergistic effect, a qualitative increase in the competitiveness of economic units and beneficiaries of all three sectors. The core of the mentioned strategy for digital convergence of the real sector of the economy should be the concept of adopting business tokenization, that is, building a business model of digital assets based on tokens of tangible and intangible assets, which should generate new added value; it was indicated above that there cannot be another standard for building a business model.

In terms of such a statement, the main problem comes down to choosing an appropriate arrangement in terms of practical implementation, which has several important axes. First of all, it is necessary to take into account the limitations according to which business units of the real sector of Armenia, in almost all respects, will not be able, individually, to implement such a large-scale digitalization programme due to limited potential and resources, including professional, technological, financial, etc.. Accordingly, building a business model based on the tokenization of digital assets requires a conceptual approach. This is, first of all, *overcoming limitations through the formation of a consortium (or pool) of individual organisations in the real sector of the economy, united by common interests, aimed at building a digital business model.*

From the point of view of the programme for implementing tokenization in the format of a business consortium, the military-industrial complex is relevant; consortia in agribusiness, renewable energy, precision engineering, pharmaceuticals, the construction complex, and especially in the field of intellectual property may be of

interest. *The goal setting of the project is threefold: a) ensuring the promotion of innovation; b) a sharp increase in the efficiency and productivity of management; and c) ensuring the influx of alternative financial, in particular, investment resources.*

Important criteria for solving the problem are: 1) disclosure of factors related to the coincidence of interests of business units included in the consortium; 2) building the technological basis of the tokenized ecosystem of the consortium. In this sense, the solution to the problem faces the very sensitive and delicate issue of the public openness or inclusiveness of the tokenization matrix. In particular, a fully inclusive public digital format is desirable for manufacturing and other sectors, but unacceptable for the military-industrial complex. From the point of view of this issue, it should be taken into account that the technological matrix of the proposed model is extremely wide; it covers everything from an absolutely inclusive or open format to highly exclusive or closed centralised formats based on DLT with smart contracts embedded in them. Accordingly, technologically equivalent solutions are available for the nature of the military-industrial complex too.

A token based on real and intangible assets, in its native ecosystem of the consortium, will perform the function of a currency for measuring and exchanging value, as well as a function that contributes to an increase in value, and at the same time, as an investment asset, will be an object of purchase and sale outside of its ecosystem. In this sense, even in its native ecosystem, a token does not have a fixed value; otherwise, what is the point of introducing a unit with a fixed value, the role of which could be played by usual fiat money. The idea is the potential of a tokenized digital asset system in a consortium ecosystem to act as a catalyst for innovation, governance, and productivity and to attract future investors.

Let us emphasise once again that a business matrix based on digital financial assets—tokens—in a consortium format should become a stable business model that will solve many limiting problems and ensure a synergistic result. It is important to note that the regulatory framework for tokens is still evolving, and the rights and requirements associated with tokens can vary greatly from country to country, depending on the specific design of the token and the legal framework that governs it. In the Republic of Armenia, tokenization issues that are not legally regulated can be resolved using the Sandbox (Satoshi Nakamoto, 2008, Douglas W. Arner, Janos Nathan Barberis, Ross Buckley, 2017, ASIC, Enhanced regulatory sandbox, 2024, Bank of Jamaica, 2020) regims adopted in international practice, i.e., an experimental matrix of legal regulation.

It should also be pointed out that business tokenization is associated with certain risks, such as regulatory risk, market volatility, technological risk, and other risks. However, digitalization and tokenization of business, in Armenian realities—a shortage of investment resources and the unsatisfactory state of the stock market—can open up new opportunities for alternative investment flows, as well as increasing management efficiency, reducing costs, and founding innovation chains within the country's economy.

To summarise, it should be emphasised once again that the concept of business digitalization should be built on the axis of convergent development of the real, financial, and ICT sectors of the economy through digitalization. In general, legal regulation of business digitalization is more important for the real sector of the economy, since it is aimed at ensuring: a) promotion and generation of innovations; b) reducing production

costs, increasing productivity, and improving business management efficiency; c) disclosure of alternative investment channels and flows for business. The emerging convergent development is a prerequisite for a competitive real sector of the country's economy, including the military-industrial complex, manufacturing industry, precision engineering, winemaking, pharmaceuticals, and all other vital sectors of the RA economy.

Armenia, as a small landlocked country in the midst of intense regional competition following the 2020 war with Azerbaijan and an ongoing infrastructure blockade, does not have a sufficiently high degree of economic sustainability. Alongside this, the country is under the potential pressure of economic expansion from aggressive neighbors. We look at this as not a political issue but as having profound resilience as well as economic sustainability levels. From this angle, new concepts and approaches will be necessary for Armenia's economy to embrace in order to achieve much-needed economic sustainability and competitiveness. First of all, business tokenization forms the basis of this concept. At the same time, this approach is not a specific treatment for Armenia; in our view, it's the main future streamline in economic for all developing countries.

Given Armenia's limited resources, a phased approach could be the key to success. Initial pilot programs in sectors like agriculture or renewable energy, supported by Sandbox regulatory environments, can demonstrate the value of tokenization and encourage further investment. These pilots can serve as a template for scaling up the digitalization of other key sectors.

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