

PROBLEMS OF ASSESSING THE IMPACT OF HIGH-TECH SECTOR LENDING IN THE REPUBLIC OF ARMENIA

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Introduction. The guarantee of sustainable economic growth and competitiveness is the provision of advanced rates of development of the innovative sphere. To solve this problem, each country chooses an economic policy that meets the structure of its economy and resources. In some countries, the emphasis is on fiscal policy to achieve this goal, while in others, monetary policy tools are used. A number of countries have used both monetary and fiscal policy instruments. It is quite difficult to say which of these models is more effective, as, nevertheless, there is a great activity of technological changes in all groups of countries.

In any case, the assertion that the development of technologically advanced industries is largely due to the level of concentration of both financial and quality human resources is confirmed. From this point of view, in this research, special attention was paid to the issues of output volumes due to the impact of financing in the sectors considered to be high, medium-high-tech sectors of the Republic of Armenia. The study of the level of the latter will allow to understand what is happening in the high-tech spheres of the Republic of Armenia, how different tools of fiscal-monetary policy can influence the dynamics of the output volumes of the high-tech spheres. In this regard, high, medium high, medium low and low technological spheres were singled out within the framework of the research. One of the strengths of the analysis is the crediting of the high-tech spheres of the Republic of Armenia. It is clear that it is necessary to offer lending conditions that will allow thousands of companies operating in these areas to ensure the development of high technology through effective investment of credit. In monetary policy, the availability or containment of credit resources is extended to all sectors, but one of the objectives of this study is to show that the greater the availability of credit resources, the higher the output of high-tech sectors.

Methodology. Within the framework of the research, the high-tech spheres of the Republic of Armenia were singled out according to the classification criteria of the European Union¹. In particular, in terms of high-tech spheres, the spheres of the production of pharmaceutical products, computers, electronic-optical equipment of the

¹ https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

Republic of Armenia were considered. Medium-high-tech spheres include the spheres of production of chemicals and electrical equipment of the Republic of Armenia. The movement of production volumes in the above-mentioned sectors was observed on the basis of a quarterly database of official statistics. On the other hand, the movement of lending to high-tech sectors was observed on the basis of quarterly statistics of the Central Bank of Armenia. It should be noted that only the volumes of lending to the fields of electro-optical equipment and electrical equipment production are given in general, in enlarged groups. The study looked at quarterly data covering the third quarter of 2011 to the fourth quarter of 2021. During the research, the presented dynamics was analyzed observation of possible cycles. After analyzing the dynamics of high-medium-tech sectors, the issues of production-credit interrelationships were addressed. Correlation analysis was performed. Based on the results of the latter, econometric models with autoregression-labeled variables were considered. Prior to evaluating the models, the stationary nature of the series and the effect of seasonality were considered.

Literature review. There are many works, analyzes, researches dedicated to the peculiarities of the implementation of monetary and fiscal policy in the field of high technologies. First of all, let us single out CB researcher R. Mnatsakanyan's analysis, which refers to the assessment of the impact of technological changes on the structural shifts of the economy for a small open economy. One of the conclusions of this work is that during the period under review in the agricultural and industrial sectors, the rate of absorption of external and internal technologies was particularly low, which is due to the slow processes of structural reforms in these sectors [Mnatsakanyan R., 2017, 48]. Such a conclusion proves that the slow pace of investment in the innovation sector requires a new policy; large financial resources are needed, which will increase, in particular, the production of high-tech sector. In this respect, I. Dovbi's view, according to which the loan should be considered as an independent financial-economic category, which is a set of economic relations between the state, financial institutions, development institutes and active financial entities [Dovbiy I, 2011, 30]. O. Khrustalevna notes that the transition to the innovative stage of operation of the credit system is considered a necessary condition for ensuring a new level of economic relations. The latter envisages the development of a resource base for the activation of innovative processes, the improvement of innovative financial policies, the establishment of innovative credit institutions, the promotion of innovative investments [Khrustaleva O., 2011, 67].

Creating sources of long-term credit resources in the economy is extremely important for financing the innovation sector. From this point of view, Academician A. Aghanbekyan notes that the important thing that has not been done in Russia for decades is the formation of "long money" market funds, which would ensure the stability of banks and organizations [Aghanbegyan A., 2009, 285]. I. Dovbin concludes that the state

policy of lending to innovation activities should be in line with the concept of industrial policy and ensure the formation of a hierarchy of values and interests of the subjects of the lending system of innovation activities [Dovbiy I., 2010, 18].

Scientific novelty. One of the most important tasks of this research is to make visible the high-tech spheres of the Republic of Armenia. To study the dynamics of their output volumes in the longest possible time. On the other hand, high-tech industries have been lending for years, which is a very important financial resource in terms of supporting innovative processes. In this regard, the dynamics of foreign currency loans provided by the banking system in the high-tech sector of the Republic of Armenia was considered. The third important goal of the analysis is not only to study in detail the dynamics of output and lending volumes in high technology areas, but also to identify the interdependencies between them. As a result of econometric modeling, it became clear that there are specific dependencies and effects in a specific direction between the output and lending volumes of high-tech sectors.

Analysis. There is still not much research on the issues of the innovation lending system. However, this issue is compounded by the fact that the introduction of a proper and effective system through the use of various monetary policy mechanisms will ensure the creation of new technologies or its absorption in various sectors of the Armenian economy, which will greatly contribute to more competitive exports of relevant sectors. Therefore, first of all, it is necessary to understand the dynamics of production volumes in the high-tech spheres of the Republic of Armenia, the volumes of crediting in those spheres, the mutual relations between the two. All this will allow us to understand the efficiency of the credit system for innovative activities, first of all, in terms of ensuring results in high-tech sectors. The diagram below shows the dynamics of the volume of production of chemicals, which is considered a "medium-high" technological field, in the field of foreign currency lending.

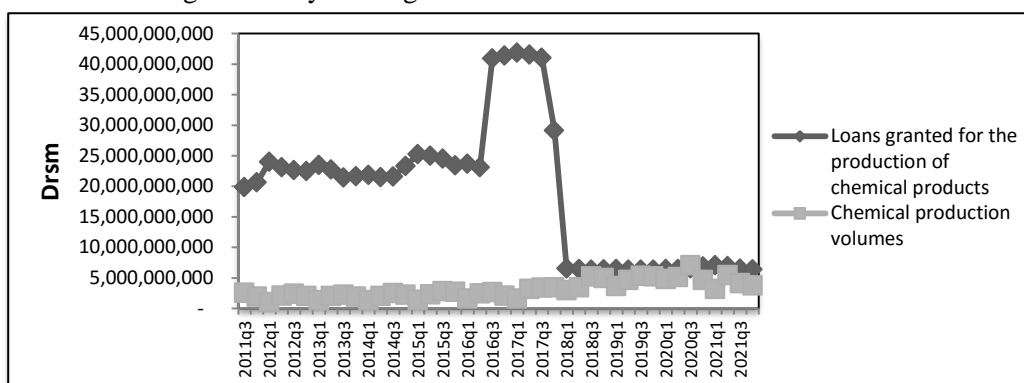


Figure 1. Dynamics of lending to the chemical industry and the sector output from the third quarter of 2011 to the fourth quarter of 2021 [www.armstat.am]

According to statistics, the volume of chemical production in Armenia in the 4th quarter of 2021 amounted to 3.8 billion drams, and the volume of foreign currency lending - 6.4 billion drams. The share of chemical production in the manufacturing industry in the 4th quarter of 2021 was only 0.7%. In the 4th quarter of 2022, as compared to the same quarter of 2021, foreign currency lending in the field of chemical production decreased by 6%, and compared to the previous quarter, by 1%. On the other hand, the production of chemicals in the 4th quarter of 2022 decreased by 19% compared to the same quarter of 2021, and by 9% compared to the previous quarter. Looking at the chart, we notice that by the first quarter of 2018, the volume of foreign currency loans exceeded the volume of chemical production. Then there is the approach of foreign currency lending to production levels. The mechanism of delayed influence may work here. That is, the loans are taken for some time, and the results are observed with a considerable delay. It should be noted that a significant increase in lending to production volumes may also be the cause of crises in the sector. The resulting loans were not used to create new value in the sector, but were used to meet current financial needs and pay off debts. Consider the manufacturing sector of pharmaceutical products in the chart below.

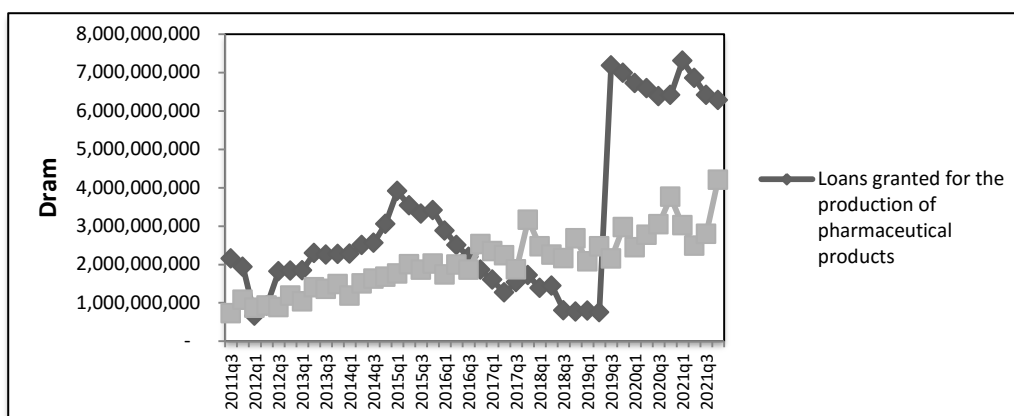


Figure 2. Dynamics of chemical production and lending in the sector from the third quarter of 2011 to the 4th quarter of 2021 [www.cba.am]

In the 4th quarter of 2021, the volumes of production of pharmaceutical products made 4.2 billion AMD, and the volumes of crediting in foreign currency - 6.3 billion AMD. The field of production of pharmaceutical products is considered high-tech. The share of the latter in the processing industry in the 4th quarter of 2021 was only 0.8%. In the 4th quarter of 2022, compared to the same quarter of the previous 2021, the previous quarter, the volume of foreign currency lending in the field of pharmaceutical production decreased by 2.1%. On the other hand, the production of pharmaceutical products in the 4th quarter of 2022 increased by 12% compared to the same quarter of 2021, and by 51% compared to the previous quarter. Looking at the chart, we notice that since the

third quarter of 2019, the volume of foreign currency lending to the sector has increased sharply, and production volumes are quite low. Let 's refer to the spheres of production of computers, electronic-optical equipment , electrical equipment.

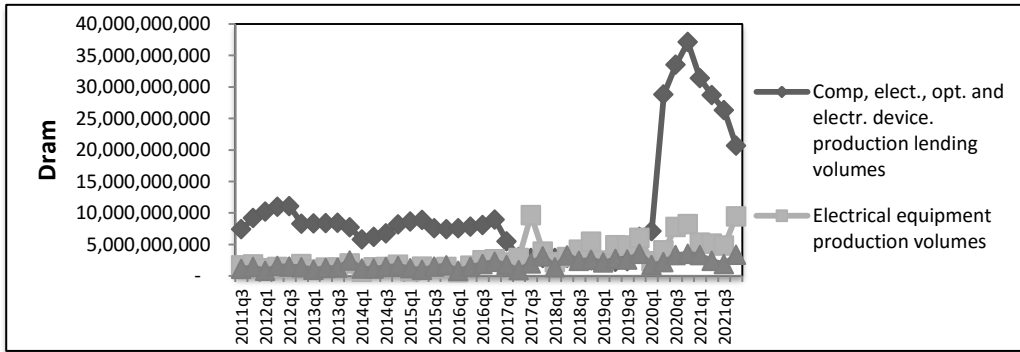


Figure 3. Comp ., electricity ., opt. and electr. device production and sector lending volumes from the 3rd quarter, 2011 to 4th quarter, 2021 [www.armstat.am www.cba.am]

In the 4th quarter of 2021, the volumes of computers, electro-optical equipment made 3.4 billion AMD, and the volumes of production of electrical equipment - 9.4 billion AMD. The volume of foreign currency lending in the two spheres considered above amounted to 20.6 billion drams. The field of computers, electro-optical equipment is considered to be high-tech, and the field of production of electrical equipment is considered to be medium-high-tech. In the 4th quarter of 2021, the share of the production of computers, electro-optical equipment in the manufacturing industry was only 0.6%, and the production of electrical equipment - 1.8%. In the 4th quarter of 2022, compared to the same quarter of 2021, the volume of foreign currency lending in the above sectors decreased by 44%, and compared to the previous quarter by 22%. Looking at the chart, we notice that since the third quarter of 2019, the volume of foreign currency lending to the sector has increased sharply, and production volumes are quite low.

Modeling. The dynamics of the indicators described above, with quarterly data, shows that the volume of lending has an impact on the production volumes of high-high-medium sectors. In order to understand these effects, a correlation analysis was first performed [Eliseeva I., 2021,36-38], as a result of which it was found that there are strong links between the production of pharmaceutical products, the volume of foreign currency lending, as well as the production of chemicals, the volume of foreign currency lending. Autoregressive models were used to identify these dependencies[Magnus J.,2004, 264-305], which can be represented as follows:

$$Y_t^i = \beta^i_0 + \sum_{q=0}^n \beta^i_{q+1} X_{t-q}^i + \sum_{q=1}^n \delta_q^i Y_{t-q}^i + \varepsilon_t^i, i = \overline{1,2} \quad (1)$$

where:

Y_t^i –production volumes in the i -th sector–in the t -th quarter,

X_{t-q}^i –foreign currency lending volumes (expressed in armenian drams) of the i -th sector in the $t-q$ -th quarter,

Y_{t-q}^i –production volumes in the i -th sector-in the $t-q$ -th quarter,

$\beta_0^i, \beta_{q+1}^i, \delta_q^i$ –unknown parameters of model i ,

ε_t^i – random error of the i – th model in the t – th quarter,

t –index of the quarter, $t = \overline{2011:3 - 2021:4}$,

q –lag index,

i –is the industry index. Moreover, if $i = 1$ it is the sphere of production of chemicals, if it is the sphere of production $i = 2$ of pharmaceutical products.

In order to evaluate the above models, first of all, the stationarity check [Magnus, 2004, 276-285] of all considered variables was performed. The results of the latter proved that all series are non-stationary and become stationary with the help of first or second order differences. Subjecting these variables, the econometric models of the corresponding variables were evaluated as PCE. Several evaluations were performed, removing the insignificant lag variables in turn. There was heteroskedasticity in the models [Marno, 2008, 146-148], which was taken into account during the evaluation. The problem of seasonality [Babeshko, 2006, 246-249] was considered, for observation the variables $q1, q2, q3,$ and $q4$ were introduced in the model, which respectively represent the first, second, third and fourth quarters. As a result, the models were selected whose quality features are as acceptable as possible. After evaluating the two models described above, the following results were obtained.

Table 1 . (1) Model evaluation results

	Y 1:	Prob:	Y 2:	Prob:
c1:	570 000 000:	0.0000:	-	-
c2:	-	-	-517 000 000:	0.0019:
q1:	-1 490 000 000:	0.0000:	-	-
q3:	-806 000 000:	0.0000:	1 250 000 000:	0.0036:
q2	-	-	1 290 000 000	0.0003
X1(-8)	0.15	0.0003	-	-
X1(-1)	0.07	0,0050	-	-
X2(-12)	-	-	0.06	0.0087
X2(-9)	-	-	0.04	0,0023
X2(-10)	-	-	-0.05	0.0001
Y2(-1)	-	-	-0.39:	0.0141:
Rsqr:	0.64:		0.66:	

The obtained results show high coefficients of determination, and all the coefficients are significant. In the first model, which describes the effect of foreign currency lending on the volume of pharmaceutical production, the variables of lending volumes with a delay of 8 lag were significant. These results mean that in the long run, the increase in the volume of foreign currency injected by the sector at the moment by 1 dram, ceteris paribus, leads to an average increase of 0.22 drams in the production of pharmaceutical products after 8 quarters or two years. In other words, if the volume of lending in the sector increases by 1 million drams in the given quarter, the production volumes of pharmaceutical products will increase by 220,000 drams on average. The impact of foreign currency loans on the production volumes of the chemical industry was observed in the 9th, 10th and 12th quarters. In particular, the 1 dram increase in foreign currency loans in the given quarter after 12 quarters will lead to an increase in the production of chemical substances by 0.05 drams. With larger numbers, it turns out that the increase of loans by 1 million drams in the field of chemical production in the given quarter leads to an average of 50,000 drams in production volumes.

Conclusions. The Armenian government continues to prioritize the high-tech sector with all the resulting assistance programs. At the same time, there is a need to provide access to credit for these sectors. The latter is possible through the application of appropriate monetary policy tools in specific high-tech sectors, as a result of which it will be possible to form an existing lending system for innovative activities.

As a result of the analysis of the crediting trend of the RA high-tech sector, it became clear that crediting affects the production volumes with a significant delay. The results of the correlation analysis showed a strong correlation between the production of chemicals, pharmaceuticals, and foreign exchange lending in the respective sectors. Implementing the corresponding stages of econometric modeling, the following results were obtained:

- In the long run, the increase of foreign currency loans in the given quarter by 1 dram, ceteris paribus, leads to an average increase of 0.22 drams in the production volumes of pharmaceutical products after 8 quarters or two years. In other words, if the volume of lending in the sector increases by 1 million drams in the given quarter, the production volumes of pharmaceutical products will increase by 220,000 drams on average.
- The impact of foreign currency loans on the production volumes of the chemical industry was observed in the 9th, 10th and 12th quarters. In particular, the 1 dram increase in foreign currency loans in the given quarter after 12 quarters will lead to an increase in the production of chemical substances by 0.05 drams. With larger numbers, it turns out that the increase of loans by 1 million drams in the field of chemical production in the given quarter leads to an average of 50,000 drams in production volumes.

References

1. Dovbiy, IP, Malakhova, E.S. Credit and Innovations: Methodological Foundations of Interaction. Russian predprinimatelstvo, 12(4), 2011 <https://cyberleninka.ru/article/n/kredit-i-innovatsii-metodologicheskie-osnovy-vzaimodeystviya>
2. Khrustaleva, O.N., Problems of transition of the credit system at the innovative stage of its activity. Kreativnaya ekonomika, 5(6), 2011 <https://cyberleninka.ru/article/n/kredit-i-innovatsii-metodologicheskie-osnovy-vzaimodeystviya>
3. Aganbegyan A. G. Crisis: trouble and chance for Russia. - M. AST: Astrel, 2009. - 285 p.
4. Dovbiy, I. P., Malakhova, E. S. Conceptual bases for the coordination of interests in the system of lending to innovative activities at the macro level. Transport business in Russia, (8), 16-18, 2010 <https://cyberleninka.ru/article/n/kontseptualnye-osnovy-soglasovaniya-interesov-v-sisteme-kreditovaniya-innovatsionnoy-deyatelnosti-na-makrourovne>
5. Econometrics: a textbook for universities / edited by Eliseeva. I. I. - Moscow: Prospekt Publishing House, 2021. - 449 p.
6. Magnus J.R., Katyshev P.K., Peresetsky A.A., Econometrics, publishing house 'Delo', Moscow 2004.-576 p.
7. Verbeek Marno, Guide to modern econometrics. Per. from English. V. A. Bannikova. Scientific ed. and foreword. S. A. Ayvazyan. - M: Scientific book, Solev Library, 2008. - 616 p.
8. Babeshko Ludmila Olegovna, Basic Economical Modeling: Learning ability. Ed. 2nd, exp. M.: KomKniga, 2006.-432 p.
9. Mnatsakanyan R., Assessment of the impact of technological changes on the structural shifts of the economy for a small open economy (using the example of Armenia), Research paper, CBA, 2017, -50 p. https://www.cba.am/AM/panalyticalmaterialsresearches/WP_2017.pdf
10. Statistical Committee of the Republic of Armenia` https://www.armstat.am/file/article/sv_12_20a_121.pdf
11. Central Bank of Armenia` <https://www.cba.am/am/SitePages/statmonetaryfinancial.aspx>

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Problems of assessing the impact of high-tech sector lending in the RA

Key words: high-tech sector, bank, loan, gross output, innovation, competitiveness, model

Ensuring the rapid pace of development of the innovative sector is one of the priority issues facing the current economies. Without these rates, it is impossible to ensure sustainable economic growth and be competitive in international markets. Countries that have already achieved high, sustainable levels of growth in the high-tech sector have been able to move significantly closer to building an innovative economy with a solid foundation. Growing in high-tech industries requires huge financial resources, which must be attracted from various sources. This study addresses the resource of the banking system for raising money in high-tech sectors. It is no secret that banks provide loans to almost all sectors of the economy, in particular, the high-tech sector of the economy. This work explores the rich international experience and possible applications. The study examines in detail the dynamics of loans provided by banks to the high-tech sectors of the Republic of Armenia. At the same time, the dynamics of gross output in the high-tech sector is studied. The use of modern econometric models considers the correlation between the gross output of the high-tech sector and lending volumes.