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The Main Directions of The Scientific Reform in Republic of Moldova

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Abstract

The article reflects the issues about reforming the Moldavian Science. The author reveals some priorities of the Strategy of Science Evolution Moldova - 2020, which is aimed at the efficient use of intellectual potential by stimulating innovation, human capital consolidation and attraction of young researchers to develop research capacity in high schools and universities.

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INTRODUCTION

In recent years, in the Republic of Moldova, generally there is a strengthening awareness of the role of innovation as an important tool for economic development, enhanced by a systemic approach to innovation, emphasis on education and the dissemination of knowledge. There is also a positive impact of innovation on economic development of the republic.

The country began to use the cluster approach, which is characterized by the transition to a more systematic innovation policy, aimed at strengthening the interaction of its various aspects and a suitable set of instruments, rather than searching for new areas of policy.

The sphere of science and innovation is the basis of all the structural changes in any economic system. In the context of globalization, any country without science, without innovation turns into a colony.

Moldova, is located in the heart of Europe and at the intersection of European interconnections. The Republic has a good climate, is compact, has an uniquely fertile land, the diversity of nationalities and cultures at historically marked tolerance. All these components should contribute to the prosperity of the country. But only the strong development of scientific research and its practical application in industry and agriculture are able to change the current disastrous situation in Moldova, the country heading to the disappearance from the map of the world. In a state, where there are almost no natural resources, the development of science and innovation can become a business card of the country.

Science Academy of Moldova (AMN) is one of the most progressive institutions in the country, which could rightfully be integrated into the European and international community. With proper management, the corresponding value of its status and financial support, competent and respectful attitude from the government and society in general, can be of great help in the process of bringing out Moldova from deadlock to prosperity. Nowadays, the scientific community of the Republic shall put every effort to stop the elimination of the only high-performance sector, operating on a global level, which was recognized by the European Community documents (adopted in 2012 in Moldova, among the first post - Soviet republics, an associate member of the European research programs).

Development reforms of the research sector

The basis for the successful integration of the Republic of Moldova in the EU is a long-term reform of the Moldavian science. The objectives of the reforms - a significant increase in the competitiveness of science, the identification and consolidation of the best researchers, infrastructure optimization, and others.

Reform of the organizational system and management of science in the Republic of Moldova began in 2004, most difficult and depressive situation of time. There has been a mass exodus of scientists from the country, the deplorable situations of the research institutes and laboratories, outdated material base, lack of access to new publications and many other problems. By the mid of 90s of the XX century, it was clear that only a fundamental changes can "break" the situation.

Adoption of the new Code on science and innovation has been a major step in this direction. The principles of the organization and planning of science in our country prescribed in detail, establish an important principle - *partnership* between State and science, while respecting the autonomy of the last.

Reforms undertaken for the development of the research sector of the Republic of Moldova started in 2004 by the Academy of Sciences of Moldova in the framework of the Code about Science and Innovation significantly raised the prestige of the Moldavian science on the international scientific arena. These reforms made possible to show to the international scientific community that

the country has a highly qualified scientific potential, which is able to compete with international partners by participating in various international projects.

Due to this, the European Union adopted a decision on the Association of the Republic of Moldova to the Seventh Framework Program in 2011 and the Program for Science and Innovation Horizon-2020 in 2014. Thus, representatives of the research sector, small and medium enterprises, non-governmental and other organizations were able to participate in the whole spectrum of the EU programs on the rights of members of the European countries and do so quite successfully. And the European Commission has financed international projects with the participation of Moldavian scientists with more than 5 million euros. "Revolutionary" reforms taken in the last 10-15 years in the system of science, in general, led to a positive outcome and are ensuring sustainable development in Moldovan research system [6].

During this period *the consolidation of the scientific community* took place in the country. For example, if 20-30 years ago in the country there were about 33 thousand scientists employed, now they are about 3 thousand at Academy of Sciences, and 2 thousand - engineers, technicians and other personnel. In addition to academic institutions (about 21), there are also industrial research institutes and universities, which also carried out research work.

An Assembly is functioning - the supreme governing body of the Academy of Sciences, which includes representatives of research organizations of all areas of scientific schools.

In the Republic of Moldova there are created appropriate conditions for research and innovation (table 1)

Table 1. The main conditions for research and innovation in Moldova [8].

<p>Availability of qualified scientific potential. Academy of Science of Moldova according to report dated 01.01.15 operated 58 organizations in the field of science and innovation, including universities and other institutions.</p> <p>In the Republic of Moldova there are many outstanding scientists and a large number of scientific schools in various areas of expertise, remarkable achievements in fundamental and applied areas, educated and multilingual population</p>	<p>Availability of research infrastructure (technical and material base - laboratory equipment, computer skills) provided by the Academy of Sciences of Moldova.</p>
<p>Availability of highly skilled researchers, that belong to fundamental scientific schools. In the country, there are staying many specialized research institutes, world-famous scientific schools, respected scientists and the class of young researchers - students and doctoral students, people engaged in intellectual work</p>	<p>National priorities of Research and Innovation (RI) sector are alienated with European.</p>
<p>Training of young researchers through doctoral and postdoctoral studies in the framework of universities and organizations in the field of science and innovations. Earlier, the percentage of young scientists (up to 30-35 years) in our institutions did not exceed 3-5%, now they make up about a third of the research team</p>	<p>Access to international research programs (the status of an associated country).</p>
<p>The presence of bilateral grants (France, Germany, Italy, Russia, Romania, Belarus)</p>	<p>Participation in the public national and international competitions. Obtaining funding for their research projects on a competitive basis</p>

Newly created, in Moldova - institutes - University and Lyceum of the Academy of Sciences, who choose talented children, giving them an opportunity to develop and become a new generation of Moldavian scientists	Priorities and directions of scientific research and innovation are defined by the scientific community of the Republic of Moldova
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Source: compiled by the authors

Moldavian Academy of Sciences has developed a strategy for the development of science in The Republic of Moldova till 2020. (hereinafter - The Strategy). This strategy is based on the vision of development of scientific research and innovation system for the period till 2020. Developed within the project «Foresight - FOR MOLDOVA», this was attended by 400 national and international experts [4]. The strategy was developed in accordance with the Law on the approval of the National Development Strategy "Moldova 2020, the Code on Science and Innovation of the Republic of Moldova № 259 from July 15 2004. [2], the Government Action Plan for 2012-2015. [3]

The strategy aims, first and foremost, on the effective use of intellectual potential and its constant replenishment by stimulating innovation, consolidation of human capital and the involvement of young researchers; on the development of research capacity in high schools and universities. In order to develop a comprehensive strategy an analysis of the research scope and innovation of the Republic of Moldova has been carried out by an international group of experts from 5 countries defining and codifying a number of problems and constraints faced by the sector of research and innovation of the Republic of Moldova.

As weak points, international experts are considering the following:

1. Lack of highly qualified scientific personnel.
2. The aging of the human scientific potential.
3. Limited financial, technological and human resources to promote the Moldavian scientific results abroad.
4. Weak cooperation links between research, education and the production sector.
5. Poor maintenance of the necessary research infrastructure for the development and implementation of international projects.
6. Modest experience in large international projects, especially in cooperation with European partners.
7. Inadequate promotion of leading Moldavian scientists outside the country.
8. Lack of incentives for researchers to participate in national and international projects.
9. A small number of scientific publications ISI. Lack of relevance of domestic science at the international level.

Assessing the problems, limitations, existing opportunities and future directions, where formulated in a strategic vision of reforming the system of research and innovation in Republic of Moldova till 2020. [6]

The aim of the implementation of this Strategy is to develop a system capable to create a scientific basis for improving the competitiveness of the national economy and the welfare of the population.

For its implementation has been identified **5 key objectives** detailed into several specific objectives, which are aimed at the currently existing problems and their subsequent decision: [4]

1. *The development of human, institutional and infrastructural capacity.*
2. *Identification and management of research priorities.*

3. *Ongoing dialogue between science and society, the dissemination of knowledge and implementation of scientific research achievements into practice.*
4. *The internationalization of research and integration into the EU scientific space and increasing international importance.*
5. *Scientific management area based on an agreed model focused on the efficiency and competitiveness.*

Strategy implementation is carried out in 4 stages:

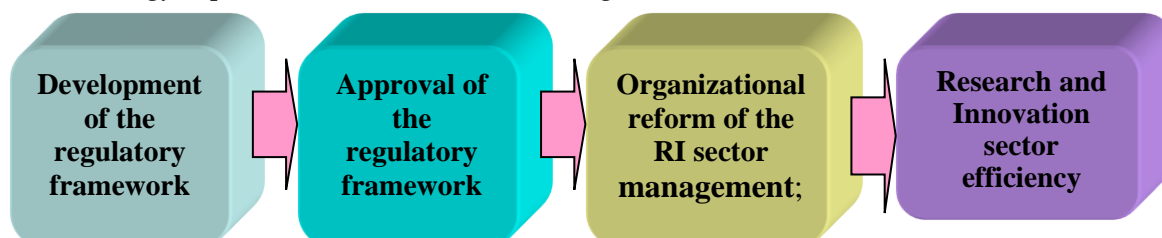


Figure 1. The stages implementation of Strategy

Source: compiled by the authors

At each stage, there are determined different results, which must be reached and implemented. The completion and timing of each phase are detailed in the Action Plan adopted by the strategy, which is the main instrument for its implementation.

According to the Strategy, there have been revised principles for evaluating the quality and efficiency of research and innovation processes, as well as the achievements of the reporting system, affecting the growth of competitiveness of scientific research and the mobility of personnel in the sphere of science and innovation in the global market.

The effective use of intellectual potential and its constant updating will be done by stimulating innovation, human capital consolidation and attraction of young researchers; on the development of research capacity in high schools and universities, etc.

The reforms will lead to substantial changes, models of research and innovation, the introduction of new models of funding research and innovation, the creation of opportunities and conditions for the participation of the business - environment in the infrastructure and assets of the scientific sphere, including financial.

An important aspect to be considered in the Strategy is *the relationship between the sector of research and innovation and society*. It is very important to ensure the active participation and cooperation, as well as responsibility with its needs; the creation of stable partnerships with more opportunities to participate in international programs and projects and national research and innovation networks, which are connected with the local and European networks.

Today, monitoring and evaluation are made on the basis of indicators proposed by the Academy of Sciences of Moldova and the National Bureau of Statistics, as well as by a sample survey carried out by research institutions in accordance with the performance evaluation of research activities "Table of innovation (Science Section)" in the European Union Member States.

The national public and private funding are used to finance the implementation of the Strategy for the Development of Science uses, as well as international funding mechanisms and external technical assistance.

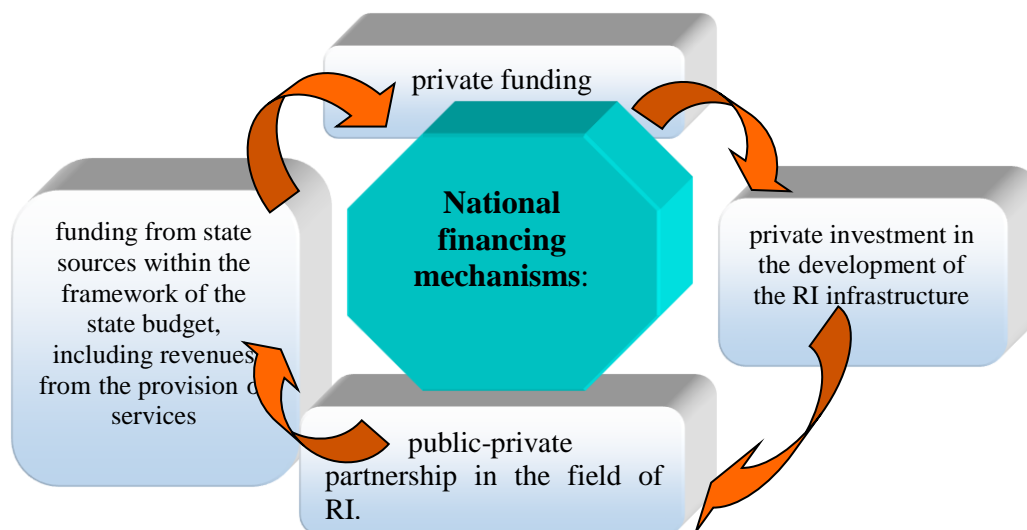


Figure 2. National financing mechanisms:

Funding from the state budget sources will be carried out in a transparent manner (based on competition) with the participation of independent experts, including those from abroad.

Expected outcomes of the Strategy. Among the expected results can be distinguished the following:

1. The proportion of the population aged 30-34 years who received tertiary higher education - to at least 32% (currently - 20%);
2. The number of young people aged 20-24 years who have reached at least the average level of higher education, will be at least 78% (currently - 60%);
3. The number of employees involved in the process of learning throughout life, to no less than 15 out of 100 employees;
4. The number of graduate students, especially engineering specialties, according to the average of the EU-27;
5. Increase the number of attracted foreign researchers for the development of research activity in the Republic of Moldova;
6. The number of young researchers will be at least 40% of the total number of researchers;
7. Carry out closer partnership between universities and businesses;
8. Development and implementation of coherent RI management model, focused on efficiency and competitiveness, requires more funding RI sector to 1.5% of GDP by 2020.
9. It will be introduced to improve the harmonized legal mode of science and innovation in the Republic of Moldova;
10. Significantly increase reached levels, at the level of institutions, broadband interconnections;
11. Number of scientific publications, at least one of the authors of the business;
12. Introduce a single information system for the development and evaluation of projects in the field of RI (and corresponding methodology), as part of a strategic information system in the field of RI (with the functions of data collection (*benchmarking*)).

Implementation of the Strategy is provided *through an integrated mechanism*, involving multiple subjects. The role of each entity is determined by the means at its disposal of means and tools that can effectively be used.

Republic of Moldova - the first of the Eastern Partnership countries and the CIS, received the status of an associated country to this communitarian programs. These programs are pioneers in the Republic of Moldova, which rightfully associated our community. As a result, the Academy of Sciences of Moldova and the scientific community have made a significant contribution towards Euro integration process of our country.

International mechanisms of funding and external technical help

The greatest successes in ASM have been achieved within the framework of *international cooperation*. In order to ensure international cooperation Centre for International Projects was established in 2009 (CIP), responsible for the organization of calls for proposals in accordance with the international treaties to which the Republic of Moldova, the coordination of the network of national contact points (the NCP) and the scientific community in various European structures.

To improve the efficiency of financial resources management mechanism, was established in June 2012 *Funding Center for basic and applied research (FCBAR)* which has an autonomous status and to ensure transparent and open environment for all stakeholders involved in competitive programs and projects in the field of basic and applied research.

International funds (mainly European) are widely involved in order to finance activities in the field of RI. One of the first international organizations that provided funding for research projects for Moldova was CRDF - US Civilian Research Foundation. For the first time Moldavian scientists (it was 15 years ago) were able to participate in the program of joint research with their foreign counterparts. 350 projects involving nearly 2,500 people on our side, and about 600 visited the United States in research and educational purposes. [6]

For the purpose of European integration in the field of RI, aimed at stimulating economic growth, the use of the scientific potential of the Academy of Sciences of Moldova participate in the competitions of the European research programs: first it was the FP7 Framework Program, and now - The program "Horizon-2020".

Currently, of particular importance is the new EU Framework «Horizon-2020" Program for Research, which today is the main financial instrument for implementing the «Innovation Union» European program. The program aims to ensure global competitiveness, and brings together all EU funds allocation framework for research and innovation under one single program. Available funds under the program amount to 80 billion. Euros and will be used during 2014-2020.

In the process of Moldova's participation in the H2020 program, just by filling 130 proposals by our participants, represented by the following institutions: 68 scientific institutions, 56 universities, 27 small and medium enterprises, 19 non-governmental organizations and 17 other organizations. There were financed only 15 projects in which Moldova was the coordinator of only one.

Actively used opportunities to support and stimulate innovation offered by foreign and international organizations such as UNECE, UNIDO, European Commission program TAIEX and TWINNING, OCEMN, Science and Technology Center in Ukraine (STCU), SCOPES (Scientific and technical cooperation between the countries of Eastern Europe and Switzerland), the NATO program "for the sake of peace and security Science", etc. [7]

Effectively developing scientific cooperation, with international research institutes and schools, using previously accumulated materials, methods, their knowledge. Academic experts have successfully adapted to new conditions and adopt new approaches, successfully developing them.

The Academy of Sciences of Moldova is the organizer of a large number of scientific, technical and practical forums, conferences, national and international, which are attended by representatives of international foundations and organizations, the diplomatic corps, President of the Academy of Sciences of Europe and America. It participates in international forums.

The Academy of Sciences has close ties with foreign colleagues, including scientists from Moldova, who, after emigrating to 90 years support the Moldavian science, share experiences and participate in joint projects and take young researchers from Moldova for training and internships in the leading scientific centers world.

In 2015, after a first experience of participation in communitarian programs and for more in-depth integration into the European Research Area, at the meeting of the Higher Council for Science and Technological Development and the General Assembly of members and correspondents of the Academy of Sciences of Moldova proposed a new draft law on the reform of science. This project is in line with international requirements and will allow to step to a higher level of quality in the development of science in the country, while maintaining the scientific potential, and developing the scientific infrastructure, the relevant international standards.

The project envisages the establishment of the National Agency for Research and Innovation, following the Government. The new structure will be engaged in the process of selection, evaluation and funding of programs and projects in the field of research, development and innovation in the framework of public tenders. Then, in partnership with the ministries, the Academy of Sciences of Moldova and the Council of Rectors will develop a National Program for Research and Development, which will be a key tool for promoting the state policy in this sphere of activity.

The concept includes five priority areas (Figure3) [10]:

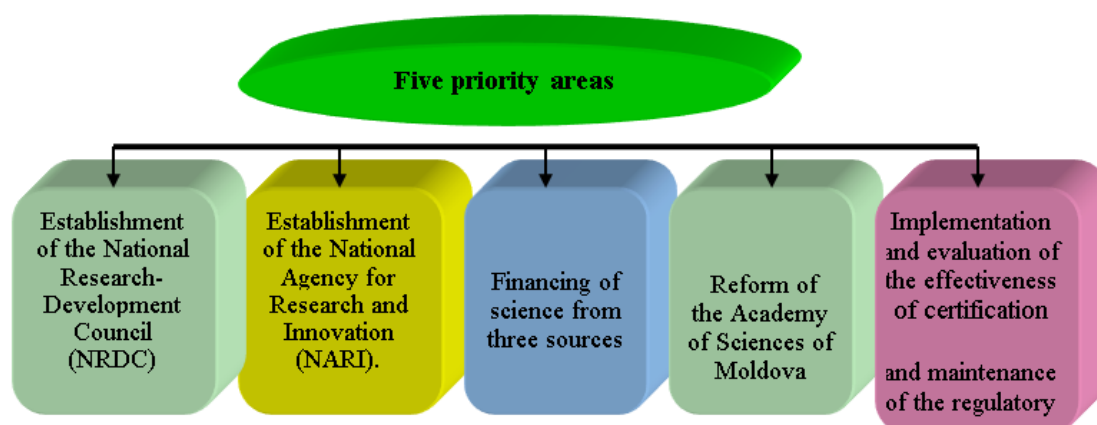


Figure 3. The stages implementation of Strategy
Source: compiled by the authors

That aim to consolidate the scientific community. The new project, developed by the Academy of Sciences, provides the following:

1. **Establishment of the National Research-Development Council (NRDC)** As an advisory body to the Prime Minister, who not being a legal entity, reviews and recommends a project of government policy in the field of research, development and innovation. At the state level, the Council will ensure communication and cooperation between the main organizations involved in the development and implementation of policies in this area.
2. **Establishment of the National Agency for Research and Innovation (NARI).** NARI will be the central administrative authority, responsible for the development and implementation of policy in the field of research, development and innovation, the budget allocation for the implementation of research projects, development and innovation on a competitive basis. The Agency will organize the whole process of selection, evaluation and funding of scientific research programs and development projects and innovation in the context of a public competition. **NARI** will work in partnership with the ministries, the Academy of

Sciences and Rectors Council. It will develop a national research and development program, which will be the main tool to promote the state policy in this area.

3. **Financing of science from three sources.** According to the concept it will be carried out the revision of science funding mechanism by implementing the following methods of research funding:

A. *The institutional form of financing:* the provision of financing, necessary for basic expenses related to research, development and innovation, including overhead costs, remuneration researchers, support staff, leaders of the organization and its subsidiaries.

B. *Funding on a competitive basis* - is funding research based exclusively on public competition, depending on the version, organized by the Agency for all organizations in this field.

From *Joint research funding*, Development and innovation of two or more sources, including on the basis of partnership between the public and private sectors.

4. **Reform of the Academy of Sciences of Moldova** - reconstruction and development of management and self-government institutions of the Academy of Sciences of Moldova. ASM is an autonomous public institution of national interest in the field of research, development and innovation, a legal entity of public law, which acts on the principles of self-government. The General Assembly will be the representative body and executive body - the Presidium of the ASM.

Within the framework of the ASM, academic departments and institutes will be organized internal expertise and public examination of research projects, development and innovation and their results at the request of the National Agency for Research and Innovation. Any research organization may join the ASM in the country.

ASM will be financed from the budget, in accordance with the Law on the State Budget, as well as other alternative sources. In accordance with changes in the Code on Science and Innovation, ASM will only use financial resources to institutions within the Academy, and remain organized research post - doctoral studies.

1. **Implementation and evaluation of the effectiveness of certification and maintenance of the regulatory framework** which will encourage the involvement of young people in science. This will simplify the working conditions in the scientific field to support young people and increase opportunities for the professional development of talented young career.

Priority directions of development of science in the Republic of Moldova in the near future: [4]

- *Giving science a high status.* Changing the mindset: understanding why science is higher importance than other areas.
- *At the state level* a significant increase in management efficiency. To do this, implement an innovative model that will use the infrastructure of the Academy of Sciences for the administration sciences.
- Creating a special *Agency Administration system organization of science in the Republic of Moldova.* Leaders such an organization should be carried out with the participation of representatives from universities, the Academy of Sciences, national departmental institutions, non-governmental organizations, businesses, which would include a governing council and the Agency, with the director and his deputy of their choice. The candidacy of its directors must be approved by the Assembly of the Academy of Sciences, as well as the Government, which will greatly enhance the credibility and impact of the Agency. Creation of a special Council for the development of science and research under the leadership of Prime Minister (Deputy who should be President of the Academy of Sciences and President of the Council of Rectors).

- Founders of the Technology Transfer Agency should become the Academy of Sciences in cooperation with the Ministry of economy, with the involvement of universities and business.

Table 2. The level of research institutes, universities and individual researchers[9].

At the level of research institutes and universities advisable	At the level of individual researchers
<p>The adoption of state decisions on the institutional support of a number of important institutions such as the Academy of Sciences, universities, and others.</p> <p>It should only finance their leadership (director, his deputy) and the so-called "core" consisting, for example, of the five leading scientists determines the main directions of work. Salary of members of a study group in this case must be high, as a minimum, and maximum (depending on the amount of the project</p>	<p>The salary of the scientist should be in direct proportion to the amount of the project and its results and implementation. At the same researcher who comes to science, it should offer the use of new techniques, processes, products, etc. Or to obtain fundamentally new, "breakthrough" theoretical knowledge</p>
<p>If in the next 2-3 years the research team is not able to obtain financing for new projects on a competitive basis, it will be recognized as ineffective, and will cease to exist</p>	<p>The state should urgently promote and develop scientific incubators, start-ups in the training of specialists in universities</p>
<p>Carrying out a major audit of all existing institutes and laboratories. This refers to the evaluative study of work units to determine whether the serious projects and their successful implementation</p>	<p>It is important to attract talented young science enthusiasts, researchers. The government should give those special scholarships and higher wages, which would exceed the existing scientific wages by 2-5 times. Such scholarships necessary to allocate 100 to 1000 per year</p>
	<p>The researchers (especially young ones) should be encouraged and the creation of small businesses to test and implement their achievements, with the corresponding preferential taxation system</p>

Source: compiled by the authors

Currently the reduction inefficient scientific institutions is carried out on a competitive basis. The reform affected all scientific departments. It took place in four areas: *strategic development, increase research efficiency, the growing influence of science and innovation to society, training and further training*. In the making of the reform project the experience of European science was taken into account, especially the model of development of science in West Germany as one of the most effective.

Implementation sets out the main directions of reform and the development of science depend from many internal and external factors, the main ones being: economic growth / decline; the conditions of the economic crisis / recovery; development trends; dominance of certain sectors.

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