

Original article

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DEFENSE EXPENDITURES WITHIN THE FRAMEWORK OF POSITIVE EXTERNAL EFFECTS FROM THE PRODUCTION OF HIGH-TECH WEAPONS (*THE CASE OF ARMENIA*)¹

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Abstract. The article explores the issues of defense spending optimization in Armenia from the point of view of possible positive externalities of the production of high-tech weapons. It attempts to answer the question of how to solve the well-known dilemma of “guns versus butter” for Armenia amid the current geopolitical and geoeconomic challenges.

To achieve the objectives, the differences between the concepts of *effectiveness* and *efficiency* of defense spending were considered. The potential impact of the production of high-tech weapons on the economy and the military sector was discussed through the prism of the “exploration-exploitation” dilemma. Such an approach is aimed at emphasizing the differences between the economic efficiency at different stages of new military technologies’ life cycle and the opportunity cost of military spending. As for possible positive externalities of the high-tech weapons production, an improvement in the balance of payments, relieving the public debt-servicing burden, developing human capital, increasing employment, creating and deepening bilateral and multilateral military-political and military-technical cooperation are presented as such in the article. However, *peace* and *transfer of technology to other sectors of the economy*, in defiance of the accepted approaches, have not been considered to the externalities of the high-tech weapons production.

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The study concluded that the redistribution of a part of defense spending to the high-tech sector, the ultimate goal of which is to gradually ease the burden of military spending for the state, can be the beginning of qualitative changes in terms of economic development and security due to the positive externalities of innovation and mastery of high-tech industries.

Keywords: Defense spending, externalities of production, high-tech weapons, defense industry, military innovations.

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Introduction

The quandary about economic development and military security ensuring – better known in academic circles as the “guns or butter” dilemma – is one of the most difficult for countries that are not rich in natural resources but have serious defense and security issues. The complexity of the dilemma is caused by the fact that a state with intricate security problems cannot theoretically have a developed economy, because on the one hand it will not be possible to prevent the “brain drain” and “capital flight”, which are the main driving forces of economic development in any country, and on the other hand, under conditions of high probability of possible shocks, it will be difficult to ensure the stability and effectiveness of fiscal and monetary policies which are important pillars of economic growth.

It is also theoretically impossible that an underdeveloped state could provide such a level of protection against internal and external security threats that would be acceptable to the majority of the population. Security is a very expensive public good and requires a viable and efficient economy. The only way to get out of the vicious circle of limited opportunities and the incommensurable complexity of tasks faced by small countries with limited resources is to develop an indigenous defense industry based on advanced technologies. This statement is based on the fact that the defense industry was almost the main driving force of scientific and technological progress, the cradle of breakthrough innovation, from which new technologies were also transferred to civilian areas. However, the problem takes on a slightly different content if we take into account that in the last two decades, since the beginning of the 21st century, the reverse process has been taking place, and now technologies from the civilian to the military sector are being transferred (Sayler, 2019).

The paper discusses the issues of increasing the efficiency of military expenditure in Armenia (as a small country with limited resources) from the standpoint of the development of indigenous advanced technology based on defense industry

and the possible positive externalities thereof. The discussion came to a close with an attempt to answer the question of how to solve the “guns or butter” dilemma for Armenia in the face of current geopolitical challenges.

The influence of military spending on the economy of Armenia

For almost two decades, Armenia has been characterized by a large share of military expenditure in the country’s general government expenditure and consistently ranked among the top-fifteen countries in this indicator (see Figure 1).

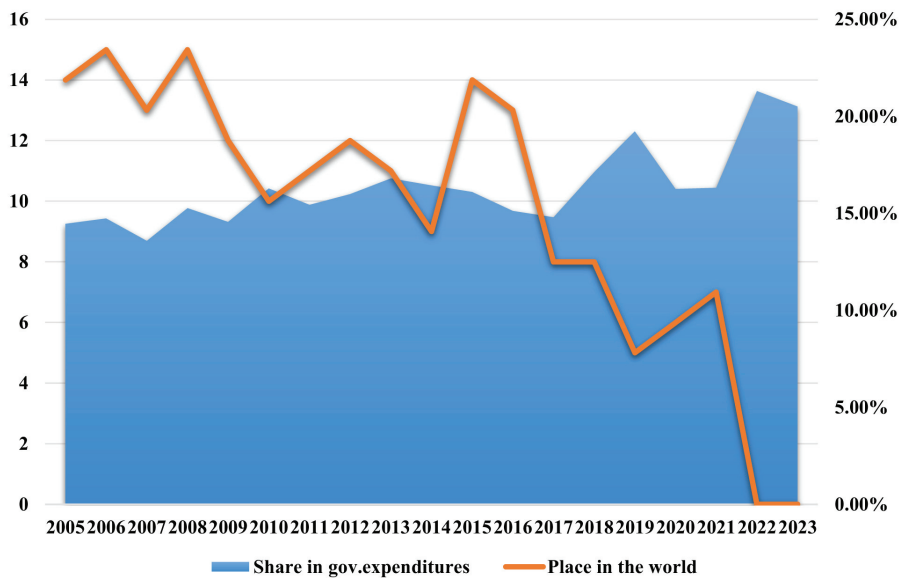


Figure 1: Share of military expenditure in RA general government expenditure for 2005–2023

Sources: The chart was built based on data published by the Stockholm International Peace Research Institute (data for 2005–2021, URL: <https://milex.sipri.org/sipri>) and RA interactive budget data for 2022, 2023. URL: <https://e-gov.am/interactive-budget>.

The high military expenditures have been objective due to the security issues facing the country over the years, but the question of their effectiveness remains controversial, especially now, after the 44-day war in Nagorno-Karabakh, where most military experts attribute Azerbaijan’s victory to its technological advantage (Amirkhanyan, 2022). However, the inefficiency of the allocation of military spending, despite its extreme importance, is only one aspect of the issue, because the military spending in Armenia has negatively affected the development of the entire economy. In particular, based on the regression analysis of statistical data from 1996 to 2020 using Johansen cointegration and Granger causality tests, we have previously shown that the increase in Armenia’s external debt was determined by a two-year time lag in the growth of military spending. A similar causal relationship was found between the trade balance and external debt. Moreover, the trade balance, in turn, determined the change in military

spending, while reverse causality – that is, military spending determined the change in the trade balance – was not confirmed (Harutyunyan, 2023). Such results of the econometric analysis led to the conclusion that a large proportion of Armenia’s external debt was formed as a result of the weapons and military equipment import necessary for addressing the defense and security issues facing the country.

Military expenditure by itself, without affecting the negative balance of foreign trade (that is, if they were not directed mainly to imports), could not influence external debt. This is obvious because the long-term relationship between non-military expenditures and external debt is generally not discovered, despite the fact that there are categories in non-military expenditures (for example, expenditure on social security), which outweighs military expenditures. It is pertinent to note that in 2020, the RA public debt reached 63.5% exceeding the dangerous threshold of debt-to-GDP ratio set by RA law “On public debt” – 60%.

Over the past five years, payments for servicing public debt have reached up to 10% of state budget expenditures, which is equivalent to about 2.7% of GDP (see Figure 2).

It turns out that the country’s security issues and the military spending allocated for their addressing led in a chain reaction to such economic changes that have created additional security problems but this time from the standpoint of military-economic security, the overcoming of which is also associated with significant difficulties for a small state like Armenia.

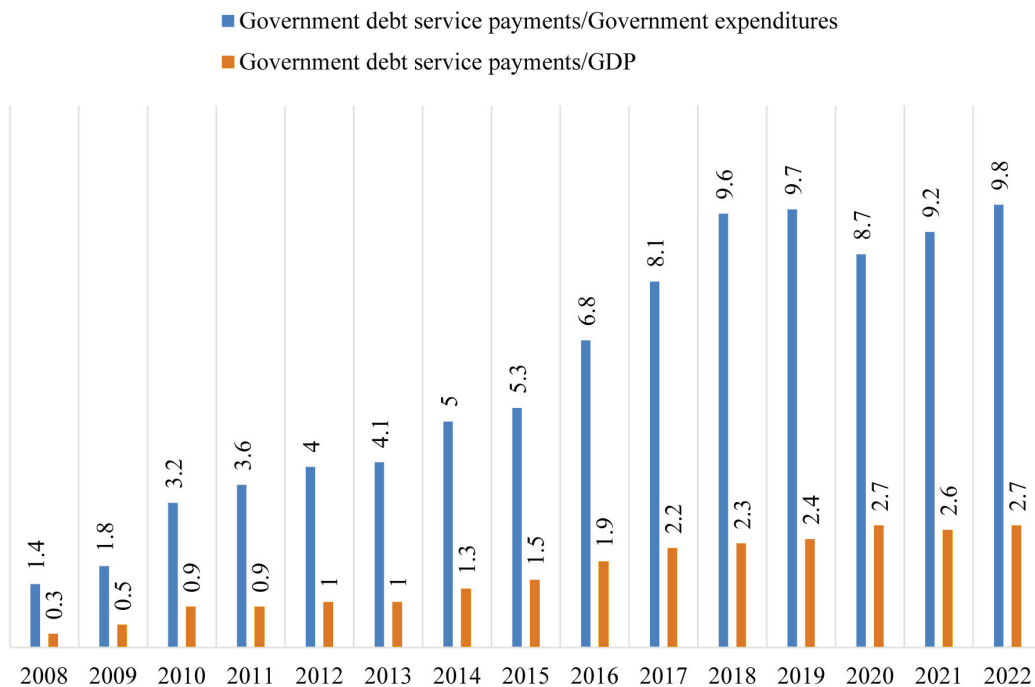


Figure 2: RA Government Debt Service in 2008–2022.

Source: Official website of the Ministry of Finance of the Republic of Armenia. URL: www.minfin.am/hy/archive (accessed: 22 May 2023).

Under such conditions, it is obvious that the development of such a manufacturing sector should be placed at the core of the economic development of the country, which will expand the possibilities of rapid economic growth, create preconditions for a gradual reduction in the import of military equipment and strategic products, and most importantly, will lead to positive externalities in the entire economy.

The fact that the defense industry has such a potential for positive changes is confirmed and substantiated by the examples of different states (including Armenia) and by various studies (Lesnykh, 2008; Ando, 2017; Harutyunyan, 2017b). However, the nature of modern wars, the speed of penetration of technological innovations into the military realm and the current realities of their widespread use require that more attention be paid to studying the possibility of developing “new technology-based” weapons production and assessing the bipolar influence of the main factors.

The issue of cost-efficiency of the production of new technological weapons

The introduction and application of new technologies in any field, including the military, predicts “inevitable” advantages over competitors, as well as a noticeable increase in efficiency. However, when talking about the efficiency of innovations, it is important to pay attention to the difference between the concepts of *cost-efficiency* and *effectiveness* (Namatulina and Prokofiev, 2013). If the former is about a simple comparison of costs and outputs and the most economical use of resources, the latter is about the goals to be achieved with these costs, without taking into account the price and means to achieve them. In the matter of *effectiveness*, the most obvious and unequivocal assessment of the production of weapons based on new technologies is the degree to which the country’s security is guaranteed.

Meanwhile, consideration of the issue from the point of view of *cost-efficiency* can reveal certain contradictions, underestimation or ignoring of which can distort the true assessment of efficiency. In any case, it is unacceptable to uncritically equate technological innovations with positive changes. Here are some aspects of the production of new technological weapons that may be of significance in assessing cost-efficiency.

One of the well-known dilemmas in the academic literature on the implementation of national innovation systems is the “*exploration-exploitation dilemma*”. It is based on the fact that people (decision makers) have a natural and often justifiably tendency to “sacrifice” long-term benefits (available due to the *exploration* and innovation) to short-term benefits (available through *exploitation*) (Berger et al., 2014).

If we project judgments on the issue of the efficiency of innovations in the military sphere, it becomes obvious that the choice of an “*exploitation strategy*” can imply the use of already known, time-tested weapons under conditions of minimal uncertainty or the purchase of such weapons, if we consider the issue in the context of an alternative “purchase or development” of new techno-

logical weapons. The “*exploration strategy*” is the search for new opportunities, for example, the development of new weapons under conditions of considerable uncertainty of their usefulness.

In the private sector, the solutions to this dilemma are not so complicated, since financial resources are all that can be lost because of unsuccessful innovations. Meanwhile, the failure of innovations in the military sector, and inefficient allocations of military research and development (R&D) in the face of limited financial resources, can lead to a decrease in the combat capability of the Armed Forces of the state, deepening defense and security issues and loss of human lives (Andrews and Macdonald, 2016).

The next important circumstance from the point of view of cost-efficiency is the high cost in *the development stage* of new military technologies (the emphasis is important, because already in *the production stage*, the cost intensity is significantly reduced, which subsequently leads to a decrease in the prices of new military technologies (O’Hanlon, 2020; Waldrop, 2016; Harutyunyan, 2022). These costs may be substantiated by the requirements of using patented innovations and the need to maintain confidentiality, and are quite often not justified. Such overspending has long been an ordinary reality for developed countries; for example, in the period 1990–2010, at least 53 billion US dollars were invested in military innovations in the United States, none of which turned into a final product (Rodriguez, 2014).

Notwithstanding, if for developed countries such costs are rational, at least for the simple reason that they prepare fertile ground for future innovation and technological improvements, then for small developing countries, such costs can be considered irreversible losses (especially in the case of inconsistency of innovation policy), which also significantly increase the burden of military spending for the economy and society.

It is also important to consider that military innovations and the use of new technologies in the military sphere cannot be effective, moreover, can often become counter-productive when addressing defense and security issues unless they are harmonized with strategic, conceptual, and organizational changes. New technologies can provide notable success on the battlefield, but in themselves they rarely lead to radical changes in the balance of military forces.

Nevertheless, the most important measurement for assessing the cost-efficiency of the production of new technological weapons is the opportunity cost. Consideration of the opportunity cost through the prism of P. Wicksteed’s concept of “lost opportunities” (Blaug, 1994, p. 454) assumes that the assessment of the production costs of new technological weapons come down to the measurement of the utility that has been given up in making these costs. In other words, in conditions of limited resources, the channelling some part of the expenditures to military innovations or to development and production of new technological weapons can, in general, cause a loss in the combat capability of the Armed Forces and reduce the effectiveness of the military domain. On the other hand, if the government does not allocate enough resources to military innovations, then it, per se, renounces their potential effectiveness in the future. The allocation of military spending between maintaining the current com-

bat capability of the Armed Forces at a sufficient level and building new future capabilities is a distinctive risk management exercise that tries to balance the expectations of future effectiveness and the ability to maintain the defense and security of the country using traditional means (Kuo, 2022).

The measurement of effectiveness always involves two sides of weight scales. Therefore, an assessment of the cost-efficiency of innovative weapons cannot be complete unless we consider all the positive spillover effects (positive externalities) from high-tech weapons production.

The possibility of positive externalities

The externalities of high-tech weapons production have been studied mainly using the methodology for assessing the spillover effects of military R&D spending. For instance, one of the most interesting studies carried out for OECD countries based on data of military R&D spending, non-military R&D spending, employment and wages across 26 industries over a period of 23 years, attempted to identify how public R&D funding affects private R&D, and its ultimate effect on productivity growth in the country, therewith military R&D spending was used as an instrumental variable.

The study revealed that the increase in government funded R&D spending, which was generated mainly by increases in defense R&D, translate into significant increases in privately funded R&D expenditures with the most reliable estimates of the long run elasticity between 0.2 and 0.5. In particular, a \$1 additional increase in public R&D funding resulted in \$2.4 to \$5.9 of extra R&D funded by the private sector (Moretti et al., 2016).

This is somewhat contradicts to the views of those researchers – for example, Hartley (2006) – who believe that military research and development has obvious opportunity costs, because military R&D often monopolistically use limited highly qualified scientific personnel and assets, which otherwise could be used with great benefit in civil sector’s scientific research works. Other studies refute this last statement. In particular, case studies on the examples of the United States (Chakrabarti, 1993) and Israel (Peled, 2001) confirm that military R&D contribute to the growth of output in the civilian sector and to economic growth through technological changes based on patents for the use of military R&D results (Harutyunyan, 2017a).

In our opinion, when assessing the externalities of new technology-based weapons production, it is important to take into account the fact that we are dealing with a monopsony market, where the government is the only buyer of manufactured products, and it buys any military products and services to ensure the country’s security, guarantee peace and increase its political weight and influence in the world.

Discussing the issues from this standpoint, *peace*, which some analysts see as a positive spillover of weapons production, ceases to be so, since *peace*, which can be seen as an equivalent of *security*, is the ultimate goal of the state defense order and, therefore, of military spending, but not their externality. This view is also shared by Hartley, who believes that any “technical spin-offs” of defense

R&D should be regarded as a “windfall benefit” of defense spending (Hartley, 2011, p. 13). However, *security* as a multi-product basket, including defense, feeling of protection, safety, peace, economic stability and risk reduction (Solomon et al., 2008), enables a person, an individual, a member of society to realize freely and without hindrance their abilities and talents, contributing to the growth of their well-being, and hence the well-being of society as a whole. From that perspective, the most important positive externality of the new technological weapons is the prevention of the “brain drain” from the country, which is a substantial factor in the development of economy.

In current conditions, transferring new technologies developed for weapons production to civilian sectors can also be considered as a positive externality, but with some caveats. Over the years, this trend really prevailed, and many countries such as Israel, Singapore, South Korea, Turkey, etc., have managed to give a powerful impetus to the innovative development of the entire economy thanks to the development of military technologies. However, new digital technologies, which are an important factor determining the nature of future wars and weapons, are mainly improved in the civilian sector, and only when transferred to the military sector. Furthermore, the financial resources allocated to scientific and technological developments in the civilian sector have significantly exceeded the costs allocated to defense R&D so that the defense sector has become somewhat dependent on the civilian or commercial sector in terms of some technological developments (Missiroli, 2020). Therefore, in modern times, it would be more logical to consider the development of new technological weapons production as an externality of new technological civilian production, rather than the other way around.

The positive externalities of the new technology-based weapons are not limited to the two manifestations presented, but also include an improvement in the balance of payments, facilitating the management of external debt, the development of human capital, the increase in employment, the establishment and deepening of bilateral and multilateral military-political and military-technical cooperation, which can create additional security pillars. From the point of view of the discussion on the redistribution and optimization of military spending, to which the paper refers, these realities will ultimately confirm that it is necessary to allocate a significant part of military spending to domestic research and development of high-tech weapons. Having in mind the unfavorable outcome of the 44-day war for Armenia, it is quite reasonable to assume that military expenditures in Armenia have not been optimally distributed for years, which has led to the so-called “failure of military innovation” (Amirkhanyan, 2022), but a more in-depth analysis of the problem can lead to completely different conclusions.

Inferences for Armenia

There are several reasons that can objectively justify the low share of R&D allocations in the structure of military expenditures in Armenia over many years (see Table).

Table

**Dynamics of the allocations to military R&D in Armenia
for 2008–2023 (bn. AMD)²**

	Military/ Defense Spending	Military/ Defense R&D Spending	Share of Military/ Defense R&D Spending in Military/ Defense Spending (%)
2008	125.4	0.8	0.6
2009	149.6	1	0.6
2010	135.7	1	0.7
2011	146.2	1.1	0.8
2012	154.5	1.2	0.8
2013	182.7	1.4	0.7
2014	194.1	1.5	0.8
2015	199	1.6	0.8
2016	207.3	1.6	0.8
2017	209.8	1.6	0.8
2018	245.6	2.4	1
2019	309.6	2.9	0.9
2020	307.2	4.7 = 0.76+3.9	1.5
2021	311.7	5.4 = 0.76+4.6	1.7
2022	345.5	5.9 = 0.71+5.2	1.7
2023	517.3	7.6 = 0.76+6.8	1.5

Source: Laws “On the State Budget of the Republic of Armenia” 2008–2023. URL: Budget (minfin.am).

First of all, it is obvious that in terms of military innovations, development of new types of military equipment and weapons, and the modernization of the military sphere as a whole, Armenia fell into the aforementioned “exploration-exploitation” trap. As many theorists studying military innovation pointed out, the best time for innovation is peacetime, although there is a high probability that in peacetime “wrong choices and irrelevant investments will occur and will be hard to correct” (Murray and Millett, 2010, p. xiii). However, the situation prevailing in Armenia for almost three decades preceding the 44-day war is dif-

² Data in the table is presented from 2008 onwards, because before that, the funds allocated for military/defense R&D were not separately presented in the state budgets. Starting from 2020, as an indicator of R&D spending in the defense sector, Table 1 shows the amount of budget funds allocated to two programmed activities: “Scientific and technical (military and technical) support for R&D” (presented as a programmed activity of the Ministry of Defense) and “Special purpose scientific and scientific-technical research in the field of defense” (presented as a programmed activity of the Ministry of High-Tech Industry).

difficult to consider a peacetime. The constant danger of renewed war, large and small Armenian-Azerbaijani and Artsakh-Azerbaijani border clashes with indefinite regularity, and the intensive replenishment of the enemy's arsenal with offensive weapons would in no way allow us to perceive the period as a period of peace. It was necessary to be ready for warfare every day. For a small country with limited capabilities, "*being ready for warfare every day*" meant first of all choosing an "**exploitation strategy**", that is, replenishing the arsenal with time-tested weapons, which implied minimal uncertainty compared to innovations. Even with the adoption of strategic approaches characterized by the priority of promoting innovation, the funds allocated to the military R&D could not be sufficient to ensure the production of tested and effective new technological weapons for the defense sector in a short period (within 5–10 years). The best argument for such a statement is the military R&D expenditures of several countries – Turkey, South Korea, Israel – standing out for their indicators of developing an innovative defense industry. For example, in these countries in 2017 the military R&D expenditures amounted to 1.6, 3.8 and 6.7 billion US dollars, respectively (Sargent Jr., 2020). Compared to Armenia's GDP, these figures correspond to 10%, 33% and 58% of Armenia's GDP in 2017 (USD 11.5 billion), respectively.

Another important consideration is that the military doctrine of the Republic of Armenia has a pronounced defensive character, which is reflected in the whole process of building up the entire of the Armed Forces of the Republic of Armenia, including military procurements, where defensive weapons prevail. Meanwhile, the production of new technological weapons required an "aggressive" innovative strategy, the leitmotif of which was to be formed in the realm of military strategy. The defensive strategy of "deterring the enemy" or "depriving the enemy of the opportunity to win" could not give this leitmotif to the country once defeated the strongest enemy, with an already formed "winner's complex", especially in the conditions of limited resources and many socio-economic problems facing the state.

It would also be difficult to determine the optimal amount of military R&D allocations, according to which they could measure the effectiveness of newly developed military equipment and weapons in tests, without reducing the minimum necessary level of security, as well as deepening socio-economic problems of the country as a result of negative externalities. In fact, the best what the military budget could provide was a "*minimum level of security*", but Armenia paid for this twice as much (as it follows from the current external debt of service indicators), since the country's military spending cycle ended at the customs border.

The new age of digital transformation provides an opportunity to radically change the situation, and, above all, by changing the direction of technology transfer, and, consequently, through positive spillover effects. In this regard, it could be considered a far-sighted and well-thought-out decision to change the departmental subordination of the Defense Industry Committee from the Ministry of Defense to the Ministry of High-Tech Industry, because this change corresponded to the perspective of transferring the positive externalities of the high technologies development in civilian sector to military. But the expecta-

tions remained incomplete since the budget funds allocated for these purposes, actually were under fulfilled during the last three years. Thus, in 2020, the implementation rate of special research work carried out within the budget program “Special purpose scientific and scientific-technical research program” was 72%, and the executive authorities substantiated the deviation with the COVID-19 pandemic and declared martial law in the country. In 2021, the implementation rate was only 26% and the main reason cited for the deviation was the “delays in the deadlines set by the contract procurement schedules by the companies implementing R&D as a result of the supply slowdown amid the pandemic”. The military R&D implementation rate was only 34.6% in the first nine months of 2022. The deviation was due to “problems in the logistics of imported raw materials, equipment and a reduction in the capabilities of the microelectronic base, as well as the fact that the Defense Industry Committee approved intended research topics in September”³.

Undoubtedly, the reallocation of a part of military spending to the high-tech sector could be the beginning of qualitative changes both in terms of economic development and addressing security issues. The point is that such changes will allow to gradually alleviate the military burden on the state due to the positive externalities from innovation and high-tech production. However, it looks like that in this breakthrough period of the development of cross-cutting digital technologies, Armenia is again losing the opportunity to develop new models of high technological weapons and military equipment, to introduce innovative technologies into the military sphere, or at least to incubate such a potential.

Determining the optimal amount of budget funds allocated for military R&D for Armenia, with a clear definition of time horizon for qualitative changes, as well as determining the optimal amount of budget funds allocated to individual R&D projects (topics) to ensure the effectiveness of these programs, remains a separate topic for research.

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³ State budget reports of the Republic of Armenia for 2021, 2022, and first nine months of 2022 regarding the output (performance) indicators of the state budget programs and activities according to the public authorities implementing these activities. Source: URL: Պետական բյուջեի հաշվետվություն (minfin.am)

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