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# Innovation Performance Review



ARMENIA



UNITED NATIONS

**United Nations Economic Commission for Europe**

**INNOVATION  
PERFORMANCE REVIEW  
OF ARMENIA**



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## **NOTE**

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## ***FOREWORD***

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Innovation is a major driving force of economic prosperity in modern economies that makes it possible to tackle environmental and social challenges while ensuring improved living standards. An understanding of how innovation emerges, and the impact of public interventions, is necessary in order to design evidence-based policies that can address barriers to innovation and disseminate its benefits widely across the economy.

The *Innovation Performance Review of Armenia* continues the series of national assessments of innovation policies which includes the earlier Reviews of Belarus, Kazakhstan and Ukraine. These policy advisory exercises draw on the experience accumulated by the UNECE in the identification of good practices and policy lessons in the area of knowledge-based development, in particular concerning the special circumstances of countries with economies in transition.

This *Review* presents the outcomes of an advisory project undertaken at the request of the Government of Armenia. It provides a set of recommendations and options to encourage innovation and enhance the effectiveness of public policies. Close collaboration with the national authorities and other experts from Armenia throughout the project has ensured that the final assessment reflects a common understanding of the situation in the country and the validity of the proposed recommendations.

Innovation is a complex process that involves multiple actors. The *Review* takes a comprehensive approach that looks critically at the different components of the national innovation system, their mutual relations and the overall economic, institutional and policy context in which innovation activities take place. This distinctive approach provides a solid foundation to identify areas where policy interventions could be most beneficial by removing bottlenecks and develop existing potential.

I would like to thank the Government of Armenia for its support in the implementation of this joint project. I hope that the recommendations of the *Review* will be useful to policymakers in their efforts to promote innovation.



Michael Møller  
Acting Executive Secretary  
United Nations Economic Commission for Europe

## ***PREFACE***

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The practical work on the *Innovation Performance Review of Armenia* began in June 2013 with a preparatory mission by representatives of the UNECE secretariat to establish contact and discuss the structure and content of the *Review* with the national authorities and other stakeholders. The main project mission took place from 9 to 16 September 2013 with the participation of a team, including representatives of the UNECE secretariat, international and national experts.

The *Review* reflects the outcome of a series of consultations and discussions between the *Review* team and policymakers, government officials, representatives of academic institutions and the business community and other innovation stakeholders of Armenia.

The draft text of the *Review* was submitted for comments to the authorities of Armenia and to a group of independent international experts who had not participated in the field mission. The main outcomes of the project, including its main conclusions and recommendations, were presented and discussed during the Substantive Segment of the eighth session of the Committee on Economic Cooperation and Integration on 13 February 2014 with the participation of the *Review* team, the external reviewers, the members of a high-level delegation from Armenia and delegates from other UNECE member States.

The final text of the *Review* was prepared for publication by the UNECE secretariat reflecting the outcome of these discussions as well as other comments and suggestions by different stakeholders.

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## ***ACKNOWLEDGEMENTS***

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The *Innovation Performance Review of Armenia* was prepared by a group of international and national experts as well as staff of the UNECE Secretariat. The *Review* was the result of a collective effort in which the lead authors for each chapter were: Mr. José Palacín (Chapter 1), Mr. Rumen Dobrinsky (Chapter 2), Mr. Thomas Stahlecker (Chapter 3), Mr. Slavo Radosevic (Chapter 4), Ms. Annamaria Inzelt, (Chapter 5), Ms. Anna Kaderabkova (Chapter 6), Mr. Manfred Spiesberger (Chapter 7) and Mr. Christopher Athey (Annex). Ms. Julia Djarova, Mr. José Molero and Mr. Zhumatay Salimov reviewed the first draft of the *Review* and provided relevant suggestions. During the discussion at the Substantive Segment of the eighth session of the Committee on Economic Cooperation and Integration, Mr. Ashot Khandanyan, Mr. Mikayel Melkumyan and Mr. Gagik Makaryan presented comments and suggestions on behalf of the delegation of Armenia. Mr. Christopher Athey, Mr. José Palacín and Mr. Ralph Heinrich contributed to the overall editing of the publication.

The smooth work throughout the project was greatly facilitated by the helpful support and cooperation of the State Committee of Science of the Republic of Armenia which was the lead partner of UNECE in Armenia in implementing this project.

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## ***CONTENTS***

Foreword .....	iii
Preface .....	iv
Acknowledgements .....	v
List of tables .....	ix
List of figures .....	x
List of boxes .....	xi
Abbreviations .....	xii
Executive summary .....	xv
<b>Chapter 1 Recent economic and innovation performance .....</b>	<b>1</b>
1.1 Economic structure .....	1
1.2 The public sector .....	3
1.3 Economic performance .....	3
1.4 Labour force and education .....	4
1.5 International economic relations .....	4
1.6 Key innovation indicators .....	4
<b>Chapter 2 National innovation system and innovation governance .....</b>	<b>7</b>
2.1 Basic features of the methodological approach .....	7
2.2 National innovation systems .....	8
2.3 National innovation system of Armenia .....	10
2.4 Innovation governance in Armenia .....	17
2.5 Recommendations .....	20
<b>Chapter 3 Framework conditions, innovation policies and instruments .....</b>	<b>25</b>
3.1 Framework conditions for innovation .....	25
3.2 Legal framework for innovation and innovation strategy .....	28
3.3 Innovation programmes and instruments .....	32
3.4 Assessment of innovation strategy and programmes .....	39
3.5 Recommendations .....	40
<b>Chapter 4 Knowledge generation and absorption .....</b>	<b>43</b>
4.1 Technological and industrial upgrading .....	43
4.2 R&D, innovation and technology diffusion .....	45
4.3 Assessment: research, innovation and industrial policy .....	56
4.4 Recommendations .....	59

## ***CONTENTS (continued)***

<b>Chapter 5</b>	<b>Industry-science linkages and collaboration in the innovation process.....</b>	<b>63</b>
5.1	State facilitation of industry-science collaboration.....	63
5.2	Mechanisms for industry-science interaction .....	67
5.3	ISL Implementation .....	69
5.4	Technology transfer and other match-making organizations.....	73
5.5	Industry-science linkages .....	75
5.6	Barriers to industry-science linkages .....	77
5.7	Recommendations .....	78
<b>Chapter 6</b>	<b>Financing innovative entrepreneurs.....</b>	<b>81</b>
6.1	Framework conditions for business .....	81
6.2	Efficiency enhancers .....	82
6.3	Innovative entrepreneurship.....	86
6.4	Support for innovative entrepreneurship.....	89
6.5	National and sectoral development framework .....	90
6.6	International financing of innovative entrepreneurship .....	92
6.7	Assessment.....	95
6.8	Recommendations .....	96
<b>Chapter 7</b>	<b>The role of innovation in international economic integration .....</b>	<b>99</b>
7.1	Internationalization of the economy and innovation.....	99
7.2	Internationalization of education.....	104
7.3	Strategic framework for research internationalization .....	107
7.4	International cooperation agreements .....	108
7.5	Key projects and actors for international cooperation .....	114
7.6	Recommendations .....	116
<b>Annex</b>	<b>Prospective innovation-driven investment projects and information sources .....</b>	<b>119</b>
1	Introduction .....	119
2	Priority focus areas for innovation activity .....	120
3	Public sources of information on investment and innovation projects .....	122
4	Private investment opportunities.....	128

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## ***LIST OF TABLES***

Table 1.	GDP composition by sector, 2004-2013 .....	2
Table 2.	Composition of GDP, final consumption, 2003-2012.....	2
Table 3.	GDP and its components: annual percentage change.....	3
Table 4.	External trade of Armenia, 2006-2013.....	4
Table 5.	Key programmatic and legislative measures relating to Armenian NIS .....	11
Table 6.	Selected education indicators for Armenia and other countries.....	27
Table 7.	Main actors and instruments in innovation/science policy .....	32
Table 8.	Budgetary framework for the funding of science, 2011-2016 .....	36
Table 9.	Innovation actors and instruments in industrial and economic policy .....	38
Table 10.	Technological and organizational capabilities of firms .....	45
Table 11.	Number of ISO 9001 certificates, 1999-2011 .....	46
Table 12.	Supply side factors of R&D .....	47
Table 13.	Demand side factors of R&D .....	48
Table 14.	Indicators of higher vocational education, 2000-2012.....	49
Table 15.	Yearly patent data by type of patentee .....	69
Table 16.	Characteristics of cooperation by type of industrial R&D.....	70
Table 17.	Type, function and depth of industry-science collaborations .....	76
Table 18.	Financial market development indicators in Armenia .....	83
Table 19.	New business entry density, 2004-2011.....	87
Table 20.	Innovation and business sophistication indicators in Armenia .....	88
Table 21.	Guarantees for SME loans.....	91

## ***LIST OF FIGURES***

Figure 1.	Armenian granted patents, 2000-2012 .....	5
Figure 2.	World Economic Forum scores for Armenia .....	6
Figure 3.	National innovation system of a small open economy.....	9
Figure 4.	Innovation governance system of Armenia.....	18
Figure 5.	Trademark applications by residents, 1995-2011 .....	47
Figure 6.	Labour force by level of education, 2011, per cent.....	48
Figure 7.	Gross expenditures on R&D, 1996-2011 .....	50
Figure 8.	GERD per researcher, FTE .....	50
Figure 9.	Structure of expenditures on R&D by sources, per cent .....	51
Figure 10.	Scientific and technological activities performed, 2000-2012 .....	52
Figure 11.	Share of scientific employees by age group, 2000-2012 .....	52
Figure 12.	Employees of organizations engaged in scientific R&D, 2000-2012 .....	53
Figure 13.	Funding structure by scientific discipline, 2003-2011 .....	53
Figure 14.	Resident patent applications, 1993-2011 .....	54
Figure 15.	Number of international publications, 1991-2011 .....	55
Figure 16.	Impact of international scientific publications .....	55
Figure 17.	International scientific publications by scientific domain, 1981-2011 .....	56
Figure 18.	Gross expenditure on research by scientific field, per cent.....	64
Figure 19.	Armenian export and import shares, 2012 .....	100
Figure 20.	Net FDI stocks as at end 2012.....	101
Figure 21.	Export destinations of the Armenian ICT sector.....	103
Figure 22.	Personal remittances received, per cent of GDP .....	103
Figure 23.	Main countries of origin for foreign students.....	105
Figure 24.	GERD financed from abroad, per cent of GDP .....	108
Figure 25.	Eastern Partnership countries' participation in FP7 funded projects .....	111

***LIST OF BOXES***

Box 1. The central innovation programme for SMEs (ZIM) in Germany ..... 34

Box 2. Foreign companies collaborating with a university or NAS institute ..... 70

Box 3. IPR-related issues in employment contracts at the NAS  
Institute for Physical Research ..... 73

Box 4. TTO regulations of the NAS Institute for Physical Research ..... 74

Box 5. Examples of ISLs for commercialization ..... 77

## ***ABBREVIATIONS***

ADA	Armenian Development Agency
ADB	Asian Development Bank
AMD	Armenian Dram
ANEL	Armenian National Engineering Laboratory
ATS	Armenian Technology Start-ups
BMWi	German Federal Ministry of Economics and Energy (Bundesministerium für Wirtschaft und Energie)
BSEC	Organization of the Black Sea Economic Cooperation
BSTDB	Black Sea Trade and Development Bank
CANDLE	Center for the Advancement of Natural Discoveries using Light Emission
CIS	Commonwealth of Independent States
CJSC	Closed Joint Stock Company
CNRS	French National Centre for Scientific Research (Centre national de la recherche scientifique)
COST	European Cooperation in Science and Technology
CRDF	Civilian Research and Development Foundation (US)
D-STEP	Distributed Science Technological Park
DB	World Bank Doing Business Survey
DCFTA	Deep and Comprehensive Free Trade Agreement
DESY	German Electron Synchrotron (Deutsches Elektronen-Synchrotron)
EaP	Eastern Partnership
EBRD	European Bank for Reconstruction and Development
EDB	Eurasian Development Bank
EDMC	Enterprise Development and Market Competitiveness
EECA	Eastern Europe and Central Asia
EIF	Enterprise Incubator Foundation
ERA-NET	European Research Area Networks
ERASMUS	European Community Action Scheme for the Mobility of University Students
EU	European Union
FDI	Foreign Direct Investment
FEZ	Free Economic Zone
FMO	Entrepreneurial Development Bank (Netherlands)
FP7	Seventh Framework Programme for Research and Technological Development, 2007-2013 (EU)
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GITC	Gyumri Information Technologies Center
GV	Granatus Ventures
GVC	Global Value Chains
HEI	Higher Education Institution
ICT	Information and Communication Technologies
IFC	International Finance Corporation
IMF	International Monetary Fund
IncoNet EaP	Science Technology and Innovation International Cooperation Network for Eastern Partnership Countries

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INTAS	International Association for the promotion of cooperation with scientists from the independent states of the former Soviet Union
IP	Intellectual Property
IPR	Intellectual Property Rights
ISFIE	Initial Strategy for Formation of the Innovation Economy
ISLs	Industry-Science Linkages
ISO	International Organization for Standardization
ISTC	International Science and Technology Center
IT	Information Technologies
JINR	Joint Institute for Nuclear Research
KfW	German Development Bank
LLC	Limited Liability Company
MES	Ministry of Education and Science
MNC	Multinational Corporation
MOE	Ministry of Economy
MSc	Master of Science
MTA	Ministry of Territorial Administration
NAS	National Academy of Sciences of the Republic of Armenia
NATO	North Atlantic Treaty Organization
NCF	National Competitiveness Foundation of Armenia
NCIE	National Center of Innovation and Entrepreneurship
NGO	Non-Governmental Organization
NIS	National Innovation System
NTBF	New Technology-based Firm
ODIMM	Moldovan Organization for the Development of SMEs (Organizația pentru Dezvoltarea Sectorului Întreprinderilor Mici și Mijlocii)
OECD	Organisation for Economic Co-operation and Development
PC	Personal Computer
PCT	Patent Cooperation Treaty
PhD	Doctor of Philosophy
PPP	Purchasing Power Parity
PPP	Public-private partnership
R&D	Research and Development
RA	Republic of Armenia
RAU	Russian-Armenian (Slavonic) University
RTD	Research and Technology Development
RTO	Research and Technology Organizations
S&T	Science and Technology
SBIR	United States Small Business Innovation Research program
SCOPEs	Scientific co-operation between Eastern Europe and Switzerland
SCS	State Committee of Science
SDS	Strategy for the Development of Science 2011-2020
SELIP	Strategy of Export-led Industrial Policy
SEUA	State Engineering University of Armenia
SIC	Social Innovation Camp
SME	Small and Medium-sized Enterprises
SME DNC	Small and Medium Entrepreneurship Development National Center of Armenia
SNCO	State Non-Commercial Organization

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STEM	Science, Technology, Engineering and Mathematics
STEP	Science and Technology Entrepreneurship Program
STI	Science, Technology and Innovation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TAIEX	European Neighbourhood Policy Instrument, Technical Assistance
TEMPUS	Trans-European Mobility Programme for University Studies
TTA	Technology Transfer Association
TTO	Technology Transfer Office
UCO	Universal Credit Organization
UITE	Union of Information Technology Enterprises
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Develop Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics
VAT	Value Added Tax
VLSI	Very Large-scale Integration
WEF	World Economic Forum
WEF GCR	World Economic Forum Global Competitiveness Report
WTO	World Trade Organization
YCRDI	Yerevan Computer Research and Development Institute
YSMU	Yerevan State Medical University
YSU	Yerevan State University
ZIM	Zentrales Innovationsprogramm Mittelstand (Central Innovation Programme for SMEs, Germany)

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## ***EXECUTIVE SUMMARY***

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The *Innovation Performance Review of Armenia* provides a critical examination of the national innovation system (NIS), the institutional framework of innovation policy and the various mechanisms and instruments of public support for innovation. On the basis of this broad assessment, policy options and recommendations are offered to improve the innovation performance of the country and enhance the innovation capacities of stakeholders.

### **Assessment**

#### ***National innovation system and innovation governance***

Armenia has made considerable progress in the establishment of an NIS. Many important ingredients of this process are in place: strategic vision, political will and support at a high level of Government. Building an NIS has been set as a strategic objective by the Armenian authorities, who have taken concrete practical steps in implementing this objective. Importantly, this process is underpinned by a systemic understanding of innovation.

However, within this understanding of innovation, a narrow interpretation of innovation prevails, focusing on frontier (cutting-edge) technological innovation. Such a biased understanding is reflected both in the innovation policy mix and in the efforts to support NIS formation and implementation. As a result, a range of innovation-related activities are left out of the scope and coverage of existing policy instruments. This reduces overall policy effectiveness and does not support the establishment of a fully-fledged and efficient NIS.

Strategic documents draw on key national assets such as the strong science base, a large Armenian diaspora and traditional national values such as education and skills. Special emphasis is placed on components of the NIS that are seen as a priority (“NIS pillars”). Implementation relies on creating a self-enhancing momentum that builds on the demonstration effects of successful implementation. The strategy therefore begins with areas that have a greater chance of success.

However, a number of building blocks and linkages that are vital for a well-functioning NIS remain non-existent. The most critical among these gaps are the poor linkages between education/science/R&D and industry. Also, innovation intermediaries and support institutions in the country are rather weak. Early stage financing is practically non-existent. As a result, the local environment is not conducive to innovative entrepreneurship.

Strategic and policy initiatives demonstrate an understanding of the main constraints within the national context, including a small, landlocked economy with limited natural resources. The strategic aim of transforming Armenia into an R&D centre of multinational high-tech companies is well aligned with these constraints. However, greater focus needs to be assigned to the internationalization of Armenian R&D institutes and businesses by their integration into global value and supply chains.

Poor industry-science linkages constitute one of the weakest structural components of the Armenian NIS. The governance structure, split between the State Committee of Science and

the Ministry of Economy, de facto reinforces the disconnection between the two subsectors rather than building bridges between them. On the other hand, Armenia has a strong science base in some areas, which is not employed to its full potential.

The disconnection between the governance of R&D and of innovation is part of a broader problem – the overall fragmentation of the Armenian NIS. There are many bodies tasked with the implementation of different innovation support programmes, which are often very small. Fragmentation is an impediment to both the coherence of national innovation policy and coordination between the different bodies with responsibilities in the area of innovation support. In addition, the current role of the NAS in the national innovation governance system is somewhat ambiguous, being dependent on project R&D funding from the State Committee of Science (SCS) but without clear attributions in other stages of the innovation process.

There is a strong dependence on innovation policy instruments supported by donor funding (both official aid and private sources), which is also a factor in explaining the programme's fragmentation. While donor aid has been instrumental in helping to initiate some funding programmes, such an orientation cannot be regarded as a sustainable long-term policy course. In addition, excessive reliance on aid in the NIS strategy carries certain risks such as those of aid addiction and possible capture by private interests.

#### ***Framework conditions, innovation policies and instruments***

There has been significant progress in recent years in developing a legal framework for science and innovation and creating a number of supporting institutions. However, the impact of public initiatives is limited by the lack of an innovation culture in large parts of the business community, the scientific and educational sectors and public administration.

Armenia has developed a number of support initiatives seeking to promote innovation in the private sector. The Enterprise Incubator Foundation (EIF) is an effective tool, given its relative autonomy and organizational/institutional proximity to the business sector, which is the main target group. However, in practice, its coverage is limited to the information and communication technologies (ICT) sector. The Technology Transfer Association is also a promising model. The impact of public support is limited by low demand for innovation.

There have been significant changes in the institutional structure and funding mechanisms of public R&D in an effort to encourage commercialization. Further reforms would facilitate the commercial orientation of research and its transformation into innovation.

In order to improve policy design and implementation, it is essential to monitor and assess the impact of policies. In Armenia, the poor statistical base and a limited evaluation culture make it difficult to obtain a clear picture of technological capabilities and this poses clear challenges for evidence-based policy making.

#### ***Knowledge generation and absorption***

Armenia's development options are closely linked to transition towards a knowledge-based economy, influenced by a scarcity of natural resources and high transport costs due to its geographical position. Armenia's main asset is its skilled labour force. However, neither the current educational system nor the system of vocational training is geared to the challenges

posed by a development path that should rely on human capital. Despite some good training initiatives, companies encounter difficulties in finding qualified staff.

The R&D expenditures needed for supporting innovation-based competitiveness are very low. Lack of data makes it difficult to form a clear view of R&D spending and innovation activities, particularly in the critical business sector. In addition to low R&D, shortcomings in engineering and innovation management constrain firms' innovation capacities. Low innovation demand does not create incentives for technological upgrading among companies.

There has been some restructuring of the R&D system, including mergers between some research institutes. However, more extensive changes are required in order to ensure that the necessary increases in innovation investment are absorbed in an effective way.

Foreign direct investment (FDI) in Armenia is mainly driven by a desire to obtain access to the market rather than increasing efficiency. There are some positive experiences where foreign companies have developed a network of local suppliers and contributed to technological upgrading. However, the potential for FDI to contribute to innovation and technological change in the wider economy remains largely untapped.

### ***Industry-science linkages and collaboration in the innovation process***

Linkages between science and industry are rather poor. Successful research commercialization could bring important benefits to both the organizations conducting the research and the wider economy, including an increased ability to retain scientific talent and the upgrading of scientific capacities. Improving industry-science linkages (ISLs) requires the coordination of multiple policies, including those on science, innovation, foreign direct investment and industrial development. Transparency is crucial to the success of all programmes and calls for open tenders.

Despite progress, scientific and innovation management capabilities remain weak in all relevant organizations: business, research institutes, and public administration. New intellectual property rights (IPR) legislation provides an opportunity to manage the commercialization of research results, but technology transfer functions are not well defined in scientific organizations. There is a need to substantially upgrade management capabilities in order to support research commercialization. Building ISLs is a time-consuming, costly and risky process. Public support is necessary to overcome shortages in skills and financial resources and to facilitate the development of appropriate strategies in relevant organizations.

The current legal framework does not support or encourage closer industry-science linkages. Scientific organizations do not have sufficient autonomy to engage in commercial activities. In addition, there are no clear regulations to facilitate the effective use of the autonomy that has been granted. This absence of guidelines creates a vacuum, placing an additional burden on research organizations seeking to develop these linkages.

Industry-science linkages are influenced by the level of economic development and historical and institutional traditions of individual countries. Armenia can learn from advanced countries but also from successful developing economies and, in particular, from other countries with economies in transition. However, these lessons cannot be applied without a deep understanding of the national situation. A systemic review of the current legislation and

the existing practices on ISLs is necessary in order to identify the main barriers and opportunities and assess policy impact. Armenia has been gradually introducing the evaluation of research organizations, which is a good starting point.

### ***Financing innovative entrepreneurs***

There are multiple initiatives to support, directly or indirectly, innovative entrepreneurship in Armenia. Anecdotal evidence shows some of them to be rather successful. However, there is limited data to assess current trends regarding entrepreneurship in Armenia or the impact of the measures being implemented. Potential beneficiaries are also not fully aware of the different ways in which they can find support. This general lack of information severely constrains the ability to design effective policies to encourage innovative entrepreneurship.

Initiatives to support entrepreneurship have different targets and are implemented by different agencies. This fragmentation partly reflects attempts to address the needs of different clients. However, fragmented initiatives and limited connections between various programmes lead to a lack of strategic direction in efforts to support entrepreneurship, and limited synergies in programme implementation.

The Armenian diaspora is a potentially important resource for the development of entrepreneurial activities in the country. It provides access to external knowledge networks that can support the internationalization of domestic companies. Members of this diaspora, who have become successful entrepreneurs abroad can contribute both expertise and financing to the development of new ventures in Armenia, while helping to overcome the limitations of the domestic market.

### ***The role of innovation in international economic integration***

Armenia has limited natural resources and a small domestic market. Opportunities for trade with neighbouring countries are limited by transport and geopolitical factors. Production and export of innovative goods is rather limited. These challenges require focused efforts to enhance the contribution of trade to the innovation capacities of the country.

The Armenian diaspora is a strong asset for national economic development, being a source of financing, expertise and contacts. There are multiple initiatives in the country enjoying the support of members of the Armenian diaspora, including in areas relevant for innovation such as the relatively knowledge-intensive ICT sector, education and research. Further initiatives should be developed to build on existing achievements.

The university sector can attract foreign students. Competitive advantages include moderate living costs, affordable student fees and a solid, well-established reputation for teaching quality in certain areas such as medicine. Good efforts have been made to make degrees comparable and internationally recognized through links to US and Russian universities, and by joining the Bologna process. In a competitive landscape, developing existing potential and preserving current strengths requires further effort.

Armenia embraces and encourages international R&D cooperation. There have been efforts to internationalize evaluation, including the establishment of a database of diaspora scientists. Instruments to support bilateral R&D so far concern mainly small-scale mobility initiatives

for researchers. Some international grant programmes have been discontinued or reduced, with the main source of international funding being the EU Seventh Framework Programme (FP7). Association to the EU's Horizon 2020 programme has been envisaged. The experiences of CIS countries can be a source of valuable lessons when designing and implementing innovation instruments. The Commonwealth of Independent States (CIS) Innovation Programme could provide new cooperation opportunities with countries that share common problems and enjoy strong cultural and scientific linkages. However, specific skills need to be developed to take advantage of the opportunities created by international cooperation.

## Recommendations

Recommendations and policy advice can be derived from the assessment of the innovation performance of Armenia which could contribute to increasing the efficiency of the national innovation system and enhancing the innovation capabilities of stakeholders. These recommendations, which concern a large number of innovation related issues, have diverse scope, including strategic considerations, changes in the allocation of resources, new policy orientations or the design of specific instruments.

The Review recommends a **broader understanding of innovation**, to include non-technological aspects. Emphasis should be put not only on cutting edge technological innovation but also on the introduction of technologies that may exist elsewhere but are new to the Armenian market as well as innovative processes and services. The importance of social innovation and innovation in management should be recognized.

Such a broader understanding of innovation could be promoted by an awareness raising campaign, both among policymakers and other innovation stakeholders. The innovation strategy should be critically reviewed in order to identify the main gaps in the current orientation that result from the prevailing narrow view of innovation, and an implementation plan developed to introduce supplementary components in the national innovation strategy and related areas of innovation policy.

The authorities should undertake a concerted policy effort to develop the **building blocks and linkages** that are currently missing in the NIS and are not targeted in the current strategic orientation. This effort could include a critical analysis of key missing components of the NIS, which should be prioritized in terms of their importance for the efficient functioning of the NIS. A supplementary medium-term action plan should be devised for further institutional development of the NIS, along with policy instruments specifically targeting the establishment and strengthening of currently absent or weak NIS linkages. These efforts should incorporate an international dimension, in particular with regard to industry-science linkages, innovation intermediaries and early-stage financing while also promoting the integration of Armenian R&D institutes and businesses into global value and supply chains.

Targeted policy efforts to **strengthen industry-science linkages (ISLs)** within the NIS, both internally and across borders, could include specialized policy instruments that support innovation projects covering the full innovation cycle from research to market and which are conditional on collaboration between Armenian R&D institutes (including those within the National Academy of Sciences) and local businesses. Such policies should be accompanied by the necessary training for specialists, and initiatives encouraging collaborative R&D and

innovation projects involving Armenian R&D institutes (including those within the National Academy of Sciences) and businesses from other countries. Possible joint schemes for promoting innovation could be discussed with potential foreign partners. Policy instruments to support ISLs could be implemented through policy programmes jointly run by the State Committee of Science and the Ministry of Economy.

In order to **streamline innovation governance structures**, there could be greater efforts to clearly define the power and duties of different bodies and facilitate horizontal communication between them. Options could be explored for possible consolidation of those implementation bodies currently under the functional responsibilities of the Ministry of the Economy. There could also be a public consultation on the rationale for establishing a new public body governing both R&D and innovation which would take over the respective functions now undertaken by the SCS and the Ministry of the Economy. The functional role of the NAS in the NIS could also be reviewed in order to improve its integration within the governance of innovation activities and its commercialization of research results.

The authorities should plan and implement measures for fully **aligning with national priorities all support programmes jointly run with donors**, while aiming to gradually reduce the relative share of donor funding within innovation support. There should be clear criteria under which the Government operates and co-finances, jointly with donors, innovation support programmes that support national strategic objectives. Innovation support programmes should be jointly reviewed with donors to ensure they contribute to the achievement of national priorities and to a streamlining of innovation governance structures, avoiding fragmentation that places excessive pressure on coordination mechanisms. Options should be developed, as part of long-term budgetary objectives, for increasing the share of national public resources allocated to innovation support programmes, and gradually reducing the reliance on donor funding.

It is important to increase general awareness of the importance of innovation. Possible ideas include promoting successful business concepts and innovative companies as role models in the media and at national/international conferences, including with the support of the Armenian diaspora. Media campaigns could be developed to encourage an entrepreneurial spirit in higher education and research institutions.

The authorities should strengthen efforts to **increase private sector innovation activities**, building on existing initiatives. This could include enhancing the role of the EIF as an autonomous and policy-oriented “one-stop” innovation support agency with a mandate that extends effectively beyond ICT. A large, self-standing and visible programme to support R&D and innovation in the SME sector could be introduced, with a fixed annual budget and with no imposed specific thematic priorities, administered under clear and understandable guidelines, application procedures and selection criteria. It would be beneficial to strengthen participatory elements in the design of innovation policies with private sector involvement. Appropriate regulations and standards, e.g. energy efficiency, may also encourage innovation. The innovation capacity of the business sector may be strengthened through training on innovation management, R&D support, marketing and internationalization. Lessons can be drawn from the work of successful private initiatives like the Technology Transfer Association with a view to using this experience in other areas, such as low-tech innovations or non-technological innovations.

Efforts to **strengthen applied R&D and commercialization** activities in public research institutes should be continued, for example by increasing the competitive elements in the funding provided to institutes developing technologies with commercialization potential. The role of the National Academy of Sciences in innovation could also be strengthened, distinguishing between its two main missions: basic research and applied research, with increased amounts of funding coming from contract research for companies.

There is a need to **improve the statistical system** and introduce **robust policy evaluation** methods, so that decisions can be grounded on a solid empirical basis. There should be an aim to adopt international standards regarding R&D and innovation statistics. An ongoing monitoring and evaluation system should be implemented, at least for the most important innovation support schemes. This should be transparent, coherent and comprehensible and track the impact on participating companies, with feedback from this evaluation to policy design and implementation. As a result, weak programmes should be modified or discontinued. “Strategic intelligence” could be developed using foresight and scenario exercises, technological road mapping and external evaluations.

The education system requires reforms that ensure the **relevance of knowledge and its dissemination** in the wider economy. Curricula should be evaluated and modernized to ensure that graduate skills correspond to the needs of technologically-driven growth. This is a medium-term target that should be embedded in a suitable strategy. It will be important to improve teacher training, particularly in the higher education sector, including through a programme of competitive grants to facilitate internationalization and access to foreign best practice. There is a need to differentiate between research and vocational universities, establishing separate objectives and evaluation methods for these two groups. Some R&D institutes could be integrated into research universities. Close linkages between both types of universities and R&D institutes should be established through doctoral and other educational programmes. Relevance may also be enhanced by stronger linkages between vocational universities and the business sector, including foreign firms.

Innovation activities could be increased through a number of concerted actions. These could include increasing public R&D spending and, in particular, encouraging higher spending in the business sector. R&D statistics should also be harmonized with international standards and innovation statistics introduced, with appropriate coverage of the business and enterprise sector. Current twinning programmes in this area should be extended, and Armenia could seek assistance from Eurostat. The innovation capacities of firms could be improved by supporting engineering and innovation management, including through quality improvement programmes like those for implementing ISO9001 standards, ISO14000 environment standards and industry-specific international standards (such as Capability Maturity Model Certificates). Innovation vouchers could be introduced for the purchase of a wide range of innovation services to encourage innovation activities in SMEs and help bridge the gap between the research sector and SMEs. Public procurement could also be used as a mechanism to promote technological upgrading while addressing the needs of Government agencies for solutions that meet their needs. The programme should provide early-stage financial support to high-risk innovative technology-based small firms with commercial promise, following the example of the US Small Business Innovation Research (SBIR) programme.

Measures to increase the **efficiency of resource allocation to R&D** could include restructuring the system of R&D institutes, e.g. by reorienting some of them to become technical institutes supporting knowledge-intensive SMEs. These institutes should rely on a combination of public and commercial funding and cooperate closely with technoparks. R&D should be evaluated on the basis of multiple criteria, reflecting the diverse functions of different organizations. In addition to international excellence, which should be applied primarily to select institutes within the higher education system, local relevance should also be taken into account. Introducing international evaluation of R&D organizations could serve as a basis for the integration of university R&D departments and R&D institutes and the gradual increase of educational expenditures.

The impact of FDI on technological upgrading could be increased by **integrating FDI and innovation policy** to promote a shift towards FDI in technology, engineering and business support service centres. This would require coordination between the agencies involved in policy design and delivery in these areas. A programme could also be developed to promote subcontracting as part of FDI support, so foreign companies could more easily incorporate Armenian suppliers in their value chains. The programme should include medium-sized and large companies (integrators) and SMEs based in Armenia. Integrators should monitor the implementation of the programme and encourage cooperation among participating companies. Funding should be provided on a matching basis to assist potential suppliers in raising their quality and productivity levels.

Innovation policy should emphasize the **importance of ISLs** and introduce relevant programmes to improve the current situation. Public initiatives could include the development of instruments that target links between industry and science, where the provision of public financing depends on the existence of collaboration. Higher education graduates should also be encouraged to establish start-ups, so that new firms linked to science emerge. FDI policy and science, technology and innovation policy should be co-designed to attract more foreign investors employing Armenian scientific assets. Cross-border linkages between Armenian science and innovative foreign companies should be promoted, thus creating a source of income and facilitating access to global networks of knowledge.

Substantial public support is required to promote ISLs at the early development stages, with initial public funding necessary before technology transfer activities can become profit making. Facilitating the development of technology transfer functions or offices within scientific organizations, including through training on licencing and research contracts and intellectual property related issues, would encourage development of the necessary capacities and facilitate commercialization. Other possibilities include designing a scheme to support patenting alongside advice on whether to seek international protection and grants to partly cover the associated costs, and strengthening the capacity of the Intellectual Property Agency to offer broader services to its clients

The **economic autonomy of higher education institutions** (HEI) and the National Academy of Science's research institutes could be increased by undertaking the necessary legal reforms while encouraging them to develop internal regulations concerning technology transfer. Specific options could include harmonizing the Law on HEI and the Law on state non-commercial organizations to remove legal barriers to ISLs, and providing equal opportunities to different organizations in order to revise their Charters so they can engage in entrepreneurial activities. It is important to put in place an appropriate framework for the

creation of spin-off companies emerging from research and educational organizations, clearly addressing all relevant issues. Finally, guidelines should be developed on intellectual property issues to be included in employee contracts, and guidelines on the management of technology transfer offices.

**Evidence-based policy making** and the development of a strategy for research organizations requires well-developed evaluation initiatives. The authorities should promote both internal and external evaluation of government agencies and research organizations. The evaluation results should lead to decisions on strategy formulation and policy changes, with a clear impact on the allocation of financial support. Scientific organizations should be evaluated on a periodic basis, covering scientific performance, scientific assets, physical and human capabilities, governance and management, and linkages with industry. Likewise, technology transfer offices receiving state support should be evaluated periodically to assess whether such assistance should continue.

There is a need to develop **better information on entrepreneurship** and support initiatives, which should be widely shared. This could include learning lessons from entrepreneurship support initiatives, identifying good practices, factors explaining their success and the conditions required to scale-up or expand the scope of these initiatives. This would require a strengthening of analytical capacities and the development of robust impact evaluation methodologies. Joining the Global Entrepreneurship Monitor surveys would provide a basis for making comparisons between business activities across time and in relation to other countries. These data would facilitate analytical and evaluation efforts. Finally, information and awareness campaigns could be developed, with the support of entrepreneurial associations and other stakeholders, to ensure that potential beneficiaries are aware of the possible forms of support and how to access them.

It is important to provide a **strategic orientation for entrepreneurship support**. Strategic targets should be defined, and then regularly evaluated and updated. The implementation of the strategy should envisage clear responsibilities, allocation of resources and coordination mechanisms. Beneficiaries and other sources of expertise, such as the diaspora, should be involved in determining the strategic orientation. A body with clear responsibilities and competencies for implementation and monitoring of the strategy could be set up. Synergies and complementarities should be identified among various programmes. Coordinated approaches should introduce schemes that build on previous experiences or seek to complement different programmes.

Further options should be explored to tap into the **potential of the Armenian diaspora** to support innovative entrepreneurship in the country. These could include awareness and information campaigns targeting the diaspora in existing and planned research programmes as a source of potential business opportunities. A framework for business angel financing should be developed that takes into account cross-border aspects, so it can attract resources from the diaspora. The diaspora could also be involved in the design and implementation of mentoring and coaching schemes for entrepreneurs and, in particular, those originating from educational and research organizations.

There should be initiatives to increase the **potential of trade** to improve innovation performance in the country, building on existing efforts. These could include extending the existing Strategy of Export-led Industrial Policy to include other knowledge-intensive sectors

beyond ICT. Promising sectors should be identified systematically through appropriate screening, assessment of potential niches and foresight studies. Specific sectoral strategies should be elaborated and implemented. Sectors should be identified where the procurement of innovative goods and services from abroad is most important, and access to these goods and services prioritized. Linkages between companies from promising export sectors and research organizations should be improved, including through support to joint projects that serve to better use the research potential and encourage collaboration.

Promising efforts to involve the diaspora in innovation-related initiatives should be continued, in line with national priorities. These could include developing mobility schemes for temporary stays of diaspora researchers in Armenia and establishing international research groups between diaspora researchers and Armenian colleagues. In particular, cooperation should be targeted with diaspora researchers who are active in applied research and have good experience with innovation. Efforts should be made to attract students from the diaspora communities to study in Armenia through enhanced information and promotion measures.

The **internationalization of education** also offers considerable opportunities, and should be encouraged. Possible initiatives include improving the quality of education, through the upgrading of equipment, investment in infrastructure, and curricula development, including through cooperation with international partners or companies. The educational needs of particular branches of industry could be addressed, in cooperation with industry representatives, building on the experiences of the ICT sector. Efforts to attract foreign students should be broadened beyond medicine to include other promising areas, such as natural sciences.

In order to reap the benefits of **international cooperation in research and innovation**, options include prioritizing research and innovation in Armenia's cooperation with the EU, leading to more intensive use of instruments such as the European Neighbourhood and Partnership instrument, the Technical Assistance and Information Exchange instrument (TAIEX) and Twinning. Skills and mechanisms could be developed to make good use of the opportunities opened by a possible association to the EU's Horizon 2020, including information and training for researchers and innovators, matchmaking and networking and use of mobility programmes to prepare Horizon 2020 projects. Joining EUREKA and Eurostars and participating in selected European Research Area Network (ERA-NET) projects and other EU instruments could also be beneficial. International cooperation could also be supported by building closer links with the innovation agencies of the countries of the Customs Union (Belarus, Kazakhstan and the Russian Federation), and exploring the possibility of developing bilateral funding instruments with these agencies. There are policy learning opportunities from studying the experience of other CIS countries in innovation support, in particular in areas such as start-up funding, attracting remittances for public-private co-funding schemes, technology transfer and innovation vouchers. Participation in international programmes and informal research cooperation should be screened in order to identify niches of excellence and the existence of competitive teams in certain areas. This screening should form the basis for a strategy to nurture and develop these niches. Finally upgrading infrastructure and equipment is important in order to make domestic research institutions more attractive for international research cooperation.

## *Chapter 1*

### ***RECENT ECONOMIC AND INNOVATION PERFORMANCE***

Armenia is a lower middle income economy, according to the World Bank classification, with a GDP per capita of around \$3,200 in 2013 (\$6,300 on a purchasing power parity basis). The country has a small domestic market and problematic transport links with the outside world, which poses challenges for economic development.

The breakup of the Soviet Union, the conflict over Nagorno-Karabakh with Azerbaijan and the ensuing loss of communication routes for external trade resulted in a severe output contraction in the early 1990s. Growth returned in 1994. The economy expanded at an annual rate of around 5% in the period to 2000, with a substantial acceleration afterwards. Over 2001-2008, GDP increased by more than 12% per annum. Besides rapid growth, improved living standards relied on substantial remittance inflows. After a sharp contraction in 2009, growth has resumed, but at a rate well below that observed in the pre-crisis period.

The export base is rather narrow and dominated by commodity-based products with limited processing. Innovation and technological modernization would help boost exports of higher value added, develop new sources of growth and overcome the constraints on economic development of a small domestic market and poor external transport links.

#### **1.1 Economic structure**

While services dominate the Armenian economy, agriculture is the largest single sector, accounting for almost one fifth of GDP and 40% of employment (Table 1). By contrast, the manufacturing sector is quite small, representing less than 10% of GDP on average over 2009-2013. Food products and beverages account for around half of manufacturing production while basic metals represent around one quarter.

The construction sector, fuelled by remittances, grew rapidly between 2004 and 2008, its share of total GDP growing by around 10 percentage points over this period and peaking at 25% of GDP. Since then, the relative importance of construction activity has declined, falling to 10% of GDP by 2013.

Large remittances and capital inflows have made possible very high levels of consumption in relation to GDP, and a persistent external gap (Table 2). The relative weight of consumption has increased since the 2008 financial crisis and, by 2012, consumption exceeded GDP. Gross fixed capital formation rose quickly during the construction boom, but by 2013 had fallen to levels observed one decade earlier (around one quarter of GDP).

**Table 1. GDP composition by sector, shares in per cent, 2004-2013**

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture, hunting, forestry and fishing	22.6	19.1	18.7	18.2	16.3	16.9	17.0	20.3	19.1	19.2
Extractive industry	3.2	3.2	2.6	2.3	1.6	1.7	2.6	2.7	2.9	2.4
Manufacturing	13.6	13.5	10.8	9.4	8.8	8.7	9.7	10.6	9.9	10.1
Electricity, gas and water	5.3	5.0	3.8	3.3	2.9	3.1	3.3	3.9	4.3	4.9
Construction	15.5	19.6	23.7	24.5	25.3	18.6	17.3	13.0	12.2	10.3
Trade and catering	11.9	11.8	11.7	11.3	12.0	13.4	13.6	13.3	13.9	14.3
Transport and communications	6.0	6.0	6.3	6.9	6.8	7.2	7.2	6.7	6.7	6.5
Education	3.0	2.8	2.8	2.8	2.7	3.6	3.5	3.2	3.0	3.0
Health	2.2	2.5	2.5	2.5	2.7	3.5	3.2	3.7	3.8	4.1
Others	9.6	9.1	9.7	10.2	11	14.3	13.3	14.2	15.4	16.2
FISIM <sup>1</sup>	-1.3	-1.2	-1.1	-1.4	-1.5	-1.6	-1.9	-2.5	-2.7	-2.9
Net taxes	8.4	8.6	8.5	10.0	11.4	10.6	11.2	10.9	11.5	11.9
<b>GDP</b>	<b>100</b>									

*Source:* National Statistical Service of the Republic of Armenia

<sup>1</sup> Financial Intermediation Services Indirectly Measured.

Economic growth developed an increasingly domestic focus as a result of the construction boom in the pre-crisis period. Amid rapid economic expansion and increased investment effort, the ratio of exports to GDP declined, and by 2009 was less than half the level observed in 2003. Net external demand has been persistently negative over the last decade and the imbalance has become larger over the last five years, representing around 25% of GDP.

**Table 2. Composition of GDP, final consumption, shares in per cent, 2003-2012**

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Consumption	93.5	92.6	86.0	82.3	81.8	81.8	93.7	95.1	96.6	101.4
- <i>Private</i>	83.3	82.5	75.5	72.3	71.6	71.6	80.4	82.0	83.7	88.5
- <i>Public</i>	10.2	10.2	10.6	10.1	10.2	10.2	13.3	13.1	12.9	13.0
Gross fixed capital formation	23.0	23.9	29.8	35.5	36.9	39.8	36.4	33.4	26.1	23.7
Changes in inventories	1.3	1.0	0.7	0.4	0.8	1.1	-1.7	-0.6	1.2	0.1
Net external demand	-17.9	-15.6	-14.4	-15.9	-20.0	-25.6	-27.5	-24.5	-23.6	-24.8
- <i>Exports of goods and services</i>	32.2	29.7	28.8	23.4	19.2	15.0	15.5	20.8	23.8	24.6
- <i>Imports of goods and services</i>	50.0	45.3	43.2	39.3	39.2	40.7	43.0	45.3	47.4	49.4
Statistical discrepancy	0.1	-2.0	-2.1	-2.4	0.4	2.9	-0.8	-3.5	-0.3	-0.4
<b>GDP</b>	<b>100</b>									

*Source:* National Statistical Service of the Republic of Armenia

## 1.2 The public sector

The Armenian economy is dominated by the private sector, which accounts for around three quarters of economic activity, according to the EBRD. The public sector is small, with total expenditure representing around one quarter of GDP over 2011-2013. Low tax revenues have been a significant constraint on the ability of the public sector to provide public services. The tax to GDP ratio increased by 2.5 percentage points over 2011-2013 to reach around 22%, but this remains below levels seen in comparator countries. Public and publicly-guaranteed debt was 45% of GDP by the end of 2014, of which 85% was foreign currency debt.

Small-scale privatization was completed in the early years of transition, and there are few large enterprises under state control. According to the EBRD index of large-scale privatization, only Kyrgyzstan shows a comparably low level of state ownership among CIS countries. Increased deregulation has reduced the influence of the state in the Armenian economy. However, public sector lending to the domestic economy is substantial, reaching around 10% of GDP in 2012, as the Government intermediates a number of foreign financing lines to support a variety of programmes in different sectors.

## 1.3 Economic performance

The Armenian economy grew rapidly between 2002 and 2007, with an annual average GDP increase of more than 13% – a pace of expansion driven by the construction sector and fuelled by remittances and other foreign inflows. It was accompanied by a slowdown in productivity growth and increased importance of non-tradables. Growth came to an abrupt halt with the financial crisis in 2009, resulting in a sharp contraction of GDP. Economic growth recovered to 7.2% by 2012 (Table 3), but slowed to 3.5% by 2013.

**Table 3. GDP and its components: annual percentage change**

	2007	2008	2009	2010	2011	2012
GDP	13.7	6.9	-14.1	2.2	4.7	7.2
Consumption	12.3	4.5	-4.0	3.9	2.6	7.8
Investments	19.7	12.6	-30.9	0.5	-5.2	-5.7
Exports	-3.5	-13.1	-10.4	26.5	14.7	8.4
Imports	13.0	7.3	-19.2	12.8	-1.4	-2.8

*Source:* National Statistical Service of the Republic of Armenia

The current account balance has showed a large deficit since 2007, peaking at almost 16% of GDP in 2009. This is the result of a domestically focused growth model, supported by diaspora-related foreign financial inflows. While the current account deficit has declined, it was around 10% of GDP in 2012. Current account deficits would be much larger in the absence of very sizeable migrant remittances, averaging around 19% of GDP over 2011-2013. Remittances shrank by around 30% during the crisis, but have since bounced back.

Inflation has largely reflected the dynamics of the domestic agricultural sector and international food prices. It accelerated sharply over 2010-2011, before declining to an average 3.2 % in 2012 as a result of a strong harvest. In 2013, it once again increased to reach 5.8%, driven by high food and energy prices.

## 1.4 Labour force and education

The Armenian population has been relatively stable over the last decade. Yerevan accounts for around one third of the total population. The economically active population has shown little fluctuation over the past five years, while there has been some increase in the activity rate, from 59.5% in 2008 to 62.7% in 2013. A high unemployment rate (17.2% in 2012) is a significant driver of high levels of migration.

Armenia's education level is relatively high. The gross enrolment ratio in tertiary education was 46% in 2012, according to UNESCO statistics, against 20% in Azerbaijan, 28% in Georgia and 44% in Kazakhstan. However, it fell well short of levels observed in countries with higher income levels, such as Russia (75%) and Ukraine (80%).

## 1.5 International economic relations

Armenia is a small economy, with extensive commercial relations with the rest of the world. The ratio of average exports and imports of goods and services to GDP, reached almost 40% in 2013. Trade is characterized by a persistent imbalance (Table 4), with imports being more than twice the value of exports during the period 2009-2013.

**Table 4. External trade of Armenia, 2006-2013**

		2006	2007	2008	2009	2010	2011	2012	2013
\$ billion	Exports	1.6	1.8	1.8	1.4	2.0	2.5	2.6	2.8
	Imports	2.7	3.8	5.0	3.8	4.4	4.7	4.9	5.3
	Balance	-1.1	-2.0	-3.2	-2.5	-2.4	-2.3	-2.4	-2.5
% GDP	Exports	24.3	19.5	15.1	15.8	21.3	24.3	25.8	26.8
	Imports	42.0	41.4	42.7	44.3	47.1	46.8	49.5	50.5
	Balance	-17.7	-21.9	-27.6	-28.5	-25.7	-22.5	-23.8	-23.6

*Source:* National Statistical Service of the Republic of Armenia, Central Bank of Armenia

Manufactures accounted for only 22% of merchandise exports in 2012, according to World Bank data. Ore concentrates and metals represent around half of exports, but limited refining capacity means these are typically exported as low-value concentrates. Russia is the largest source of imports, with imports from CIS countries representing 31% of the total in 2012. By contrast, the CIS accounted for only 23% of exports in 2012, below the EU's share of 37%.

FDI was significant before the crisis, contributing to construction and real estate boom. FDI peaked at 8.3% of GDP in 2009, but more than halved over the period 2011-2013. The 20% purchase by Gazprom of ArmRosGazprom for \$155 million in 2013 accounted for around one quarter of total FDI that year, and reflected a debt-for-equity swap.

## 1.6 Key innovation indicators

### *Inputs*

Research and development expenditures are low in Armenia, averaging 0.24% of GDP over 2010-2012, with little annual variation observed in recent years. This is only around a quarter

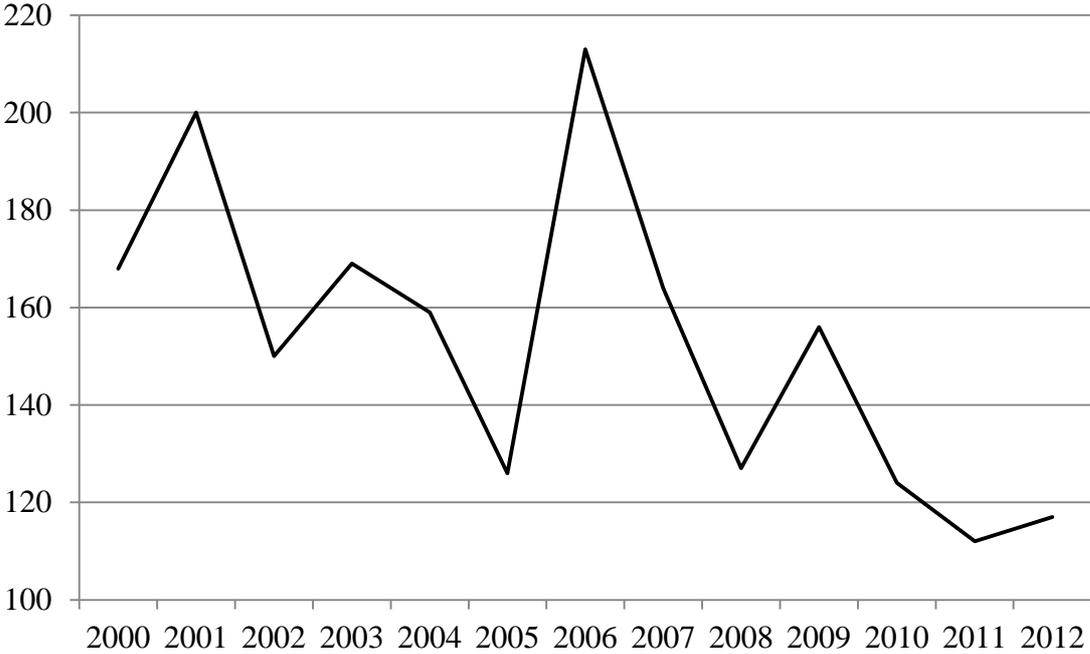
of the ratios observed in Belarus and Ukraine. The statistical record of R&D expenditures is incomplete, as only public organizations are included. The share of financing from the state budget has increased since the 2008-2009 financial crisis and accounted for 67.1% of R&D expenditures over 2010-2013.

Around 5,600 staff worked in research organizations in 2012, a decline of 19% since 2008. Female researchers account for only 42.8% of total researchers, according to 2011 UNESCO statistics. They are particularly underrepresented in engineering and technology (35.1%) but are prevalent in medical and health sciences (58.6%) and agriculture (54.6%).

**Outputs**

There is no data collected on the innovative activities of enterprises, which makes it difficult to form a clear impression of innovative performance in the economy (Chapter 4). Patenting activity is another indicator of innovation performance for which there is information available. National statistics show a declining trend regarding the number of patents granted, particularly since the 2008-2009 crisis (Figure 1).

**Figure 1. Armenian granted patents, 2000-2012**



Source: Intellectual Property Agency, Ministry of Economy of the Republic of Armenia, <http://www.aipa.am/en/patent/>.

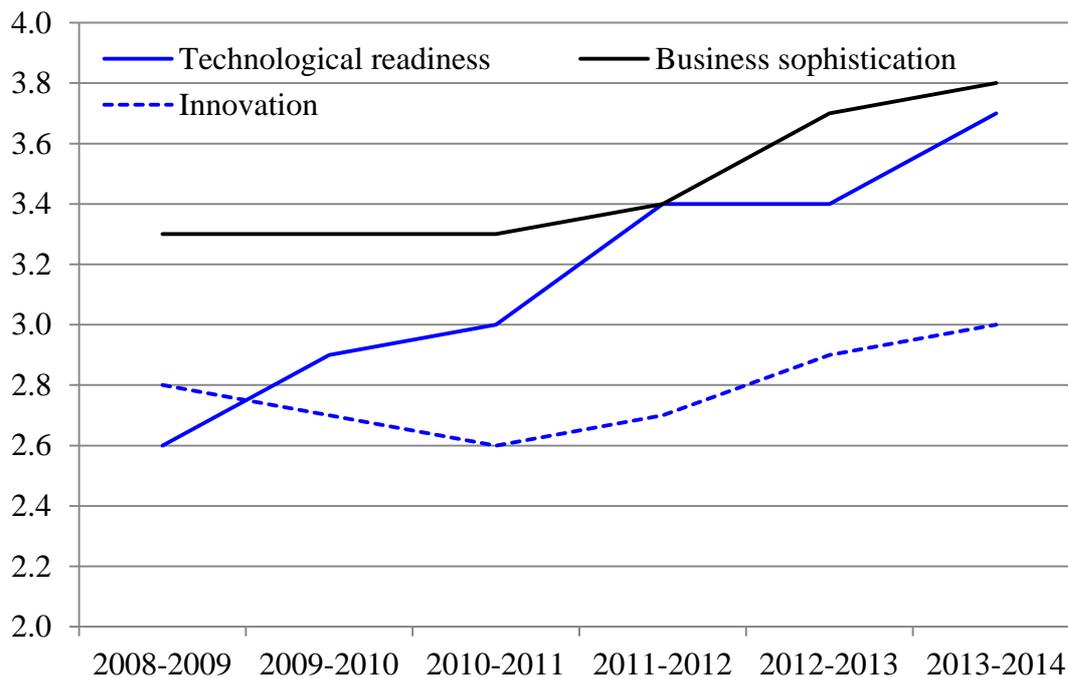
Other indirect indicators of innovation performance, such as changes in the composition of trade, do not suggest an improvement over the last decade. Thus, according to World Bank data, the share of manufactures in exports fell between 2000 and 2012 from 43 per cent of total exports to 22 per cent, while the share of ores and metals, which are associated with lower technological dynamism, rose from 27 per cent to 43 per cent over the same period.

### ***Global competitiveness and innovation indicators***

The World Economic Forum's Global Competitiveness Report (WEF GCR) provides an assessment of 12 "pillars of competitiveness" for a large group of countries, ranking them across multiple dimensions. The importance of the various pillars and the relative weights they receive when compiling an aggregate competitiveness index depend on each country's stage of development. According to the WEF, Armenia is between the factor-driven and efficiency-driven stages of development. At the factor-driven stage, countries compete on the basis of their factor endowments, while at the efficiency-driven stage, the efficient use of resources becomes more important to increase labour productivity and wages.

Scores are calculated for each of the pillars. Armenia has registered some progress in recent years regarding technological readiness, business sophistication and innovation (Figure 2). The position in the rankings also improved between 2008-2009 and 2013-2014, despite an increase in the number of countries covered (from 134 to 148 countries). While the advance has been remarkable with regard to technological readiness (from 112<sup>th</sup> to 72<sup>nd</sup>) and business sophistication (from 120<sup>th</sup> to 87<sup>th</sup>), there has been little change regarding innovation (from 106<sup>th</sup> to 103<sup>rd</sup>).

**Figure 2. World Economic Forum scores for Armenia**



*Source:* World Economic Forum, Global Competitiveness Report, various issues.

United Nations Industrial Development Organization (UNIDO) compiles a Competitive Industrial Performance Index that considers three dimensions of industrial competitiveness: the capacity to produce and export manufactures, the level of technological deepening and upgrading and the overall impact on world manufacturing. Armenia was ranked in 98<sup>th</sup> position out of 133 economies in 2010. The score obtained has persistently declined since 2010, contributing to a fall in Armenia's position in the rankings (from 90<sup>th</sup> in 2005).

## Chapter 2

# NATIONAL INNOVATION SYSTEM AND INNOVATION GOVERNANCE

Chapter 2 introduces some key features of the methodological approach that will be followed in the Innovation Performance Review of Armenia, which is based on the National Innovation System (NIS) concept. It then provides an overview of Armenia's NIS and an analytical assessment of its structure and functioning. The chapter proposes a number of conclusions and recommendations to complete the process of building Armenia's NIS, as well as to improve its effectiveness and governance.

### 2.1 Basic features of the methodological approach

While the definition of innovation has evolved over time, it has always been associated with the commercial application of knowledge. It is now widely accepted that innovation is multi-faceted, and should be considered in a broad sense. The OECD defines four broad types of innovation: product innovation, process innovation, marketing innovation and organizational innovation.<sup>1</sup> Each type of innovation may be associated with different undertakings, products or services, and may be interpreted differently (as an innovation or not) in different contexts. Hence, an existing product in one market may be an innovation when introduced to a new market. Importing a new-to-the-market technology from abroad or introducing a new organizational model to a firm on the basis of managerial models in established firms are also innovations in such a context.

This Review adheres to this broad conceptual understanding of innovation. This is important, especially when assessing emerging market environments, which generally lag behind the technology frontier. In such an environment, R&D based innovations at the technology frontier (frontier innovation) may not play a major role in the economy. However, there may still be a vibrant innovation process based on imitation and the introduction of new-to-the-market products and technologies.

Innovation in the modern economy is a highly complex process. The journey from idea to market requires mobilization of a wide range of skills and capabilities, with success depending on cooperation between the many actors and stakeholders possessing these capabilities. "Innovation stakeholders" include: innovative entrepreneurs; academic and R&D institutions; the business sector as both a source and target of innovation; innovation intermediaries and support institutions; public bodies mandated to support innovation; financial institutions; national policies and framework conditions relevant to innovation; consumers, or more generally the market for innovation; and others.

Cooperation among these stakeholders (e.g. between industry and science, small and large firms, foreign and domestic firms, etc.) is an important feature of modern innovation that is

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<sup>1</sup> OECD. Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual), 3rd edition. Paris: Organisation for Economic Co-operation and Development, 2005.

integrated into the methodology of this Review. Weak collaboration between innovation stakeholders can be considered as a systemic failure, and there is a rationale for appropriate policy intervention. A number of modern innovation policy instruments specifically target cooperation among actors in the innovation process.

At the same time, innovation stakeholders may be reluctant to engage in cooperation if the wider legal and regulatory framework is not business friendly. Concerns may relate to inadequate protection of property rights (in particular, intellectual property rights), weak contract enforcement, uncertain and unpredictable business and regulatory environments, and other risks related to the joint implementation of cooperative ventures. All these features influence the framework conditions for innovation, which are a key ingredient of successful innovation, and so are included in the methodological approach of this Review.

Finance is another central component of the innovation process. The process of transforming an idea to a marketable product or service is not only long and risky, but also costly. Many innovative ventures fail when they exhaust their start-up financial resources. Moreover, due to the high risk, most financial institutions do not engage in innovation financing. Success depends on a specific group of financial institutions able to deal with the risks of early-stage financing, e.g. business angels, venture capital firms, and also specialized public funds. The lack of such institutions – which effectively thwarts a vibrant innovation process – may reflect an immature market environment, or market and/or systemic failures. In both cases, there is a rationale for corrective policy interventions.

## **2.2 National innovation systems**

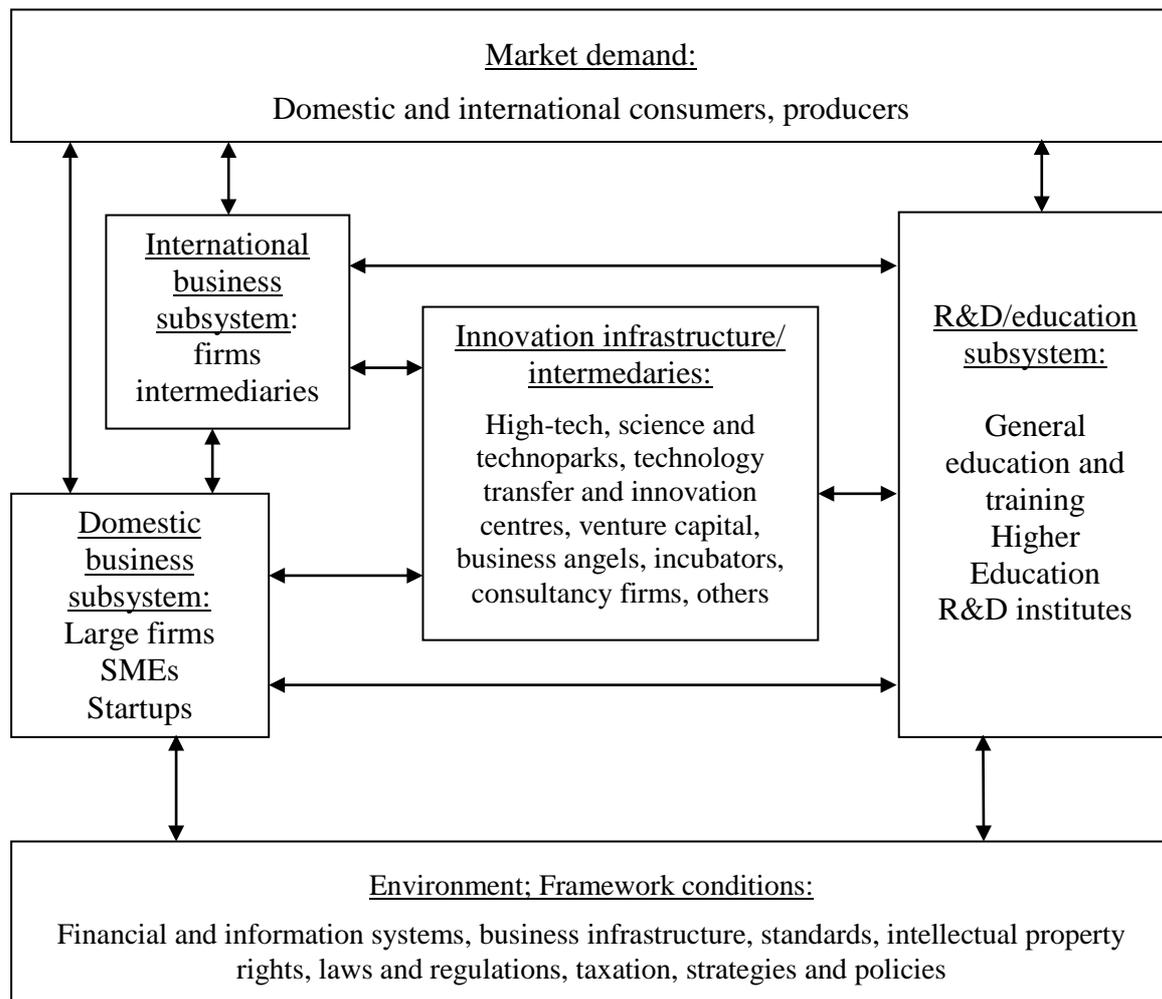
The NIS is the central methodological concept of this Review, and centres on the systemic interdependencies that influence the processes of generating and diffusing innovation in the economy. One of the broad definitions of the NIS (Figure 3) is: “the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies”.<sup>2</sup> The systemic approach to innovation helps identify specific aspects (strengths, weaknesses, driving forces, etc.) of the innovation process, along with possible measures and policy actions to improve innovative performance.

The NIS concept includes the various types of stakeholders in the innovation process, as well as their linkages and interactions. The ease and speed of moving from the innovative idea to the market defines the efficiency of the innovation process.

From a systemic perspective, while the NIS can be structured and presented in different ways, there are key subsystems whose efficient operation and interaction defines the level of maturity of the NIS. One key subsystem is the (national and international) market for innovative products and services, because innovative products need to reach the market and establish a visible presence. Actual or latent market demand can exert a powerful “pull” for the development of new products or services.

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<sup>2</sup> Chris Freeman (1987), *Technology Policy and Economic Performance - Lessons from Japan*, London: Pinter Publishers.

**Figure 3. National innovation system of a small open economy**

*Source:* Adaptation from: C. Freeman (1987), National systems of innovation: the case of Japan, in: Technology Policy and Economic Performance, London, Printer Publishers.

In addition to market “pull”, innovative businesses can also “push” novel products to market, creating new demand and establishing their own market niches. Another key subsystem is therefore the (national and international) business sector as a supplier of innovative products. Of course, businesses are also customers of each other. Very few firms are capable of completing the innovation cycle, from idea to market, internally. Firms are therefore key sources of demand for innovation and R&D, and very much part of the market subsystem.

The third key subsystem is the R&D and education system, including academic and R&D institutions. This is at the core of knowledge creation and dissemination, which is essential for frontier innovation in science. It is also an important driver of innovative processes based on imitation, and the introduction of new-to-the-market products and technologies.

The above subsystems require interlinkages to enable collaboration between innovation stakeholders. An extensive network of linkages is a precondition for collaboration and, ultimately, for the efficient functioning of the NIS. Conversely, poor links among subsystems and innovation stakeholders are a key cause of suboptimal performance in the innovation

process. Innovation intermediaries providing various innovation support services have an important role to play in bridging gaps and creating links between these three subsystems, and are thus another critical component of an effective NIS.

Finally, the business environment, framework conditions and infrastructure at the national, regional and local levels shape the incentives for all economic agents, including those in the innovation system. This environment is largely derived from past and current policies, legislation, regulations, system of taxation, etc.

When considering Armenia, it is important to highlight the specific features of a well-functioning NIS of a small, open economy in a globalized system. Firstly, it is necessary to stress the importance of a high degree of international economic integration and participation in the international division of labour, both for a vibrant wider economy and for an effective NIS. Well-functioning linkages with large international markets are a precondition for the growth of local firms, enabling the inflow of modern technologies and new ideas, including through the participation of local agents in global value chains (Figure 3).

In small economies, the domestic market is not sufficiently large to generate the demand needed to support local knowledge generating institutions and innovating business entities. Both direct linkages and linkages facilitated by innovation intermediaries are important for the connection of local innovation stakeholders to international partners and, ultimately, for the establishment of stable relations within global supply and value chains.

The existence or absence of vibrant and well-functioning linkages can be partly attributed to geopolitical factors and other national specificities. But they are also to a large degree shaped by – and the result of – national policies to develop sustainable international linkages.

### **2.3 National innovation system of Armenia**

Before independence, scientific and innovation activities in Armenia followed the traditional Soviet model of central planning and control and a linear type of linkages from research to product development. At that time both science and industry in Armenia were closely integrated with rest of the Soviet economy and were part of large scale value chains in this market. The disintegration of traditional economic, industrial and trade links after the collapse of the Soviet Union rendered much of the R&D sector and local industry obsolete under market conditions.

#### ***Innovation policy developments since independence***

During much of its independence, Armenia did not have a clear vision and policy as to the role of innovation in the national economy. During the 1990s and the first half of the 2000s, the economy was dominated by survival strategies in the context of broken traditional economic links. It was only in the mid-2000s that the policy focus shifted towards science and innovation, and a number of important policy initiatives were launched.

It was also during the 2000s that public policy started to put an increasing emphasis on science, R&D and innovation. This was the period when a number of legislative acts were adopted and a range of high-level policy decisions were taken (Table 5).

**Table 5. Key programmatic and legislative measures relating to the Armenian NIS (chronological order)**

<b>Laws, programmes, resolutions</b>	<b>Policy making</b>	<b>Implementation</b>
Law on Small and Medium Entrepreneurship State Support, 2000 (amended 2010)	Ministry of Economy (MOE)	SME DNC
Law on Scientific and Technological Activity, 2000	Ministry of Education & Science (MES)	
Government Resolution on the ICT Development Concept Paper and Action Plan (May 2001)	Ministry of Economy (MOE)	
Presidential Decree N896 on Information Technologies Development Support Council (July 2001)	Government, Republic of Armenia (RA)	
Government Resolution on Statute of the National Academy of Sciences of the Republic of Armenia (NAS) (April 2002)	Government of RA	NAS
Government Decree No. 282 on Establishment of Small and Medium Entrepreneurship Development National Center of Armenia (SME DNC) (March 2002)	MOE	SME DNC
Government Resolution on National Science and Technology Development Priorities (August 2002)	MES	MES
Government Resolution on the Concept of Innovation Policy and State Support Programme of Innovation Activities for 2005-2010 (2005)	Government of RA	MOE
Law on State Support to Innovation Activities, 2006	MOE	MOE
Government Resolution of September 2006 authorizing the Ministry of Economy as the body responsible for development and implementation of innovation policy	MOE	MOE
Government Resolution No. 1269 on the State Committee of Science (October 2007)	MES/SCS	SCS
Government Resolution on optimization of the infrastructure of NAS (2006)	Government of RA	NAS
Government Resolution on State Program of Education Development for 2008-2015 (2008)	MES	
Government Resolution on Information Technology Sector Development Strategy (2008)	MOE	EIF, ADA
Strategy on the Development of Science for 2011-2020 (May 2010)	MES/SCS	SCS
Science and Technology Development Priorities for 2010-2014 (May 2010)	MES/SCS	SCS
Strategic Action Plan for the Development of Science for 2011-2015 (June 2011)	MES/SCS	SCS
Law on the NAS (2011)	MES/SCS	NAS
Government Resolution on the Strategy of the Republic of Armenia on Intellectual Property Rights Protection (June 2011)	MOE	Intellectual Property Agency
Concept Paper on the Initial Strategy for Formation of the Innovation Economy (2011)	MOE	EIF, National Centre of Innovation and Entrepreneurship
Government Resolution on the Strategy of Export-led Industrial Policy of the Republic of Armenia (December 2011)	MOE	ADA, SME DNC, Industrial Dev't Foundation

The subsystems and components of the Armenian NIS are assessed in detail elsewhere in this Review. The main focus here is on the systemic characteristics of the NIS, and the role of the public bodies in the NIS that affect, both directly and indirectly, the interactions among innovation stakeholders.

During the transition from a planned to a market economy, the division of competencies and responsibilities among the various branches of government saw significant change. The National Assembly, with its legislative power, has high-level oversight of S&T and innovation policy formulation, and is supported in these functions by the Committee on Science, Education, Culture, Youth and Sport, and other parliamentary committees.<sup>3</sup> At the executive level, functional responsibilities are divided between several public bodies. Innovation governance, implicit in the established institutional system and interactions between different bodies, is discussed below.

The process for developing key legislative and regulatory documents in the sphere of science and innovation is broadly in line with the standard legislative procedures in Armenia:

- A commission is created, including leading experts from the relevant government bodies, the scientific community and other stakeholders;
- The commission prepares a draft of the proposed legislative or regulatory document;
- This draft is published for discussion and feedback from the scientific community and general public;
- The commission prepares a revised draft reflecting these discussions and feedback;
- The revised draft is then submitted for comments and suggestions from all public bodies with functional responsibilities in the respective areas; and
- The draft final version is submitted for approval by the Parliament (legislative acts) or Government (regulatory documents and normative programmes).

Many policy acts adopted during the 2000s focused on delineating the functional roles and responsibilities of the main public bodies tasked with specific functions in facilitating and supporting the innovation process such as the NAS, Ministry of Education and Science (and State Committee of Science), Ministry of Economy, and others.

The Law on the NAS (2011) followed a series of government resolutions regarding the Academy's status and the optimization of its structure. In accordance with the 2011 Law, NAS is defined as the highest self-governing scientific organization and as having a special status. It is directly subordinated to the Government, and the President of the Academy participates in government sessions. The Academy's basic funding is specified in a separate line of the state budget. However, for the remaining share of public funding received (thematic, target, etc.), NAS has to participate in the competitive calls organized by the State Committee of Science, alongside other Armenian research institutes.

The 2011 Law tasked the NAS with undertaking and coordinating basic and applied research targeting Armenia's knowledge-based and more general development. NAS, which includes around 35 research institutes and centres, was de facto acknowledged as the official scientific adviser to the Government. The law for the first time empowered the Academy and its

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<sup>3</sup> INNO-Policy TrendChart - Policy Trends and Appraisal Report Armenia, EC, 2007

research institutes to undertake activities targeting the commercialization of R&D results, including through the promotion of spin-offs. However, there are no mechanisms in place to implement the coordinating functions assigned to the NAS in relation to basic research, and few practical steps have been taken regarding the commercialization of R&D results.

The division of responsibilities between the State Committee of Science (science and R&D) and the Ministry of Economy (innovation proper, in the sense of technological development and bringing innovative products to market) is an important systemic feature.

Chronologically, regulations on science and R&D activities have tended to be a step ahead of those related to innovation, understood here as the commercialization of R&D. The first legislative act was the Law on Scientific and Technological Activity of 2000 that defined, for regulatory purposes, key concepts related to scientific R&D activities and organizations. The government resolution of 2007 on the establishment of the State Committee of Science was a key policy decision. While established as a committee within the Ministry of Education and Science, the SCS was empowered with wide-ranging responsibilities as the leading public agency in the governance of science, including coordinating the drafting of legislation, rules and regulations on the organization and funding of science. Shortly after the creation of the SCS, competitive project financing was introduced as a complement to basic funding of public R&D institutions, which has fallen in relative terms.

SCS is also the lead agency for the development and implementation of research programmes in Armenia. The SCS led the preparation of three key documents, subsequently adopted by the Government, that shape the main directions of science and R&D activities in Armenia at present: the Strategy for the Development of Science 2011-2020 (SDS), the Science and Technology Development Priorities for 2010-2014 and the Strategic Action Plan for the Development of Science for 2011-2015. SDS lays out the strategic vision of building a competitive knowledge-based economy drawing on fundamental and applied research. The Action Plan seeks to translate this vision into operational programmes and instruments supporting R&D activities in the country.

The Armenian authorities recognized early the important role played by the ICT sector in technological development and research commercialization in the wider economy, and in the evolution of the NIS. The process of shaping Armenia's NIS, and defining the innovation policy mix, began with a series of high-level policy decisions specifically targeting the ICT sector (Table 5). Subsequently, many of these ICT specific approaches and instruments were broadened to target other high-tech sectors. The Ministry of the Economy was tasked as the leading public body supporting innovation early in this process (Government resolution, September 2006). However, little was done over the next 3-4 years to specify practical implementation, and policy attention and support remained largely focused on the ICT sector.

Things began to change in 2011 with government adoption (Table 5) of the Concept Paper on the Initial Strategy for Formation of the Innovation Economy (ISFIE) and the Strategy of Export-led Industrial Policy (SELIP). These documents laid the grounds for a broader interpretation of both industrial policy and innovation policy proper. ISFIE also has particular significance in terms of political support and the broadening of policy instruments available for innovation support. As well as introducing a range of new policy instruments, these documents identified the implementing agencies.

The strategic vision laid out in ISFIE is Armenia's transformation into an R&D centre for multinational corporations, with key milestones up to 2020 including legal reform; development of innovation and business support institutions and instruments; educational modernization; adoption of international standards; establishment of national centres of excellence; and the internationalization of Armenian technological companies. ISFIE explicitly addresses systemic issues related to the formation of a well-functioning NIS, including the development of NIS infrastructure and systemic capabilities.

However, the ISFIE Concept Paper has a somewhat narrow scope – focusing on the attraction of high-tech multinationals and the internationalization of Armenian high-tech firms – and fails to address all the necessary building blocks and linkages needed for an efficient NIS, including those facilitating internationalization. This reflects a narrow view of innovation that focuses on high-tech/frontier innovation, as opposed to the broader understanding, discussed previously, which is more relevant to catch-up economies like Armenia. Possibly as a result, ISFIE does not focus sufficiently on important aspects of the NIS, including framework conditions, the general business environment, connectivity in the NIS, industry-science linkages, non-frontier and non-technological innovation and the need for special instruments to promote the integration of local R&D institutes and businesses into global value chains.

SELIP also reiterates a knowledge-based economy as a long-term strategic objective, although it is oriented more towards economic diversification by supporting the international competitiveness of industry sectors with export potential and export growth. Armenia's export profile is expected to shift from resource-based industries toward skills and knowledge-based sectors as a result of implementation of this strategy.<sup>4</sup> The specific policy instruments envisaged for this purpose seek to address existing market failures and explicitly exclude “picking winners”. Nevertheless, the policy is sector-oriented, based on a sectoral classification that defines some sectors as “high-priority” and hence eligible for support.

The implementation of these and other policy programmes is delegated to implementing agencies, which are subsidiary bodies of the Ministry of the Economy or associated with it. These include, but are not limited to, the following bodies:

- The Enterprise Incubator Foundation (EIF) operated initially as a support agency for the ICT sector, but its activities were recently extended to the general support of innovation and high-tech sectors. Activities include various grant schemes and establishing technology parks. Operations are based entirely on mobilizing external resources for Armenia's innovation support programmes from Governments, other official donors and private sources, including through public-private partnerships.
- The Armenian Development Agency (ADA) is tasked with implementation of the Strategy of Export-led Industrial Policy and the facilitation of FDI. It serves as a one-stop-shop for foreign investors.
- The Industrial Development Fund is a separate entity of the Ministry of Economy and implements all industrial policy instruments, including those administered by ADA.
- The Small and Medium Entrepreneurship Development National Center of Armenia (SME DNC) supports SME development through: information services; training and

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<sup>4</sup> Fostering Entrepreneurship in Armenia, World Bank, 2013.

consulting; various financial support (e.g. loan guarantees for start-ups and for upgrading SMEs); micro-franchising support; and international cooperation.

- The National Center of Innovation and Entrepreneurship (NCIE) is intended to play an important role in innovation policy design and provide various innovation support services. However, it is at an early stage of existence and is yet to become a fully-fledged entity within this mandate.
- The Intellectual Property Agency is the national body responsible for the legal protection of intellectual property in Armenia.
- The National Competitiveness Foundation is a public-private partnership that draws on international business executives of Armenian origin to attract FDI, supporting economic development and international competitiveness.

A crucial peculiarity of the conceptual framework of Armenia's industrial and innovation policy – also systematically translated into policy implementation measures – is the focus on attracting external funding from both official donors and private sources for co-financing. With few exceptions, e.g. SELIP implementation measures administered by ADA, the overwhelming majority of instruments and programmes in place rely, some almost exclusively, on external funding.

Initially, this was likely driven by a lack of domestic funding for innovation policy. There were also benefits, with private co-financing an indicator of policy relevance to the private sector, and donors bringing expertise. However, such a policy orientation also carries risks, including reduced policy independence and possible capture by private interests. Policymakers need to weigh these policy risks against the benefits.

### ***The current state of the National Innovation System***

Armenia inherited a strong R&D and education subsystem. Within the Soviet division of labour, Armenia was specialized in several fields of science and research, including physics, astrophysics, computer science and information technologies, and biotechnology. This specialization, supported by the centralized allocation of resources within the Soviet Union, meant that the share of the R&D sector in Armenia's economy and the number of scientists and R&D personnel were much greater than would be expected in an economy of this size.

Shrinkage of the R&D sector was to be expected with the disintegration of the Soviet Union and the integrative mechanisms that supported such a specialization. In the event, the sector shrank dramatically, through an uncoordinated process that resulted in significant loss of capacity. There was both “brain drain”, involving some of the best scientists, and “brain waste”, with former scientists pursuing survival strategies outside academia. R&D lost its former prestige and was no longer attractive, particularly for the best young talent. Consequently, the age structure of the R&D community started to deteriorate.

Research activity fell dramatically. It is estimated that the number of scientists fell from 25,344 in 1991 to 6,899 in 2008, while the number of research institutes fell from 124 to 83 over the same period.<sup>5</sup> Excluding the 35 institutes in the NAS system, 47 institutes fell under

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<sup>5</sup> National Competitiveness Report of Armenia (2009), *Sowing the Seeds of an Innovation Ecosystem*, Economy and Values Research Center.

line ministries and the rest were private.<sup>6</sup> At present, the overall level of public funding of R&D activities in Armenia is quite low by international standards, as discussed in Chapter 3. However, given the scale of the economic contraction during transition, even the much reduced current R&D sector in Armenia may remain oversized relative to the economy.

Armenia has a well-established system of tertiary education that includes 22 state universities,<sup>7</sup> 37 private universities, four universities established under intergovernmental agreements and nine branches of foreign universities. Universities in Armenia have a high degree of autonomy in formulating curricula and setting tuition fees. Armenia joined the Bologna Process in 2005, and universities are currently working to align the standards and quality of their qualifications. However, with only a few exceptions, universities are almost exclusively focused on teaching and do not engage in, or encourage, research by staff.

The domestic business subsystem still plays a fairly limited role in the innovation process and the NIS as a whole. Industry-science linkages and collaboration between R&D institutes and businesses in the domestic economy are weak (Chapter 5). These weak linkages are partly a legacy of the Soviet past, when the policy focus was on developing linkages across the Soviet economy, not within Armenia. R&D institutes and industry were part of value and supply chains within a large market that disintegrated, and domestic businesses have yet to become effective sources of demand for innovation. The innovative activity of the Armenian business sector is difficult to assess due to a lack of relevant statistics, although anecdotal evidence suggests it is rather limited. Innovative entrepreneurship – a key driving force of overall innovation activity in mature economies – is also very weak in Armenia. Inter alia, there is an almost complete absence of university start-ups or spin-offs.

A major reason for limited business innovation and innovative entrepreneurship is the lack of innovation intermediaries. There are very few functioning innovation support institutions such as incubators, technoparks and technology transfer centers. Early stage financing institutions, such as business angels and venture capital firms, are practically non-existent in Armenia.<sup>8</sup> According to anecdotal evidence, representatives of the diaspora sporadically perform early stage financing functions, but there is no systematic evidence to verify this. Aside from the underdeveloped innovation support infrastructure, other factors driving the lack of business innovation, and innovative entrepreneurship in particular, include general framework conditions, in particular existing hurdles in the business environment (Chapter 3).

One of the specific features of the NIS of small open economies is the importance of ensuring efficient international linkages (Figure 3). Limited market size in such economies makes such linkages an indispensable precondition for the effective functioning of the NIS. While Armenian policymakers understand this need and have taken practical steps in this direction, there remains a large, untapped potential to develop, intensify and invigorate international linkages. One area that is particularly underdeveloped is the establishment of cross-border industry-science linkages and cooperation between the local R&D and science base and international businesses.

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<sup>6</sup> Ibid.

<sup>7</sup> Public funding is only provided to “state universities” under a regulated procedure.

<sup>8</sup> These aspects are analyzed in more detail in Chapters 4 and 6.

Overall, certain key building blocks typifying the established NIS structure in mature market economies (Figure 3) remain either non-existent in Armenia, or in an embryonic form. The current NIS partly reflects the early stage of innovation policy development. While the policy acts already outlined address various aspects of innovation policy, the authorities have not yet elaborated and adopted an overarching national innovation strategy or plan, and consequently no coherent national innovation policy framework is in place. Moreover, existing policies target mainly the supply side of innovation. Linkages driven by market demand – a key driver of innovation in mature economies – seem to be very limited or non-existent.

## 2.4 Innovation governance in Armenia

Innovation governance refers to the interrelated, multi-level management efforts of various innovation stakeholders and actors.<sup>9</sup> Innovation governance includes both the decision-making rules and interactions between innovation stakeholders taking such decisions, which may, in turn, feed back to the decision making processes. From this perspective, innovation governance has both a formal component related to existing legislation, regulations and other policy decisions and an informal or behavioural component, which is related to the incentives and motivation of NIS stakeholders and actors. Innovation governance includes both public sector (competent government bodies) and private sector actors (businesses, financial institutions, innovation intermediaries, etc.) whose behaviour is driven by very different incentives and motivation. The analysis of innovation governance in a national context needs to take into account the characteristics of the governance system and processes.

One specific public sector function in innovation governance is the coordination of policy design and implementation. The need for this arises from the nature of innovation policy which – in the context of the NIS and the modern innovation process – is a largely horizontal policy addressing many actors at a similar level of governance. This means high-level policy decisions may need to be implemented by different ministries and public bodies at the same or similar level of subordination within the public administration. There may also be a need for coordination among numerous lower level bodies (e.g. agencies or departments) that are subordinated to different ministries.

Coordination to facilitate efficient functioning of cross-border NIS linkages is an aspect of innovation governance that is of particular importance to small, open economies. While in large economies it is possible to complete most coordination loops within national boundaries, this may not be feasible in economies with small markets that may also have a skewed structure. Policy coordination therefore also needs to address cross-border aspects.

A key prerequisite for both coherent policy design and coordination is an agreed long-term national vision of the directions of economic and technological development and related national priorities. The effectiveness of policy coordination also depends on the design of overarching elements of innovation policymaking, and on the existence of efficient linkages within the NIS to enable interactions among them.

Switching from more general and theoretical considerations, Figure 4 presents the most important components of the innovation governance system in Armenia.

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<sup>9</sup> Governance of Innovation Systems, volumes 1, 2 and 3, Paris: OECD, 2005.

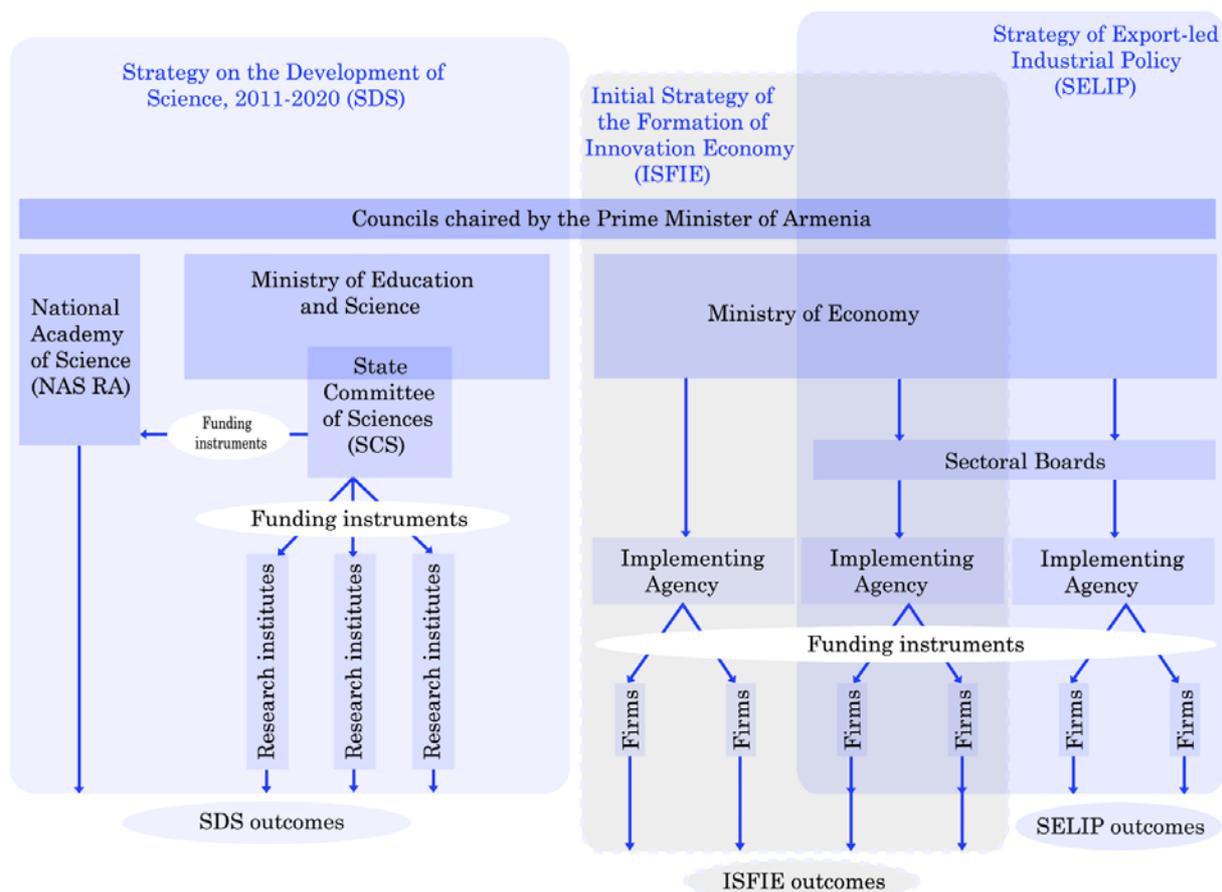
**Figure 4. Innovation governance system of Armenia**

Figure 4 reflects both the main policy documents shaping Armenia's strategic orientation in relation to innovation and the role of the key public institutions in policy implementation and innovation governance.

The policy governance system in Armenia contains a key, creative solution for policy coordination in the form of high-level councils headed by the Prime Minister. Such councils are established in various socioeconomic spheres as consultative bodies for policy coordination. They include heads of the key competent governance bodies in the respective areas, as well as representatives from business, academia and civic society. Councils in areas related to innovation policy design and implementation include:

- Science and Technology Council;
- Industrial Council;
- Information Technology Development Support Council;
- Business Support Council; and
- Small- and Medium-Size Enterprise Development Council.

For example, the Science and Technology Council may coordinate policy during the design and implementation of large-scale innovation projects involving different public bodies such as the SCS and Ministry of the Economy. The Industrial Council includes senior executives from industry and the relevant line ministers, and discusses existing problems for industry and possible steps for the Government to address these problems.

As discussed previously, the main competent public bodies for innovation policy are the SCS within the Ministry of Education and Science, the Ministry of Economy and the National Academy of Sciences.

The SCS is the lead public body responsible for implementing the Strategy for the Development of Science 2011-2020 (SDS) as well as for the Strategic Action Plan for the Development of Science for 2011-2015 which is associated with the Strategy. Within the innovation governance system, the SCS performs a wide range of functions and responsibilities in this domain, including both policy design (drafting legislation and regulations) and implementation of research funding programmes. SCS is an integrated body without subordinate structures. Therefore, in terms of governance, SCS interacts with bodies either above or at its own level of authority. In terms of policy implementation, SCS interacts with applicants for public research funding, most of which are research institutes. As regards thematic and programmatic funding, the research institutes within the NAS participate on an equal footing in SCS calls, alongside other applicants.

The Ministry of Economy is the lead public body responsible for the implementation of the Concept Paper on the Initial Strategy for Formation of the Innovation Economy (ISPIE) and The Strategy of Export-led Industrial Policy of the Republic of Armenia (SELIP), the two key policy documents in the area of innovative development. As discussed previously, the Ministry of Economy has a complex structure reflecting its diverse functions, with innovation policy design and implementation constituting only one part of its functions. Programme implementation and the administration of various policy instruments are generally delegated to a range of implementing agencies.

Like the high-level councils headed by the Prime Minister, the governance structure of the Ministry of the Economy includes Sectoral Boards (Figure 4) that perform consultative and coordinating functions. The Sectoral Boards include leading business executives from their respective branches of industry, including foreign-owned companies, and high-level public officials. Sectoral Boards are headed by the Minister of the Economy, and contribute to the development of sectoral strategies and the identification of business sector needs for policy actions. An “innovation component” is part of each sectoral strategy.

In terms of their contribution to NIS development, the two main innovation-related policy areas under the auspices of the Ministry of the Economy – ISPIE and SELIP – partly overlap, with some of their objectives and instruments contributing to development of the same NIS components. Both programmes include objectives and policy instruments supporting development of: the domestic business sector (in particular, the SME sector); innovation intermediaries; collaboration and linkages among innovation stakeholders; and linkages with the international business system. This is a positive aspect of policy design, with elements of the two strategies mutually reinforcing.

Despite the declared objectives in the relevant legislation, the actual role of the NAS in the innovation governance system is fairly limited: it does not administer any state programmes and relies on the competitive calls of the SCS for project financing. NAS is also functionally separate from the operations of public bodies tasked with the support of innovation proper (the Ministry of the Economy and its implementation agencies).

Governance of R&D activities (concentrated in the SCS) is wholly disconnected from that of innovation-related activities (delegated to the Ministry of the Economy). This is a striking feature of Armenia's innovation governance system. The analysis of the functioning of the two main policy programmes supervised by these two bodies – SDS and ISPIE – and the instruments employed in their implementation indicates almost no linkages between the objectives related to the development of science and those related to innovative performance. In principle, projects that graduate from the research funding programmes of the SCS should then enter support programmes administered by the Ministry of Economy. However, in practice, there are no functioning mechanisms or instruments to facilitate such a transition.

Research funding programmes administered by the SCS do not usually envisage practical, post-project support for commercialization. With only a few recent exceptions, SCS funding instruments do not specifically target the establishment of industry-science linkages to help transform research results into innovative products and services. Similarly, most instruments under the auspices of the Ministry of the Economy do not currently envisage the integration of R&D inputs into the project activities they support.

The current disconnect in governance between R&D and innovation activities is a regrettable outcome limiting closer industry-science linkages. This disconnect may be the result of history and path dependency but it acts, from a systemic perspective, as a built-in policy impediment to effective innovation processes.

One challenge for innovation governance in Armenia is its considerable fragmentation: numerous public institutions (particularly implementation agencies) are tasked with operational tasks in innovation and industrial policy implementation. This fragmentation is largely a result of a reliance on external finance and aid for policy implementation. Many agencies were established to serve specific donor requirements, and then incorporated into the governance system. Fragmentation can limit national policy coherence, and complicate coordination among different bodies tasked with policy design and implementation.

However, as discussed in Chapter 4, despite opportunities for streamlining and enhanced coordination, a variety of organizations can also reach a wider range of policy beneficiaries through more diverse policy models. More streamlined public support systems may also be more vulnerable to systemic failure, which is less likely when Government agencies compete to develop new policy initiatives. The effectiveness of coordination, together with leverage between the public sector, private enterprises and other organizations, are most important.

## **2.5 Recommendations**

Armenia has made considerable progress in the establishment of an NIS. Many important ingredients of this process are in place: strategic vision, political will and support at a high level of Government. Building an NIS has been set as a strategic objective by the Armenian authorities, who have taken concrete practical steps in implementing this objective. Importantly, this process is underpinned by a systemic understanding of innovation.

However, within this understanding of innovation, a narrow interpretation of innovation prevails, focusing on frontier (cutting-edge) technological innovation. Such a biased understanding is reflected both in the innovation policy mix and in the efforts to support NIS formation and implementation. As a result, a range of innovation-related activities are left out

of the scope and coverage of existing policy instruments. This reduces overall policy effectiveness and does not support the establishment of a fully-fledged and efficient NIS.

### Recommendation 2.1

*The understanding of innovation should be widened to include also non-technological aspects. Emphasis should be put not only on cutting edge technological innovation but also on the introduction of technologies that may exist elsewhere but are new to the Armenian market as well as innovative processes and services. The importance of social innovation and innovation in management should be recognized. The authorities could:*

- *Undertake an awareness raising campaign both among policymakers and other innovation stakeholders to promote a broader understanding of innovation;*
- *Review critically the innovation strategy with a view to identifying the main gaps in the current orientation that result from the prevailing narrow view of innovation; and*
- *Develop an implementation plan for introducing supplementary components in the national innovation strategy and the related areas of innovation policy.*

Strategic documents draw on key national assets such as the strong science base, a large Armenian diaspora and traditional national values such as education and skills. Special emphasis is placed on components of the NIS that are seen as a priority (“NIS pillars”). Implementation relies on creating a self-enhancing momentum that builds on the demonstration effects of successful implementation. The strategy therefore begins with areas that have a greater chance of success.

However, a number of building blocks and linkages that are vital for a well-functioning NIS remain non-existent. The most critical among these gaps are the poor linkages between education/science/R&D and industry. Also, innovation intermediaries and support institutions in the country are rather weak. Early stage financing is practically non-existent. As a result, the local environment is not conducive to innovative entrepreneurship.

Strategic and policy initiatives demonstrate an understanding of the main constraints within the national context, including a small, land-locked economy with limited natural resources. The strategic aim of transforming Armenia into an R&D centre of multinational high-tech companies is well aligned with these constraints. However, greater focus needs to be assigned to the internationalization of Armenian R&D institutes and businesses by their integration into global value and supply chains.

### Recommendation 2.2

*The authorities should undertake a concerted policy effort to develop the building blocks and linkages that are currently missing in the NIS and not targeted in the current strategic orientation. The following actions could be considered:*

- *Conduct a critical analysis of key missing components of the NIS and prioritize them in terms of their importance for the efficient functioning of the NIS;*
- *Devise a supplementary medium-term action plan for further institutional development of the NIS;*

- *Design policy instruments targeting, specifically, the establishment and strengthening of currently absent or weak linkages in the NIS; and*
- *Incorporate an international dimension when addressing existing weaknesses, in particular with regard to industry-science linkages, innovation intermediaries and early-stage financing while also promoting the integration of Armenian R&D institutes and businesses into global value and supply chains.*

Poor industry-science linkages constitute one of the weakest structural components of the Armenian NIS. The governance structure, split between the State Committee of Science and the Ministry of Economy, de facto reinforces the disconnection between the two subsectors rather than building bridges between them. On the other hand, Armenia has a strong science base in some areas, which is not employed to its full potential.

### Recommendation 2.3

*The authorities should undertake a targeted policy effort to strengthen the industry-science linkages within the NIS, both internally and across borders. Possible actions could include:*

- *Designing specialized policy instruments that support innovation projects covering the full innovation cycle from research to market and which are conditional on collaboration between Armenian R&D institutes (including those within the National Academy of Sciences) and local businesses;*
- *Providing the necessary training to specialists to encourage the development of industry-science linkages;*
- *Introducing initiatives that encourage collaborative R&D and innovation projects involving Armenian R&D institutes (including those within the National Academy of Sciences) and businesses from other countries. Possible joint schemes for promoting innovation could be discussed with potential foreign partners; and*
- *Designing and implementing policy programmes jointly run by the SCS and the Ministry of Economy to implement these instruments.*

The disconnection between the governance of R&D and of innovation is part of a broader problem – the overall fragmentation of the Armenian NIS. There are too bodies tasked with the implementation of different innovation support programmes, which are often very small. Fragmentation is an impediment to both the coherence of national innovation policy and coordination between the different bodies with responsibilities in the area of innovation support. In addition, the current role of the NAS in the national innovation governance system is somewhat ambiguous, being dependent on project R&D funding from the SCS but without clear attributions in other stages of the innovation process.

### Recommendation 2.4

*The authorities should consider possible measures to streamline innovation governance structures, including:*

- *Greater efforts to clearly define the power and duties of different bodies and facilitate horizontal communication between them;*
- *Exploring options for the possible consolidation of those implementation bodies currently under the functional responsibilities of the Ministry of the Economy;*

- *Organizing a public consultation on the rationale for establishing a new public body governing both R&D and innovation which would take over the respective functions now undertaken by the SCS and the Ministry of the Economy; and*
- *Reviewing the functional role of the NAS in the NIS in order to improve its integration within the governance of innovation activities and its commercialization of research results.*

There is a strong dependence on innovation policy instruments supported by donor funding (both official aid and private sources), which is also a factor in explaining the programme's fragmentation. While donor aid has been instrumental in helping to initiate some funding programmes, such an orientation cannot be regarded as a sustainable long-term policy course. In addition, excessive reliance on aid in the NIS strategy carries certain risks such as those of aid addiction and possible capture by private interests.

#### Recommendation 2.5

*The authorities should plan and implement measures for fully aligning all support programmes jointly run with donors with national priorities, while aiming to gradually reduce the relative share of donor funding within innovation support. The following actions could be considered:*

- *Establishing clear criteria under which the Government operates and co-finances, jointly with donors, innovation support programmes that support national strategic objectives;*
- *Reviewing innovation support programmes jointly with donors with a view to ensuring that they contribute to the achievement of national priorities and to the streamlining of innovation governance structures, avoiding fragmentation that places excessive pressure on coordination mechanisms; and*
- *Developing options, as part of long-term budgetary objectives, for increasing the share of own public resources allocated to innovation support programmes, and gradually reduce the reliance on donor funding.*



## Chapter 3

### **FRAMEWORK CONDITIONS, INNOVATION POLICIES AND INSTRUMENTS**

Section 3.1 covers the framework conditions for innovation, including human capital and the entrepreneurial culture. It then moves on to consider the legal framework for innovation and the innovation strategy. Section 3.3 comprises a more detailed consideration of innovation programmes and instruments. Finally, an assessment of the innovation strategy and programmes serves as the basis for a number of policy recommendations.

#### **3.1 Framework conditions for innovation**

##### *The general business environment*

With a population of 3.1 million, Armenia is a relatively small country. A limited domestic market along with the distance to important markets in Europe has implications for the capability of the business sector in general and innovation activities in particular. The capital city, Yerevan, is the only agglomeration in Armenia that can rely on a spatially concentrated set of innovation-related organizations. Thus, despite various political measures and initiatives to establish innovation- and technology-oriented infrastructure in regions outside the capital, the Armenian innovation system largely coincides with the metropolitan innovation system of Yerevan as the main hub of economic and research-related activities.

Disadvantages due to market size and lack of agglomeration effects can be regarded as structural hindrances that affect the innovation system, and a major challenge for industrial and innovation policy. These disadvantages are being countered by policies promoting the economic liberalization, inward investments, investor protection, exports, industrial sector development as well as innovation and research activities.

Armenia has a very free economy. According to the Heritage Foundation Index of Economic Freedom, Armenia's economic freedom score is 68.8, ranking 39<sup>th</sup> in the 2012 index. Compared to the 43 countries in the European region, Armenia is ranked 19<sup>th</sup>, placing its score above global and regional averages. Armenia ranked 37<sup>th</sup> of 189 economies in the World Bank's Doing Business 2014. This indicator sheds light on how easy or difficult it is for a local entrepreneur to open or run a small- to medium-sized business when complying with relevant regulations. The three main obstacles to running a business in Armenia are identified as contract enforcement, trading across border and paying taxes.

Regarding statutory ownership restrictions on foreign capital, Armenia has no restrictions for most of the industries in which foreign companies invest. With the exceptions of air transportation, airports, rail transportation, forestry, oil and gas, and electricity transmission, where partly monopolistic market structures dominate and foreign investment is restricted, in most of the other industries, no restrictions can be observed.<sup>10</sup> Furthermore, in most sectors,

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<sup>10</sup> See also World Bank (2013), Investing Across Sectors indicators.

Armenia has no restrictions on foreign investors bringing their own employees into the country. In addition to the protection of foreign investments by law, Free Economic Zones (FEZs) offer a range of advantages to foreign investors.

A few industries, like the wine and brandy industry, precision engineering, jewellery and diamond cutting, can rely on quite specialized skills and institutions with endogenous and systemic competitive advantages. Due to these specialized skills, barriers to entry for competitors are quite high and difficult to overcome. Other important industries can either rely on cost advantages (e.g. the pharmaceutical/generics sector) or a combination of cost advantages, natural resources and specialized skills (e.g. certain agricultural subsectors, like fruit and vegetables). The ICT industry is now being more strongly influenced by foreign investors, but is also driven by young, newly-founded Armenian companies. It is the only sector where innovations are generated for both the national and international markets and which maintains strong linkages and cooperation with universities.

Armenia offers tax credits to companies carrying out R&D. Thus, all R&D expenditures can be deducted from gross profits. The support of R&D activities by tax incentives applies to all companies. However, at the moment, not many companies are making use of these tax credits as an instrument of R&D support, mainly because of the amount of red tape involved.

The Strategy of the Republic of Armenia on IPR Protection was developed in 2011. Significant attention was given to approximating Armenia's domestic intellectual property legislation to EU standards, and Armenia has ratified most of the relevant international treaties. The institutional framework comprises the Armenian Intellectual Property Agency, the Armenian Observatory on Counterfeiting and Piracy, and membership and cooperation with international and regional organizations like the World Intellectual Property Organization, the World Trade Organization (WTO), the Eurasian Patent Office, and the World Customs Organization.

### ***Human Capital***

A well-educated labour force is one of the key inputs to an innovation system. The Armenian Government has recognized the importance of education and human capital for both the economy and social well-being. Recent initiatives have focused, for example, on involving companies in education with the aim of increasing innovation activities. The Armenian ICT sector has been particularly active: a number of public-private partnerships between ICT companies and universities have recently been established in order to generate innovative ideas at the interface of science and business.

According to the World Economic Forum's Human Capital Report (2013), Armenia ranks 60<sup>th</sup> of 122 countries for education – lagging somewhat behind Russia and Ukraine, but ahead of Azerbaijan and Georgia (Table 6). Armenia performs relatively well relative to comparator countries in terms of enrolment in tertiary education,<sup>11</sup> ranking 44<sup>th</sup> of 122 countries, while 22.9% of the labour force possess a tertiary education. The workforce and employment index ranking is weaker, at 113<sup>th</sup> of 122 countries, primarily due to high unemployment and low levels of employee training.

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<sup>11</sup> Enrolment in International Standard Classification of Education (ISCED) levels 5 and 6.

**Table 6. Selected education indicators for Armenia and other countries**

	<b>Armenia</b>	<b>Azerbaijan</b>	<b>Georgia</b>	<b>Russia</b>	<b>Ukraine</b>
Education index rank	60 of 122	71 of 122	74 of 122	41 of 122	45 of 122
Workforce and employment index rank	113 of 122	55 of 122	102 of 122	66 of 122	67 of 122
Tertiary enrolment ratio rank	44 of 122	82 of 122	68 of 122	12 of 122	8 of 122
Labour force with tertiary education	22.9%	7.6%	29.9%	54.0%	-
Emigration rate of the tertiary educated	8.9%	1.8%	2.8%	1.4%	4.3%

*Source:* World Economic Forum: Human Capital Report 2013.

*Note:* All rankings are out of 122 countries.

The high emigration rate, at 8.9% of the population with tertiary education, is higher than in comparator countries. Challenges for retaining qualified labour include the high general unemployment rate and the limited absorptive capacity of the business sector, particularly for highly-qualified employees. Armenia's current need for roughly 4,000 ICT specialists does not contradict this finding, but indicates a certain "mismatch" between the supply of ICT specialists from the Armenian education system, and demand among ICT companies.

### ***Entrepreneurship and innovation culture***

Entrepreneurship and innovation culture are not particularly well developed in Armenia. Opportunities for business development and new ventures are limited in many low-tech, labour intensive and traditional industries. With the exception of ICT, limited innovation activities are generated within existing industries and companies rather than by start-ups. Many companies are very hesitant with regard to innovations and R&D. Obstacles hindering a vibrant entrepreneurial climate include the lack of business opportunities and demand for innovations/technologies from existing industries or the State, barriers to market entry, lack of sophistication, technological and market risks and lack of financing to start-up companies by private banks and other companies (e.g. corporate venture funding). However, positive trends include the growing entrepreneurial infrastructure in terms of technoparks and incubator centres, the absence of bureaucratic barriers (e-registration) and a simplified tax regime.

There are positive trends in the ICT industry, which is developing quite dynamically and generating a significant number of start-up companies. International firms doing business in Armenia are closely connected with Armenian ICT companies and generating demand for ICT solutions. In contrast to other industries, the sale of ideas and innovations from the ICT sector to large companies is considered straightforward. In some cases, large foreign companies serve as gatekeepers to international markets.

The Government has recognized the main challenges for entrepreneurship, and implemented specific programmes or initiatives to support entrepreneurial activities. The instruments offered by the SME DNC, including training, coaching, financing, consultancy, and also by the Enterprise Incubator Foundation (Science & Technology Entrepreneurship Program, STEP) are examples of state support schemes. Furthermore, planned initiatives will support

innovation, start-up and growth financing as well as entrepreneurship education at universities, which is currently poor.

### **3.2 Legal framework for innovation and innovation strategy**

Innovation policy and priority setting was not a major concern in Armenia until the late 1990s due to major challenges related to its political transformation to an independent State. Efforts of the scientific community in the 1990s were directed mainly at solving problems as they arose, and attempts to preserve the R&D potential inherited from the former Soviet Union.<sup>12</sup> A distinct R&D and innovation strategy did not exist, and a legal framework for science had not been developed. More than two decades after independence, many structural challenges regarding innovation and technological development related to the Soviet heritage remain (Chapter 2). Institutional path dependencies in the science and public research sector continue to impact heavily on current approaches to adapting innovation-related structures and mechanisms. Today, the Government regards innovation, the creation of a national innovation system and innovation policy as key to boosting competitiveness, employment and income.

#### ***Legal framework***

One of the first pillars establishing a general legal framework for R&D was the Law on Scientific and Technological Activity, adopted by Parliament in December 2000. This regulates the activities of scientific and technical subjects, state agencies, and their relationships and use of scientific results. Although this law was not a science strategy per se, it nevertheless formulated a set of policy objectives:

- Development of scientific and technical potential;
- An effective system of scientific and technical personnel training;
- Development of the intellectual potential of society;
- Development of science and technology to address social problems;
- Integration of science, education and the manufacturing sector;
- Improvement of environmental conditions;
- Development and dissemination of a scientific and technical culture; and
- A modern science infrastructure.

Although the main objectives of the law did not mention innovation as such, the basic principles of state policy refer, among others, to supporting entrepreneurs, innovation promotion activities, and the protection of intellectual property rights.

The Law on State Support for Innovation Activity, approved by Government in June 2006, forms the basis for innovation policy implementation and the modalities of state support to innovation activity. The overall goal of state innovation policy defined in this law is to provide appropriate economic, legal and organizational conditions for innovation activity. Concrete innovation policy objectives include supporting the implementation of new technologies in the business sector and establishing innovation sub-structures, and creating a legal basis for cooperation on innovation activities among scientific research institutes,

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<sup>12</sup> incrEAST country report: Armenia, IncoNet EECA, 10 January 2012 update.

universities, industry and financing structures. The principles of state support to innovation activities are:

- Creation of a favourable legal environment for the establishment of venture and investment funds to support innovation activities;
- Provision of financial and investment support and guarantees;
- Provision of rights for state assets' employment;
- Support of innovation sub-structures, their location and development (innovation-research centres, business incubators, technology parks, innovation funds); and
- Training support for specialists engaged in innovation activity.

The Ministry of Economic Development and Trade was recognized in 2006 as the authorized body responsible for the development and implementation of innovation policy, in cooperation with other concerned ministries and organization.

At the same time as the Law on State Support for Innovation Activity, the Government formulated for the first time its objective to establish a national innovation system in its Development Programme for the Armenian Innovation System 2005-2010. This programme targeted legal and institutional preconditions for a national innovation system:

- Legislative and regulatory acts related to innovation processes, infrastructure, innovation projects, state support, innovative products, and evaluation criteria;
- Competitive funding of innovative projects;
- Strengthening fundamental and applied research institutions based on existing and emerging scientific innovation centres and industrial complexes and technology parks;
- Analysis and organization of innovative activities;
- Skills training, vocational training and qualification systems, implemented through innovative educational programmes (e.g. technology management, innovation management, project management, intellectual property protection); and
- Innovative Enterprise Activation: mechanisms for attracting private sector investments in innovation, including the possibility of Government provision of guarantees, venture financing and other funding sources.

In addition to the aforementioned laws focusing on legal aspects of innovation activities and innovation support, other documents (e.g. strategies, action plans) have been adopted or approved that focus on the development of science and technology development in Armenia, rather than on innovation in the narrow sense.

In May 2010, the Government adopted the Strategy on the Development of Science in Armenia 2011-2020 compiled by the State Committee of Science. This strategy outlines state policy for scientific development over 2011-2020, and formulates the following vision for Armenia: *“By 2020 Armenia is a country with a knowledge-based economy and is competitive within the European research area with its level of fundamental and applied research”*. The following targets have been formulated:

- Creation of a system supporting sustainable development in science and technology;
- Development of scientific potential, modernization of scientific infrastructure;
- Promotion of fundamental and applied research;

- Creation of a synergistic system of education, science and innovation; and
- Becoming a prime location for scientific specialization in the European research area.

Based on this strategy, the Strategic Action Plan for the Development of Science for 2011-2015 was approved by the Government in June 2011 and defined the following targets:

- Improvement of the S&T management system and suitable conditions for sustainable development;
- More young and talented people involved in research, education and technological development, upgrading of research infrastructure;
- Suitable conditions for the development of an integrated science, technology and innovation system; and
- Enhanced international cooperation in research and technology development (RTD).

While the strategy clearly pursues a “science push” approach, with public research institutes as the key policy target, it nevertheless mentions the goals of generating innovations and establishing an innovation system. However, the business sector, which is the main area for implementing innovations, is not mentioned.

Finally, in May 2010, the government issued a resolution on Science and Technology Development Priorities for 2010-2014 in the Republic of Armenia. The priorities were:

- Armenian studies, humanities and social sciences;
- Life sciences;
- Renewable energy, new energy sources;
- Advanced technologies, information technologies;
- Space, earth sciences, sustainable use of natural resources; and
- Basic research promoting essential applied research.

The new statute of the NAS should also be mentioned, as this makes direct references to shaping the Armenian innovation system. The new statute of NAS, approved by Government in May 2011 on the basis of the Law on the NAS, allows the NAS to carry out wider business activities concerning the commercialization of R&D outcomes and the creation of spin-offs.<sup>13</sup> This law, among other things, makes provision for restructuring the NAS, and creating scientific and technological centres by combining institutes involved in closely related research areas. Three centers/institutes are particularly relevant: the Centre of Biotechnology, Centre of Zoology and Hydroecology, and Centre of Organic and Pharmaceutical Chemistry.

In addition to horizontal innovation and science policies, the Government strategy includes focusing support schemes on selected industries (i.e., vertical or sectoral industrial policy). Within this context, the State Committee of Science invites private sector participation on a cofinancing basis in research projects targeting applied results. As at end 2011, 17 projects have been funded in so-called targeted branches: pharmaceuticals, medicine and biotechnology, agricultural mechanization and machine building, electronics, engineering, chemistry, and particularly the ICT sphere.

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<sup>13</sup> For further information, see incrEAST country report: Armenia, IncoNet EECA, 10 January 2012 update.

Regarding ICT, the Government approved the Information Technologies Industry Development Concept (based on Government Decree No. 35 in 2008), with the objective to review and adapt the legal framework to enable development of the ICT sector, and promote an e-society in Armenia.<sup>14</sup> According to an EIF report, the following actions are essential: spurring investment, supporting start-ups, protecting copyright, streamlining business registration processes, reforming tax and customs administration, and simplifying import and export mechanisms for ICT tools and products. The 2008 IT Development Concept builds on the ICT Master Strategy, already developed in 2001. It stresses that many “system forming” components are already being developed in Armenia, such as new approaches to education, business development, e-government, technology commercialization, and new support institutions. The challenge is to increase these programmes’ visibility, while orienting them towards a common goal.<sup>15</sup>

The furthest reaching action regarding ICT sector support was the establishment of EIF in 2002, which aims to increase the international competitiveness of Armenian ICT companies, develop business links with public and private institutions, Government agencies, large multinational organizations and small start-up companies, and disseminate international best practice among local companies and help them attract foreign and local investment.<sup>16</sup>

### ***Strategic priorities of current innovation policy***

The current innovation policy strategy builds on the various laws, strategies and action plans approved and implemented over the past decade. The Concept Paper on the Initial Strategy for Formation of the Innovation Economy focuses on the establishment of a national innovation system, with a vision of “Armenia as an R&D centre for supranational corporations”. It specifies various strategic horizons to 2020, each accompanied by priority areas, and concrete goals and measures. In the short term (to 2014), measures include further legal reforms, setting up and operating innovation support infrastructures (financial and physical), developing business capacities and support mechanisms for the business sector, modernizing the education system, and measures aiming to increase company formations (start-ups). In the medium term (to 2017), priorities include introducing international standards to business and engineering education, development of systemic national science and technology establishments, development of new innovative companies and modernization of existing companies. Longer term objectives (to 2020) include developing an internationally recognized engineering university and national science laboratories. In addition, Armenia is pursuing the objective of being among the leading countries implementing R&D activities by 2020, like Israel, Singapore and Ireland, and promoting the globalization of Armenian technology companies.

### ***Foresight***

Certain industries and technologies have been identified for preferential funding and support, e.g. ICT, biotechnology and medical technology. However, this identification and prioritization is not the result of a systematic foresight exercise with the establishment and implementation of technological roadmaps and scenarios. There is a lack of “strategic

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<sup>14</sup> EIF State of Industry Report 2012.

<sup>15</sup> See also INNO-Policy TrendChart Report on Armenia (2007), European Commission, Brussels.

<sup>16</sup> EIF State of Industry Report 2012.

intelligence” at policy and operational levels in the form of foresight and scenario exercises, technological road mapping, application of SWOT analyses, external evaluations, etc.

### 3.3 Innovation programmes and instruments

The Armenian innovation system is characterized by a wide range of intermediary and policymaking (semi-)public authorities (Chapter 2). Accordingly, various innovation support programmes, initiatives and infrastructure measures have been designed and implemented. Innovation policy is cross-cutting, involving many ministries, public authorities and agencies. The key policy fields explicitly or implicitly shaping the innovation system or supporting innovation are innovation/science policy and industrial/economic policy. A few private initiatives have also been launched, e.g. Technology Transfer Association, Viasphere Technopark and IT Park in Yerevan. Table 7, focusing on innovation/science policy in the narrower sense, gives an overview of the different organizations responsible for innovation/science policy, their main instruments and characteristics.

**Table 7. Main actors and instruments in innovation/science policy**

<b>Organization</b>	<b>Instruments</b>	<b>Major characteristics</b>
Enterprise Incubator Foundation (EIF)	Advisory services to companies, Government, intermediaries (e.g. financial institutions). Business services, training and coaching. Facilities and infrastructures for start-ups and existing companies (e.g. Gyumri Information Technologies Center (GITC)). Entrepreneurship and start-up support (STEP). E-government and e-society. Information provision, studies, public relations and branding activities. Armenian-Indian Centre; Representative Office in Silicon Valley. Cooperation projects with international ICT companies and donors (R&D, skills, training, engineering capabilities and curricula, etc.) Matching grants, mini-grants, early stage venture funds (foreseen with World Bank).	ICT focus, but open to all high-tech and innovative companies. Programme publicity via media, website, events and EIF network. Contests and competitions as incentives and selection instruments. Admission process for students in GITC. Workshops and congresses. Co-financing schemes: 50:50 Public and private funding, operated as a profit-oriented fund.
State Committee of Science	Targeted programme and thematic funding: support to applied research in science institutes and commercialization (“science-push”). Basic funding at different levels of institutes.	Special calls for science-business cooperation (R&D commercialization), grants, co-funding principle. Shift from basic funding to competitive mechanisms and applied orientation.
Ministry of Economy	Establishment of R&D Centres (“system-forming”): Armenian Centre of Excellence in Oncology. National Centre of Innovation and Entrepreneurship.	“Big science” initiatives with an expected regional (and innovation related) impact. Platforms to disseminate information and develop linkages between partners.

**Table 7. Main actors and instruments in innovation/science policy (continued)**

<b>Organization</b>	<b>Instruments</b>	<b>Major characteristics</b>
National Academy of Sciences	Science Development Foundation under NAS. Innovative research projects collected and submitted to Government. Plans to create technology transfer office to foster commercialization and technology transfer. Cooperation with national innovation support structures.	Initiatives planned, implementation pending. Collection of innovative projects started, but no systematic process.
Technoparks and Innovation Centres	Infrastructure, incubators, R&D and training, cooperation with local universities. Services: funding: equity and funds, space, management consultancy, marketing services.	GITC. Vanadzor Technology Centre. IT Business Park (private). Viasphere Technopark (private).

***ICT and beyond: EIF policy instruments***

Enterprise Incubator Foundation, established in 2002 within the World Bank's "Enterprise Incubator" project, is a key implementer of innovation policy. EIF was originally founded by the Government and World Bank to support ICT sector development, and EIF is now the largest ICT development initiative in Armenia, with a mandate that has grown significantly over time. Supporting the ICT sector remains its main objective, but many support schemes are also open to other innovative and high-tech companies. EIF is a "one-stop agency" for the ICT sector, dealing with aspects like legal, business and educational reform, investment promotion and start-up funding, services and consultancy for ICT companies, talent identification and workforce development. The three main instruments or services are: business development services (targeted support for local ICT start-ups, e.g. identifying business ideas, access to finance, and for branches of international ICT companies), workforce development (training, internships, seminars, competitions), advisory services (consultancy services on strategy development, technology, operations and management, marketing and sales, legal advisory, financial advisory), and facility services (facilities, support services and communications infrastructure). The main target groups of the EIF are existing technology/innovative companies (Armenian and foreign) and start-up companies. The overall strategy targets all stages of company development, from inception, through development, to growth and maturity. Other targets include Government, international financial institutions, investment agencies and other ICT-related entities. At a national level, EIF is also active in improving the ICT business and legal environment, promoting e-governance systems and development of an e-society.

The EIF has also implemented various projects with international companies like Microsoft, Cisco Systems, Sun Microsystems, Hewlett Packard and Intel. These include the Microsoft Innovation Center, which offers training, resources and infrastructure and access to a worldwide expert community. Meanwhile, the Science & Technology Entrepreneurship Program (STEP) helps technical specialists bring innovative products to market and create new ventures, and encourages partnerships with established companies. Specifically, EIF organizes the Business Partnership Grant Competition and Venture Conference annually (five

winning teams in 2013 received grants of either \$7,500 or \$15,000 for their respective projects), as well as Technology Entrepreneurship Workshops with awards for promising business ideas. Other projects initiated by EIF include:

- Computers For All;
- Classmate PC and Teacher PC;
- Sun Microsystems Development and Testing Laboratory;
- Microsoft Innovation Center;
- Armenian-Indian Center for Excellence in ICT;
- Cisco Systems Network Academy;
- Regional Mobile Applications Laboratory (mLab); and
- US-Armenian Representative Office in Silicon Valley.

In addition to the instruments already implemented by EIF, a few more measures are currently foreseen, mainly with regard to improved financing conditions for the ICT sector, with World Bank support: matching grants and mini-grants (co-financing scheme), and establishment of an early stage venture fund (public-private financing).

EIF already offers a range of support schemes and infrastructures for ICT entrepreneurs and existing companies. It has established good relations with foreign ICT companies, which are important partners for many pilot projects. Donors like the World Bank, USAID, US Civilian Research & Development Foundation (CRDF) and others make a clear contribution – financially and technically – to certain instruments. EIF has established working relations with the Armenian ICT business sector and major science institutions that are potential incubator organizations for start-up companies, alongside competitions to motivate entrepreneurs to apply for funding and help select the best ideas. EIF's mission is potentially open to all sectors, but the focus of its activities is clearly on ICT.

Due to EIF's significant experience with business-oriented innovation support schemes, there is clear potential for expansion to other industries. EIF could be the implementing organization for a large, self-standing and visible programme to support R&D and innovation across sectors (indirect-specific funding principle). Germany implemented such a programme six years ago, aiming to establish a "brand name" in innovation policy (Box 1)

#### **Box 1. The central innovation programme for SMEs (ZIM) in Germany**

The Central Innovation Programme SME (Zentrales Innovationsprogramm Mittelstand – ZIM) is the largest and most visible federal programme of public support to SME innovation in Germany. It aims to increase the capacity and competitiveness of SMEs and their contribution to growth and job creation. ZIM was designed and is implemented by the German Federal Ministry of Economics and Energy (BMWi). The rationale is to implement a central innovation support programme over a long timescale and to address the fragmentation of support schemes with possible redundancies and different responsible authorities. Submission of funding applications can take place on a continuous basis.

ZIM's targets SMEs with business operations in Germany looking to develop new or significantly improve existing products, processes or technical services.

**Box 1. The central innovation programme for SMEs (ZIM) in Germany (continued)**

Public and private non-profit research and technology organizations (RTO) are also eligible, in the capacity of an SME's cooperation partner. ZIM is open to all branches and technological sectors, and has been a reliable source of innovation support since 2008.

Funding is directed towards individual projects (R&D projects within one SME), cooperation projects (cooperative R&D projects between SMEs or SMEs and RTOs), and cooperation networks (innovative company networks and the R&D projects generated by them). Funding is also provided for services and consultation related to marketing activities (e.g. technology transfer, services, intellectual property rights, etc.), and there are also various possibilities for cooperation with international partners.

With regard to funding, total costs for R&D projects amount to a maximum of €50,000, with the share of public support being 25-45%, depending on company size and its location in West or East Germany. Funding is in the form of a non-refundable grant.

The application procedure has been formalized over time, with standardized application templates and availability of programme consultancy and special information events. Overall, ZIM is an attempt to centralize the federal innovation support schemes under one umbrella with various funding priorities (single, cooperation and networks).

***Thematic and targeted funding: integrating science and innovation policy***

Since the State Committee of Science was founded in 2007, some progress has been made towards integrating science (and technology) policy and innovation. While its statute stipulates that the SCS will function within the Ministry of Education and Science with the main aim to elaborate and implement state science policy, recent activities and instruments clearly focus on aspects including the transfer and commercialization of scientific results into practice, strengthening applied science and innovation supply. Therefore, the SCS's mandate goes further than coordination and implementation of science policy in the narrow sense.

There are currently three programmes implemented by the SCS in relation to applied R&D, commercialization and innovation:

- Basic financing;
- Contractual/thematic funding; and
- Targeted programme.

The contractual/thematic funding had been introduced in the 1990s to help reduce overlap between research teams and projects, stabilize and re-orient the science system, initiate new research trends, and provide effective organizational and financial support to research institutes.<sup>17</sup> Thematic funding was supplemented by the introduction of basic financing in 1998. Since 2002, contractual/thematic funding targets research projects in any field, with

<sup>17</sup> See incrEAST country report: Armenia, IncoNet EECA, 10 January 2012 update.

themes selected by open competition, evaluated by independent experts. Thematic funding is directed via grants to individual researchers and small research groups. The time frame for implementation of each theme is up to two years and the maximum budget for implementation is AMD 6.5 million. In 2013, this funding line's budget amounted to AMD 1,100 million, roughly 10% of the science budget. The share will increase to more than 12% by 2016 (Table 8).

**Table 8. Budgetary framework for the funding of science, 2011-2016, AMD million**

	2011	2012	2013	2014	2015	2016
Basic funding	6,834	6,809	8,349	9,007	9,875	11,219
Share of total science funding	72.4%	70.6%	73.0%	71.1%	70.6%	71.7%
Contractual (thematic) funding	821	933	1,107	1,514	1,797	1,908
Share of total science funding	8.7%	9.7%	9.7%	12.0%	12.8%	12.2%
Targeted (programmatic) funding	1,249	1,374	1,537	1,690	1,859	2,045
Share of total science funding	13.2%	14.2%	13.4%	13.3%	13.3%	13.1%
Bonus payments to scientists with academic degree	530	530	441	452	463	475
Share of total science funding	5.6%	5.5%	3.9%	3.6%	3.3%	3.0%
<b>Total science funding</b>	<b>9,433</b>	<b>9,646</b>	<b>11,433</b>	<b>12,663</b>	<b>13,994</b>	<b>15,647</b>
Share of GDP	0.25%	0.24%	0.25%	0.26%	0.26%	n/a

*Source:* Ministry of Finance; State Committee of Science.

*Note:* Excludes capital expenditure.

Currently accounting for 73% of the total science budget, basic funding is the most significant instrument of SCS. However, basic funding does not mean financing of basic research or institutional funding, but funding of basic and applied research for different groups of institutes. The groups are an attempt to differentiate the research institutes according to their capability (e.g. level 1 institutes: high-performing institutes; level 2: mid-level performance; level 3: institutes needing reorganization). The funding received by each institute will be influenced by the level to which they belong. This also reflects attempts to strengthen competition between institutes: with basic funding insufficient to cover all costs, institutes must increasingly apply for additional funding or reduce their activities. Thus, incentives have been put in place for research institutes to find commercial research partners, and increase applied research activities. A share of basic funding is also dedicated to the modernization and maintenance of scientific infrastructures and the material-technical basis.

The Targeted Programme currently amounts to AMD 1,537 million, or 13.4% of the total science budget. This will increase to AMD 2,045 million by 2016, although the share of the total science budget will not increase. Institutes apply for funding according to a competitive procedure (grants). Funding is directed to scientific programmes and themes elaborated by public agencies ("societal challenges"). Project selection is undertaken by an inter-agency commission. A key objective is to strengthen research commercialization, with private companies often involved, and motivated to approach research institutes or the SCS. Country size and strong informal networking between innovative or research-oriented companies is certainly advantageous to the promotion of this funding programme.

### ***Regional “Big Science” projects***

Government has been implementing so-called “system-forming” regional scientific-technological projects. Key objectives include attaining scientific excellence, strengthening Armenia’s international science networks and the regionalization of scientific-technological activities, in particular innovation-related aspects. The CANDLE – Center for the Advancement of Natural Discoveries using Light Emission – project is currently the most ambitious proposition. The CANDLE seeks to establish a third generation synchrotron light source for fundamental, industrial and applied research in biology, physics, chemistry, medicine, material and environmental sciences. It is supported by international organizations – either financially (e.g. exchanging scientists) or by favourable evaluations by leading expert panels or organizations. The Center for Radiation Medicine and the Armenian Centre of Excellence in Oncology are other projects seeking to build scientific potential.

### ***Innovation support activities of the NAS***

The National Academy of Sciences includes around 35 research institutes and centres, plus subsidiary services to give a total staff of around 3,700. NAS is the highest self-governing research organization carrying out and coordinating basic and applied research. Institutes are eligible for funding from the various support schemes implemented by the SCS. NAS has independently established a set of innovation support activities, including:

- A Science Development Foundation to support: research activities with innovative potential, commercialization of research outcomes and infrastructure modernization;
- Compilation of a set of innovative research projects for submission to Government;
- Plans to establish a technology transfer office to support commercialization and technology transfer; and
- Cooperation with national innovation support structures (e.g. Technology Transfer Association).

The instruments planned by the NAS clearly point in the right direction, but related activities have yet to be (fully) implemented. Given the size and scientific impact of the NAS and its research institutes, full implementation to support innovation in cooperation with the business sector would complement the SCS, EIF and Ministry of Economy programmes.

### ***Regional infrastructure: technoparks and innovation centres***

Technoparks are a means of decentralizing innovation policy through a combination of infrastructure with innovation and start-up support services. Among public initiatives, the most ambitious is the Gyumri Information Technologies Center, founded in 2005 by EIF, the Fund for Armenian Relief and Shirak Technologies LLC. GITC is an ICT focused project, providing training in cooperation with the local university, technical equipment and office space, research laboratories, and incubation services for existing and start-up companies (management and marketing services, financial support: equity and grants). By 2013, five start-ups had been founded in GITC, and four ICT companies had opened branches there. Work on the Vanadzor Technological Center (Lori region) began in 2013. Like GITC, it is intended to boost the region’s economic development, and act as a regional technological hub.

Complementing these public infrastructure projects, a few private initiatives have been launched to help provide favourable framework conditions for the ICT industry. The Viasphere Technopark is a commercial technology park in Yerevan providing infrastructure to local start-ups and international ICT companies. The IT Business Park as another private Technopark offering services to young and newly-founded ICT companies.

### ***Innovation support mechanisms: industrial and economic policy***

There are also innovation and system-forming activities under industrial and economic policy (Table 9). ADA is the main agency for FDI promotion and implementation of the Strategy of Export-led Industrial Policy. There is no specific target industry, but innovative and high-tech sectors are somewhat prioritized. ADA offers a range of services to foreign investors and export-oriented companies. An Industrial Development Fund was recently established. SME DNC is the implementing agency for SME and start-up support.

**Table 9. Innovation actors and instruments in industrial and economic policy**

<b>Organization</b>	<b>Instruments</b>	<b>Characteristics</b>
Armenian Development Agency (ADA)	FDI promotion, export development and Industrial Development Fund (recently launched). <i>No specific innovation support instrument, but high-tech sector quite important for ADA.</i>	Market intelligence, road shows, promotional campaigns, trade facilitation, site visits, business partnerships, company registration and staff recruitment support, Government liaison.
Small and Medium Entrepreneurship Development (SME DNC)	Start-up and SME support: Guarantees, micro-franchizing and micro-financing. <i>No specific innovation or high-tech focus, but business ideas often innovative.</i>	Training and coaching: business plans, entrepreneurship culture, matching activities, internationalization, financial support for start-ups (micro-financing, soft loans, guarantees).
Free Economic Zones (FEZ)	FDI promotion, new and advanced technologies, export promotion, employment creation and economic growth. <i>ICT and high-tech sectors quite important, but no innovation focus.</i>	First FEZ opened July 2013. FEZ activities depend on the concrete project: R&D and innovation related projects, industrial clusters, broader economic activities sense (e.g. Zvartnots Airport City).
National Competitiveness Foundation	Focus on healthcare, tourism, and education. <i>Innovation support not primary objective.</i>	Public private partnerships, linking national capacity of Armenia and Diaspora.

FEZs are another instrument to support innovation in a general sense. Aims include FDI promotion, development of new and advanced technologies, export promotion, employment creation and economic growth. Armenia's first FEZ opened in July 2013, centred on the Yerevan Computer Research and Development Institute (YCRDI) and the Mars manufacturing company. This FEZ is an example of a combined approach of supporting inward investment, export orientation and high-tech development. A special technological focus of FEZ Mars and YCRDI is on R&D and innovation in the fields of electronics,

precision engineering, pharmaceuticals and biotechnology, ICT, alternative energy, industrial design, and telecommunications. “One-stop-shop” services are offered to all zone residents who enjoy tax benefits, including exemption from import and export duties, profit tax, property tax, etc. However, with the FEZ a relatively new approach in Armenia, no evaluation of economic effects at the regional or country level can currently be made.

### **3.4 Assessment of innovation strategy and programmes**

There has been clear progress on implementation of research and technology initiatives during the past decade. However, major structural and institutional challenges remain in terms of Armenia’s overall economic and labour market performance. There are few measurable impacts and results of innovation-related policies – partly due to a lack of statistical data, and partly due to the relatively limited public funding for innovation support activities. Armenia’s achievements, including pockets of excellence in research and a dynamic ICT sector, are partly overshadowed by a relatively low level of business competitiveness, and significant employment and labour market issues.

The authorities have recognized the importance of innovation and innovation policy for the medium- to long-term competitiveness of the country. Several policy documents and strategies show quite a realistic assessment of the country’s scientific-technological potential, but also of its structural and institutional weaknesses.

Armenia’s innovation policy is based largely on a “science-push” approach. Many funding or support schemes seek to strengthen the application or commercialization of scientific activities. Financial incentives, the implementation of competitive funding procedure and the involvement of business enterprises are relatively new features of Armenia’s funding architecture. In this regard, EIF and its specific instruments can be viewed as an example of “good practice” within the existing institutional framework. The EIF, which includes a number of different supporting schemes and services, strong linkages to the business community and several successfully implemented projects with donors and international ICT companies, clearly has the potential to transfer its knowledge on the implementation of national innovation policies to other (high-tech) sectors, beyond its traditional ICT focus.

Despite notable achievements, the overall innovation strategy, framework and instruments leave room for improvement. As discussed in Chapter 2, there is some fragmentation of the public support system with many organizations and agencies. While this may facilitate specialization and policy experimentation, it also poses significant challenges for coordination mechanisms.

Innovation policy and innovation support as a cross-cutting policy field is the responsibility of different funding organizations and instruments. Responsibilities should be clear, transparent and comprehensible to companies or research institutes applying for funding. The EIF embodies the notion of a “one-stop-shop”, with target groups being both start-ups and existing companies. The “science-push” perspective is currently reflected by the State Committee of Science, and also partly by the National Academy of Sciences. With the exception of the ICT sector, an overall strategy is currently lacking for the commercialization of scientific results, taking account of the “absorption capacity” of the business sector.

A largely supply-oriented innovation policy approach based on scientific results neglects the need to strengthen business sector capacity to engage in research activities and innovation, (the ICT sector is again an exception). As international experience shows, strengthening the applied orientation of public research should not be confused with innovation policy. An optimal, balanced strategy should include both supply- and demand-side approaches with an innovation-friendly environment, an entrepreneurial culture, and business-friendly framework conditions.

### **3.5 Recommendations**

There has been significant progress in recent years in developing a legal framework for science and innovation and creating a number of supporting institutions. However, the impact of public initiatives is limited by the lack of an innovation culture in large parts of the business community, the scientific and educational sectors and public administration.

#### Recommendation 3.1

*The public authorities should explore ways to increase general awareness of the importance of innovation. Possible activities could include:*

- *Promoting successful business concepts and innovative companies as role models in the media and at national/international conferences, including with the support of the Armenian diaspora; and*
- *Developing media campaigns encouraging an entrepreneurial spirit in higher education and research institutions.*

Armenia has developed a number of support initiatives seeking to promote innovation in the private sector. The EIF is an effective initiative, given its relative autonomy and organizational/institutional proximity to the business sector, which is the main target group. However, in practice, its coverage is limited to the ICT sector. The Technology Transfer Association is also a promising exemplar. The impact of public support is limited by low demand for innovation.

#### Recommendation 3.2

*The authorities should strengthen efforts to increase innovation activities in the private sector, building on existing initiatives. The following actions could be considered:*

- *Enhancing the role of the EIF as an autonomous and policy-oriented “one-stop” innovation support agency with a mandate that extends effectively beyond ICT;*
- *Introducing a large, self-standing and visible programme to support R&D and innovation in the SME sector. The programme should have a fixed annual budget and not impose specific thematic priorities. It should be administered under clear and understandable guidelines, application procedures and selection criteria;*
- *Strengthening participatory elements in the design of innovation policies with private sector involvement;*
- *Appropriate regulations and standards, e.g. energy efficiency, may also encourage innovation*

- *Strengthening the innovation capacity of the business sector through training on innovation management, R&D support, marketing and internationalization; and*
- *Drawing lessons from the work of successful private initiatives like the Technology Transfer Association with a view to using this experience in other areas, such as low-tech innovations or non-technological innovations.*

There have been significant changes in the institutional structure and funding mechanisms of public R&D in an effort to encourage commercialization. Further reforms would facilitate the commercial orientation of research and its transformation into innovation.

### Recommendation 3.3

*The authorities should continue ongoing efforts to strengthen applied R&D and commercialization activities in public research institutes, including through:*

- *Increasing the competitive elements in the funding provided to institutes developing technologies with commercialization potential; and*
- *Strengthening the role of the National Academy of Sciences in innovation, distinguishing between its two main missions: basic research and applied research, with increased amounts of funding coming from contract research for companies.*

In order to improve policy design and implementation, it is essential to monitor and assess the impact of policies. In Armenia, the poor statistical base and a limited evaluation culture make it difficult to obtain a clear picture of technological capabilities and this poses clear challenges for evidence-based policy making.

### Recommendation 3.4

*The authorities should devote efforts to improving the statistical system and introducing robust policy evaluation methods, so that decisions can be grounded on a solid empirical base. The following directions could be considered:*

- *Aiming to adopt international standards regarding R&D and innovation statistics;*
- *Implementing an ongoing monitoring and evaluation system, at least for the most important innovation support schemes. This should be transparent, coherent and comprehensible and track the impact on participating companies. There should be feedback from this evaluation to policy design and implementation. As a result, weak programmes should be modified or discontinued; and*
- *Developing “strategic intelligence” using foresight and scenario exercises, technological road mapping and external evaluations.*



## Chapter 4

### **KNOWLEDGE GENERATION AND ABSORPTION**

This chapter presents first an overview of the challenges for technological and industrial upgrading in Armenia. Based on this conceptual framework, the chapter analyses the main features of technology accumulation and knowledge generation and diffusion in the country. Finally, it provides an assessment of the current situation, and makes a number of policy recommendations.

#### **4.1 Technological and industrial upgrading**

Armenian enterprises generally operate behind the technology frontier, i.e. they do not use the most advanced available technology. Its enterprises are in transition from competing on the basis of low wages, reflecting low productivity levels, towards more efficient production processes that will enhance product quality and wages. This shift requires access to foreign markets, efficient goods markets, availability of financing and well-functioning labour markets, as well as better education and training and a developed innovation infrastructure.

Over the medium term, Armenian firms will continue to compete on the basis of efficient use of existing foreign technologies, in line with other countries in Central and Eastern Europe and the CIS.<sup>18</sup> However, in many countries with economies in transition, including Armenia, there can be an excessive focus on R&D driven growth. This reflects the prevailing view in developed economies, which considers R&D as the main driver of innovation. This policy model may be appropriate for countries that are technology leaders or operating close to the technology frontier, but is not necessary appropriate for technological upgrading in catch-up economies like Armenia.<sup>19</sup>

A mainstream policy model for technological upgrading focuses on direct commercialization of the results of public or private R&D through new technology-based firms (NTBFs). NTBFs are considered drivers of innovation and sources of new growth and employment. However, evidence from the UK, US, Finland and Korea shows that high-growth firms are found in a wide range of sectors and across all regions,<sup>20</sup> and that there is no link between high technology sectors and high-growth firms.<sup>21</sup>

NTBFs are a particular subset of SMEs that are more innovative in developing or using new technologies and younger than a “typical” firm, according to the widely used OECD definition. Many governments of OECD countries have provided preferential support to

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<sup>18</sup> V. Kravtsova and S. Radosevic, Are systems of innovation in Eastern Europe efficient?, *Economic Systems*, Volume 36, Issue 1, March 2012, pp.109–126.

<sup>19</sup> S. Radosevic and A. Kaderabkova (eds.) (2011) *Challenges of European Innovation Policy: Cohesion and Excellence from a Schumpeterian Perspective*, Edward Elgar, Cheltenham.

<sup>20</sup> BERR (Department for Business Enterprise and Regulatory Reform) (2008), *High growth firms in the UK: Lessons from an analysis of comparative UK performance*, BERR Economics Paper No. 3, November, London

<sup>21</sup> M. Henrekson and D. Johansson (2010) “Gazelles as job creators: a survey and interpretation of the evidence”, *Small Business Economics*, 35: pp.227–244

NTBFs over large firms, believing NTBFs help commercialize new knowledge, bring about structural change in product markets and contribute to increasing the skill level and mobility of labour.<sup>22</sup> However, disappointment regarding the role of NTBFs in driving such improvements has emerged in a number of countries in recent years.<sup>23</sup> A new view is that it is not large firms or NTBFs per se that drive innovation, but rather an innovation ecosystem, i.e. large firms interacting with small technology-based firms that innovate based on large firms' stable technology platforms.<sup>24</sup>

For a country like Armenia, the main policy focus should not be on R&D exclusively, but broader technological and industrial upgrading. Industrial upgrading in this context is defined as "a process of improving the ability of a firm or an economy to move to more profitable and/or technologically sophisticated capital and skill intensive economic niches".<sup>25</sup> Industrial and technological upgrading during economic catch-up is largely about increased use of knowledge inputs in manufacturing and services rather than narrowly defined R&D. A good indicator of the use of knowledge inputs in manufacturing is the share of service inputs in manufacturing. In general, all EU new member States have a low share of service inputs in manufacturing, across all industries.

Technological upgrading is never based on R&D alone but requires increased absorption capacity and improved skills in the labour force. Policymakers should explore which dimensions of tertiary education, vocational education and lifelong learning are considered as bottlenecks to innovativeness and industrial upgrading, and allocate resources accordingly.

Such an approach has important policy implications. Policy cannot be confined to structural reform and support to innovation through R&D and NTBFs. It also requires the integration of FDI and value chain development into innovation policy. While the long-term focus should be on increasing local R&D, this should be in association with imported and indirect domestic R&D, embodied in the purchase of capital goods and intermediate inputs. This process of industrial and technological upgrading has strong industry specific dimensions.

The challenge is to ensure that governance and structural reforms are inextricably linked to the potential drivers of growth. In this respect, there is no trade-off between the needs for technological upgrading and structural reform. Potential areas of medium- and long-term growth should coincide with the focus areas for governance reform. Governance reforms should include not only the removal of general obstacles to doing business but, perhaps more importantly, tackling the very sector specific barriers that are often most significant. A lesson from transition to a market economy is that strong institutions together with market-enhancing governance reforms (property rights; rule of law and effective contract enforcement; minimizing rent seeking and corruption; and transparent and accountable provision of public goods) are indispensable, but are not sufficient to ensure growth without technological upgrading.

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<sup>22</sup> OECD (1998), *The OECD Jobs Strategy: Technology, Productivity and Job Creation Best Policy Practices*, Paris, p.219.

<sup>23</sup> A. Coad and A. Reid (2012), *The role of Technology and Technology-based Firms in Economic Development: Rethinking Innovation and Enterprise Policy in Scotland*, Technopolis group, Brussels.

<sup>24</sup> M. Mandell (2011), *Scale and Innovation in Today's Economy*, Progressive Policy Institute.

<sup>25</sup> G. Gereffi (1999), *International Trade and Industrial Upgrading in the Apparel Commodity Chain*, *Journal of International Economics* 48: pp.37-70.

The necessary reforms are horizontal, systemic improvements requiring administrative capacity and political consensus that may not be easy to find. An alternative way to think about policies for growth in Armenia is to improve governance capabilities in potential areas of growth like ICT, pharmaceuticals or precision engineering. The aim is to remove sector specific institutional obstacles to growth but without creating new distortions. This would require improving training and investment in human capital in specific areas, as well as designing investment promotion packages (technology, sector or area specific) without giving unfair advantages to foreign over domestic investors.

The challenge for Armenian policymakers is to find a balance between structural reform and technology specific innovation policy programmes. Structural reform and innovation policy measures should be implemented in a complementary fashion.

#### 4.2 R&D, innovation and technology diffusion

Innovation infrastructure is among the least competitive dimension of Armenia's overall competitiveness performance. According to the World Economic Forum's Global Competitiveness Report 2013, Armenia ranks outside the top 100 of 148 economies in terms of quality of research institutes (106), company spending on R&D (109), university-industry collaboration in R&D (107) and Government procurement of advanced technology products (111). However, the private sector performs relatively well in technological and organizational terms, with Armenian firms scoring amongst the highest in the region across a range of indicators, with the exception of corporate governance, as indicated by the use of external auditors to review annual financial statements (Table 10).

**Table 10. Technological and organizational capabilities of firms**

	Internationally recognized quality certification	Technology licensed from foreign companies	Own website	Using e-mail to interact with clients/suppliers	Annual financial statement reviewed by external auditors
Eastern Europe & Central Asia	19.9%	20.3%	49.0%	73.2%	36.9%
Armenia (2009)	26.9%	40.3%	62.8%	81.1%	19.1%
Azerbaijan (2009)	18.2%	23.8%	21.7%	40.3%	37.3%
Belarus (2013)	12.8%	6.8%	62.4%	85.6%	38.9%
Georgia (2008)	16.0%	17.3%	30.7%	40.5%	47.5%
Russia (2012)	12.6%	11.1%	64.6%	95.1%	23.2%
Ukraine (2008)	13.0%	26.8%	35.7%	64.0%	27.3%

*Source:* EBRD, Business Environment and Enterprise Performance Survey.

*Note:* Figures denote percentage of firms with the respective technological or organizational capability.

The share of innovative companies is also higher in Armenia than in Georgia and most other countries in a sample of eight Central European countries, Turkey and Russia<sup>26, 27</sup>. However,

<sup>26</sup> S. Kuriakose (ed.) (2013), Fostering Entrepreneurship in Armenia, IBRD/World Bank, Washington.

in the National Competitiveness Report of Armenia 2011-2012, Armenia ranked bottom of 21 countries in management practices, although this among a sample of mainly developed economies, without Central and Eastern European or CIS benchmarks.<sup>28</sup>

ISO 9001 quality certificates represent generic management standards that indicate the presence of quality assurance systems in the manufacturing and service sectors, and as such are a good proxy for the capacity of firms to integrate into global value chains (GVCs). Armenian firms hold low numbers of such certificates in comparison to regional peers (Table 11). In line with comparator countries, certificate numbers have actually fallen since the 2008 global financial crisis, indicating difficulties for firms to internationalize.

**Table 11. Number of ISO 9001 certificates, 1999-2011**

	1999	2001	2003	2005	2007	2009	2010	2011
Armenia	4	3	16	55	79	78	61	35
Azerbaijan	1	1	2	213	55	148	103	122
Georgia	2	7	7	24	88	114	72	77
Belarus	26	78	102	658	1308	2014	151	171
Russia	541	1,517	962	4,883	11,527	53,152	62,265	12,663
Ukraine	82	66,760	308	1,375	2,150	3,252	2,592	1,207

*Source:* ISO Database

Unlike its regional peers, the number of trademark applications in Armenia has declined since 2004, to around 1,000 in 2011 (Figure 5). With trademarks indicating a certain degree of product differentiation, this suggests challenges in moving towards quality- as opposed to price-based competition. Internationalization and technological upgrading are hindered by the fact that, with the exception of the diamond and software sectors, Armenia is currently outside labour-intensive GVCs, in particular producer-driven and technology-intensive GVCs.<sup>29</sup> While there are geographical and geopolitical barriers, the major issue is weak drivers of growth, including a small local market with weak purchasing power.

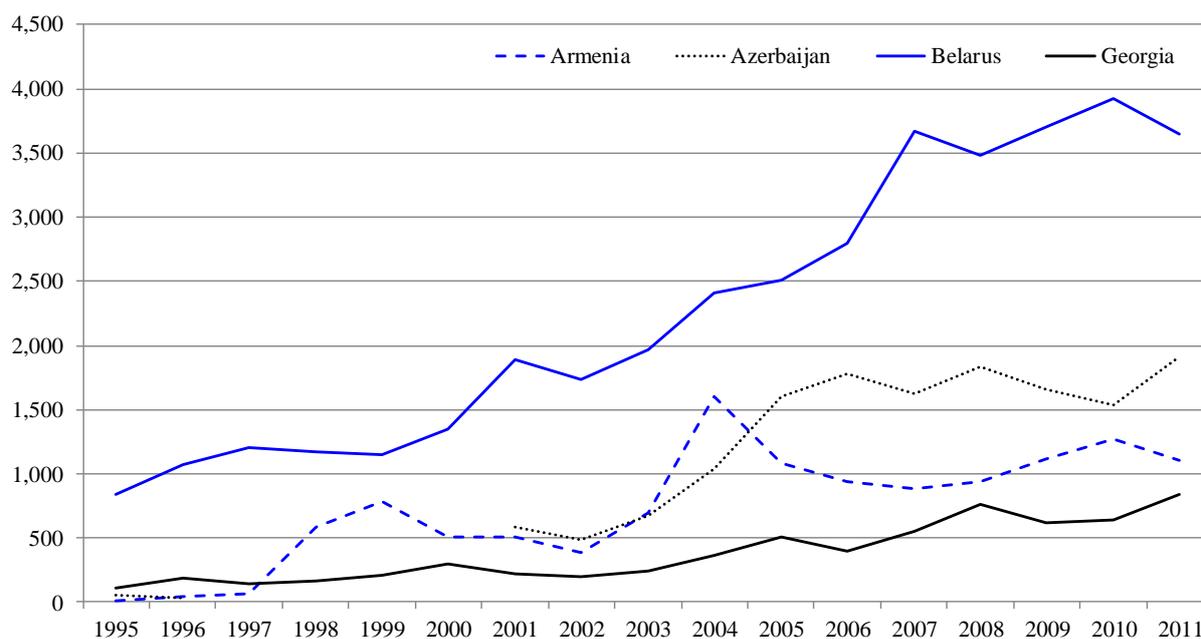
This contributes to low annual FDI flows of around \$0.5 billion.<sup>30</sup> Despite these barriers, external trade has increased. The ICT industry is a promising source of export revenues and provides knowledge services in the domestic economy. Exports in 2012 were \$119.6 million, of which \$99.3 million from foreign branches. Export growth is largely FDI driven.

<sup>27</sup> Although sampling technique and large share of IT companies may over represent innovative companies.

<sup>28</sup> Economy and Values Research Center, EV Consulting CJSC (2012), National Competitiveness Report of Armenia 2011/2012.

<sup>29</sup> World Bank (2005), From Disintegration to Reintegration: Eastern Europe and the Former Soviet Union in International Trade, Edited by H. G. Broadman, International Bank for Reconstruction and Development / The World Bank.

<sup>30</sup> UNCTAD, World Investment Report 2013, Geneva.

**Figure 5. Trademark applications by residents, 1995-2011**

Source: World Bank Development Indicators database 22 November 2013

### ***Demand and supply for R&D***

Indicator from the Global Competitiveness Report can be used to proxy for (mis-)matches in supply and demand for R&D and innovation (Tables 12 and 13). Demand in Armenia, Azerbaijan and Georgia is on average higher than supply and hence these economies are experiencing “supply deficit” in terms of R&D, and their enterprises would benefit from enhanced R&D and innovation support. Russia and Ukraine seem to have R&D on offer that is more aligned to the immediate needs of their business sectors. On the R&D supply side, capacity to retain talent is a challenge for all countries. The quality of the Armenian educational system is, however, a key strength. In Armenia, the business sector requires further development and an adequately restructured R&D sector. This is reflected by particular weakness in company spending on R&D among the demand side factors, as well as weaknesses in staff training and buyer sophistication.

**Table 12. Supply side factors of R&D**

	Quality of maths and science education	Quality of educational system	Availability of scientists and engineers	Availability of research and training services	Quality of scientific research institutions	Capacity to retain talent	Average supply
Armenia	4.2	3.7	4.0	3.5	3.1	2.6	3.5
Azerbaijan	3.3	3.1	4.4	4.2	3.6	3.5	3.7
Georgia	3.4	3.2	3.2	3.3	2.8	3.1	3.2
Russia	4.3	3.5	3.8	4.1	3.7	2.8	3.7
Ukraine	4.8	3.6	4.5	3.9	3.6	2.0	3.7

Source: Based on GCR 2013-2014. Higher numbers indicate more favourable rankings.

**Table 13. Demand side factors of R&D**

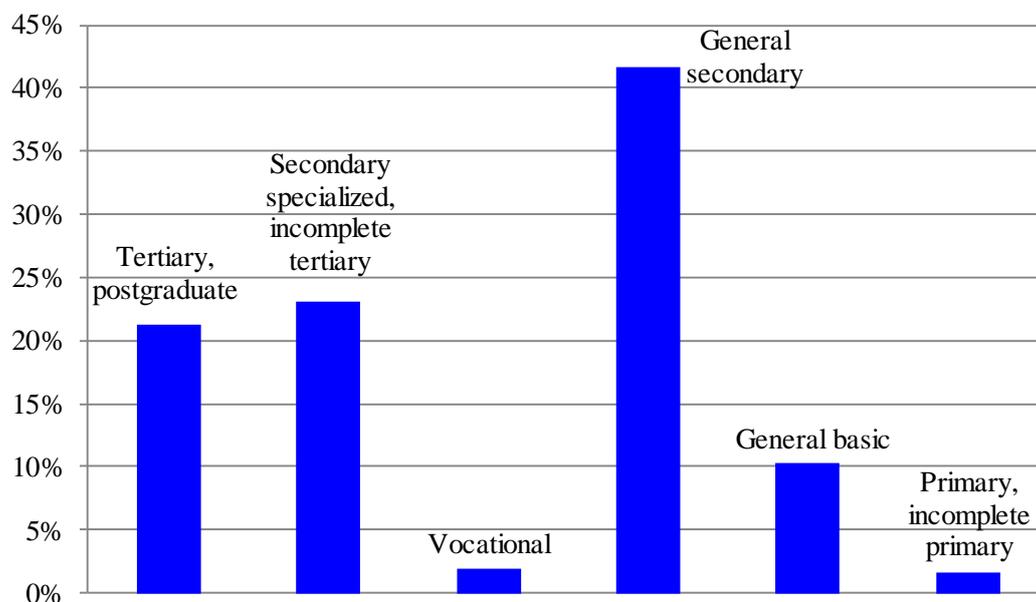
	Degree of customer orientation	Firm-level technology absorption	Extent of staff training	Buyer sophistication	FDI and technology transfer	Company spending on R&D	Average demand
Armenia	4.6	4.4	3.6	3.5	4.9	2.8	4.0
Azerbaijan	4.7	4.9	3.9	4.1	4.7	3.3	4.3
Georgia	3.8	4.1	3.6	3.2	4.1	2.5	3.6
Russia	4.1	3.9	3.8	3.6	3.7	3.1	3.7
Ukraine	4.5	4.3	3.7	3.3	3.6	2.7	3.7

*Source:* Based on WEF GCR 2013-2014. Higher numbers indicate more favourable rankings.

### ***Education***

Technological upgrading does not depend on firms alone, which operate on the basis of both their own knowledge and external inputs – primarily an educated labour force and external knowledge, including R&D. The level of skills in Armenia has been a longstanding advantage, but is highlighted by investors with increasing frequency as a constraint to growth. Public policy action is needed in this area, in order to match the initiative that has been taken by some foreign investors. The quality of the educational system is critical, and in particular drives the availability of scientists and engineers.

21% of the labour force is university educated (Figure 6), with most workers having a general (42%) or specialized secondary education (23%). This skills structure must be upgraded to facilitate Armenia's shift towards knowledge-based economic development.

**Figure 6. Labour force by level of education, 2011, per cent**

*Source:* National Statistical Office of Armenia

The number of students increased faster than the number of lecturers over the period 2000-2012, leading to an increase in the number of students per lecturer from 5.2 to 7.7, although

there has been some improvement in this ratio since it peaked at 9.4 in 2008 (Table 14). Of 37 private and 26 public universities, only seven conduct research. Private universities are largely in non-STEM subjects, and focused on teaching as opposed to research.<sup>31</sup> Foreign students represent only around 3% of the total, indicating limited internationalization of the Armenian higher education system, with the exception of medical education which receives around 500-600 students annually from abroad.

Armenian higher education is in need of modernization, so as to become a driver of growth. Some large foreign investors in ICT are cooperating with universities to overcome skills deficiencies, and should be taken as examples of good practice to be shared. Cooperation with research institutes should be expanded, including joint MSc and PhD degrees.

**Table 14. Indicators of higher vocational education, 2000-2012**

	2000	2002	2004	2006	2008	2010	2012
<b>Number of students</b>	60,726	72,283	85,109	105,830	114,399	111,003	90,145
<b>Number of professorial staff</b>	11,643	11,787	12,459	12,521	12,169	12,681	11,767
<b>Students per lecturer</b>	5.2	6.1	6.8	8.5	9.4	8.8	7.7

*Source:* National Statistical Office of Armenia

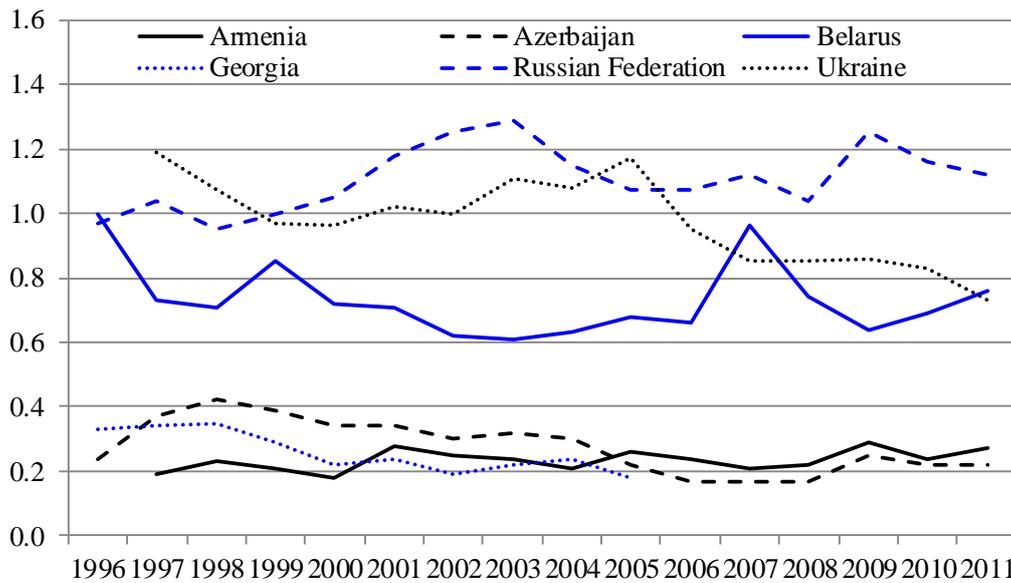
### *Armenia's R&D sector*

Armenia formerly had a large R&D sector serving the whole of the USSR and representing more than 2.5% of GDP, and was often labelled a “scientific hub”. However, break-up of the Soviet Union led to radical downsizing of the R&D system, restricted to serving domestic needs. The R&D system has since operated largely in “survival mode”, its shrinkage accompanied by loss of personnel and a marginalization of R&D. Despite economic growth since the mid-1990s, R&D expenditures remained low, at around 0.2% of GDP (Figure 7). This probably underestimates business enterprise R&D, although the overall amount, including fully business R&D, would not be much greater.<sup>32</sup> R&D could help drive future economic growth, but requires substantial investment and stronger policies to support technological upgrading in the business sector, covering both supply and demand aspects.

In both the CIS and Central and Eastern Europe, recent growth has been based largely on production as opposed to technological capability. This means that increases in productivity came through product quality improvements as a result of the introduction of widely available and imported technologies, with new knowledge playing a relatively minor role. However, sustaining long-term growth will require greater investment in R&D. The aim of such investments should be not only to generate new technology-based firms, but also to increase the absorption capacities of local firms to acquire and adopt foreign technologies.

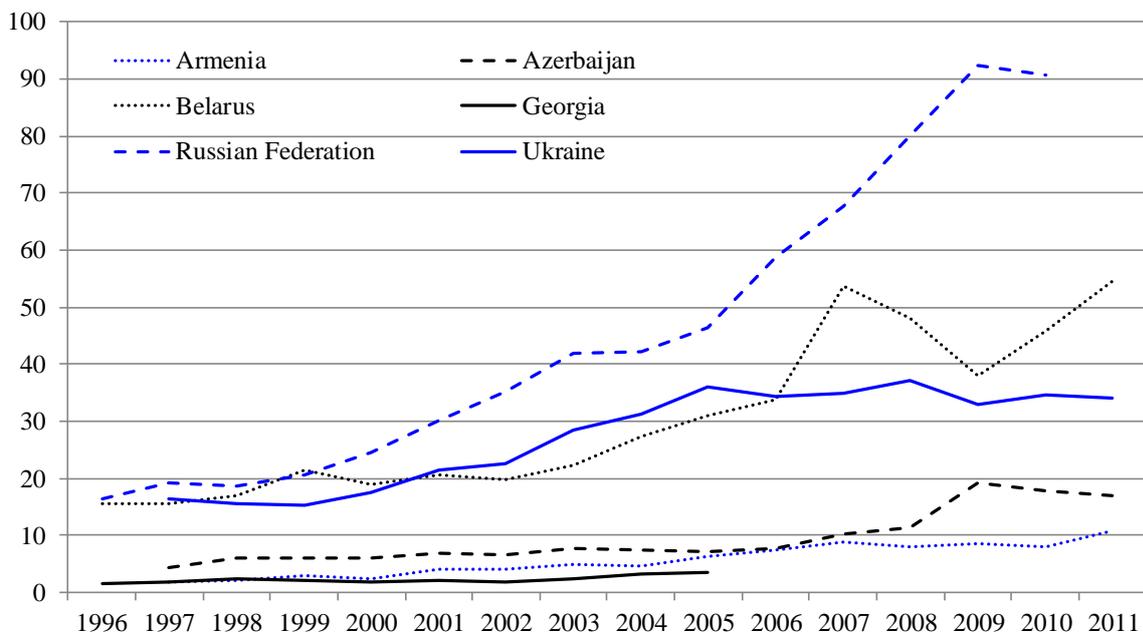
<sup>31</sup> STEM – Science, Technology, Engineering and Mathematics.

<sup>32</sup> Five business organizations with R&D expenditures can be identified from the list of individual organizations used by the National Statistical Office to record R&D expenditures.

**Figure 7. Gross expenditures on R&D, per cent of GDP, 1996-2011**

Source: UNESCO Database

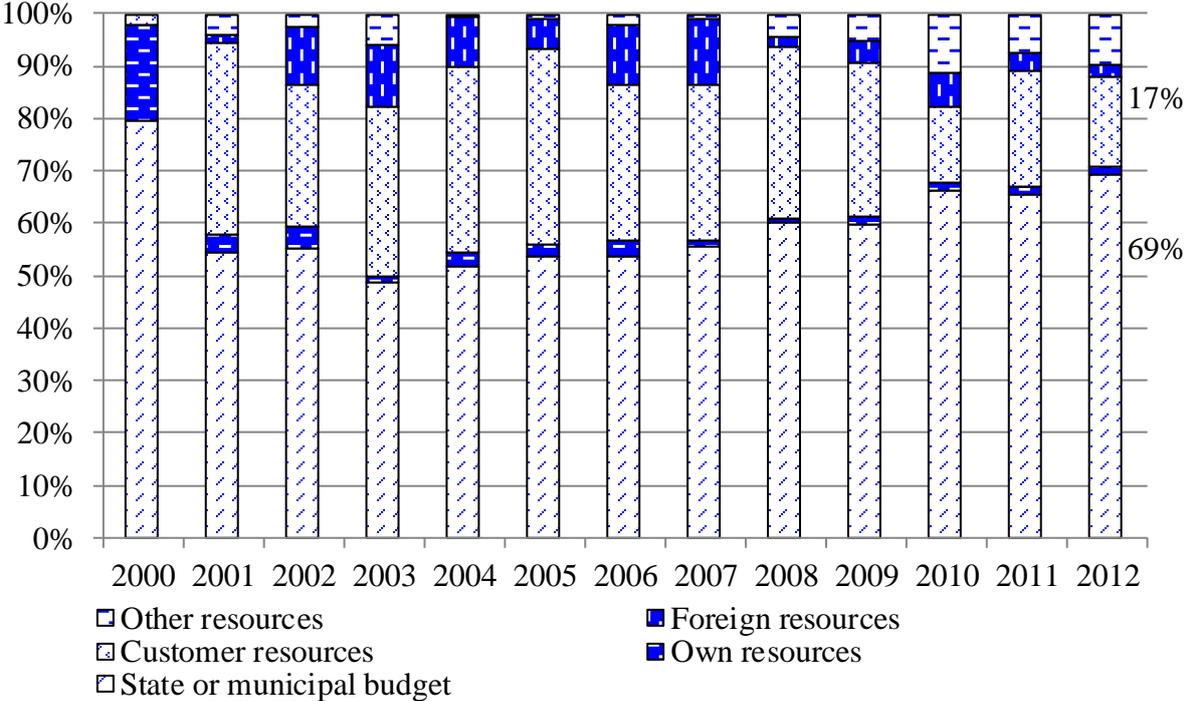
Current low levels of R&D expenditure risk slowing Armenian R&D's progression away from the existing "survival mode". Gross expenditure on research and development (GERD) per researcher is low compared to Russia, Ukraine and Belarus, with modest growth interrupted by the 2008 global financial crisis (Figure 8). Limited investment can lead to a bias towards non-capital intensive niche areas of academic research, or ingeniously creative and low budget experimental methods, largely in basic sciences.

**Figure 8. GERD per researcher, FTE (\$ PPP thousands, 2005 prices)**

Source: UNESCO Institute for Statistics Database 2013

The number of research organizations has also declined through mergers or closures, falling from 102 in 2005 to 72 in 2012. This partly reflects funding constraints, but also rationalization of a previously fragmented research system so as to better deploy limited resources. Around 70% of R&D was funded from the state budget in 2012, although before 2008, growth in R&D was driven by an increasing share of funding from (private) customers. However, this share has subsequently fallen from almost 40% in 2005 to less than 20% by 2012, leaving the system overly reliant upon public funding (Figure 9).

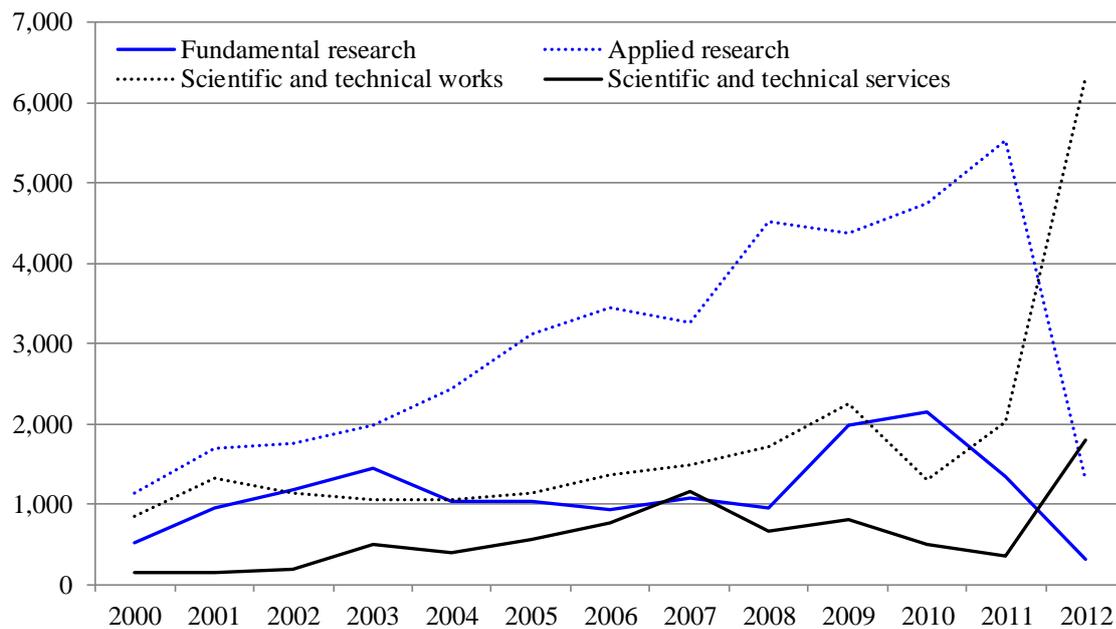
**Figure 9. Structure of expenditures on R&D by sources, per cent**



Source: National Statistical Office of Armenia

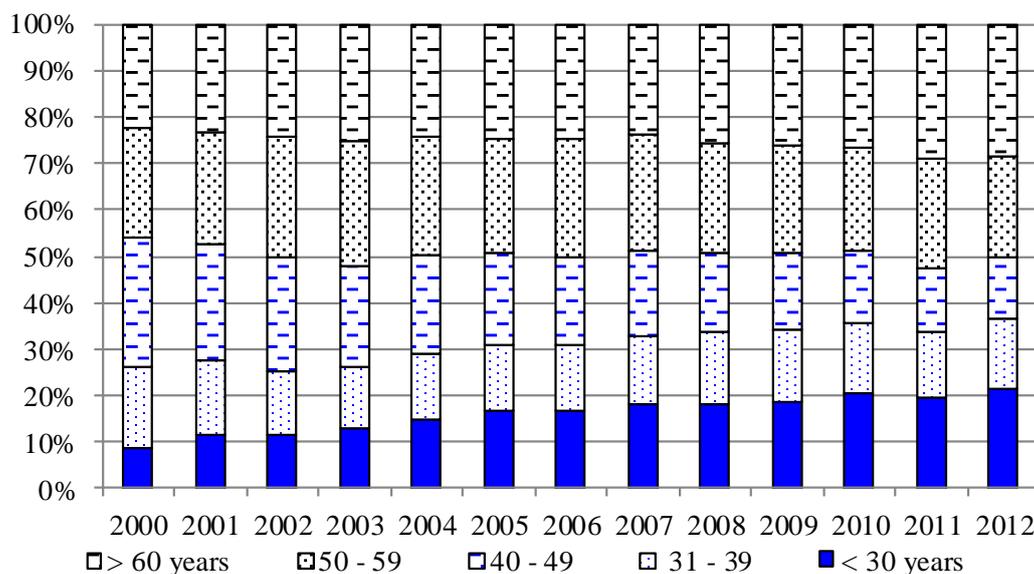
Foreign funding continues to play a marginal role in R&D financing, reflecting the weak international integration of Armenian science, although the success of ambitious plans such as CANDLE will require the attraction of funding from foreign sources. However, the share of foreign funding resources has declined since 2008, as opportunities for international cooperation become scarcer due to tightening budgetary conditions worldwide. Re-establishing these international financial linkages will be important for the Armenian R&D system.

Increasing pressure upon state budgets to prove local and commercial relevance, together with the necessity to find alternative sources of finance, has led to an increasingly applied orientation of R&D. The share of applied R&D increased from 25% in 2000 to 49% in 2011. There was a radical increase of R&D in scientific and technical works (i.e., development activities) in 2012, although this probably reflects a reclassification of applied R&D and S&T works rather than long-term change. The R&D system is very much oriented towards technological economic problems, with around 85% of R&D spending over the past decade going to applied research and S&T works and services, with only around 15% to fundamental research (Figure 10). This suggests that the R&D system is compensating for an underdeveloped domestic knowledge-intensive services sector.

**Figure 10. Scientific and technological activities performed, 2000-2012 (AMD million)**

Source: National Statistical Office of Armenia

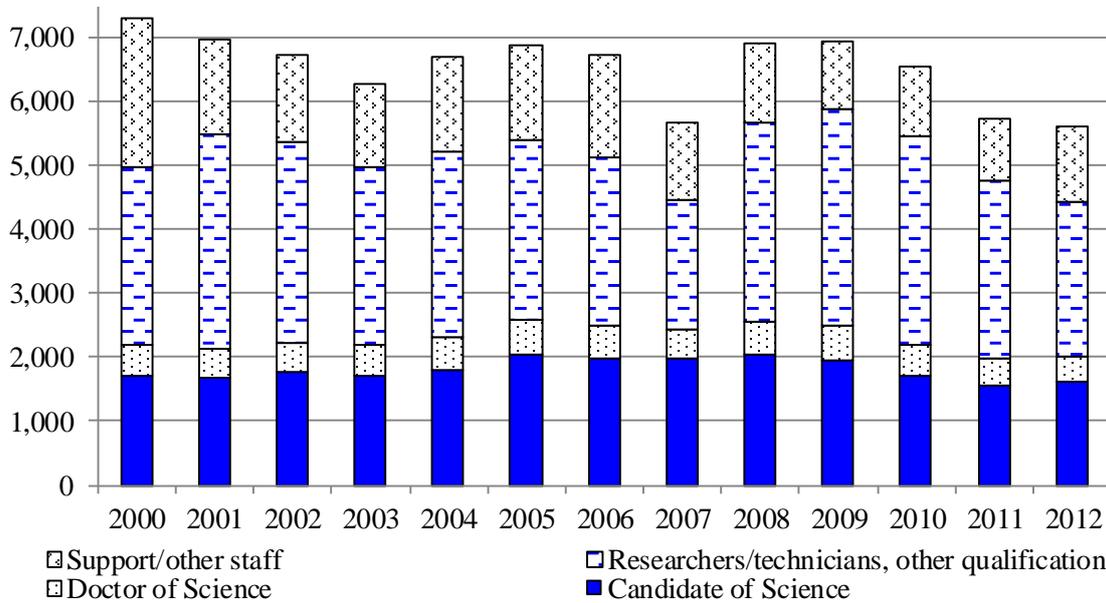
Sharp falls in R&D investment in the early 1990s led to low inflows of young scientists, now reflected by the relative scarcity of scientific employees in the highly productive 40-49 age range. However, renewed investment in science in the late 1990s and 2000s is now reflected by significant increases in scientific employees aged 30 years or younger. This has offset falls in the 40-49 age range, meaning around half of scientific employees were aged below 50 years of age throughout the period 2000-2012. If strong inflows of young scientists continue, there will be benefits as these younger cohorts progress to the most productive, middle-aged professional cohorts, helping reduce the current, transitional bias towards young researchers on the one hand, and researchers close to or above retirement age on the other (Figure 11).

**Figure 11. Share of scientific employees by age group, 2000-2012**

Source: National Statistical Office of Armenia

There was a decline in the number of employees of organizations engaged in scientific R&D over 2000-2012, although the share of employees with either a doctor or candidate of science increased from 30% to 36%, while support and other staff fell from 32% to 21% (Figure 12). This suggests an upgrading of skills in the R&D sector and increased technical specialization, which policies should support by maintaining investment in training young scientists.

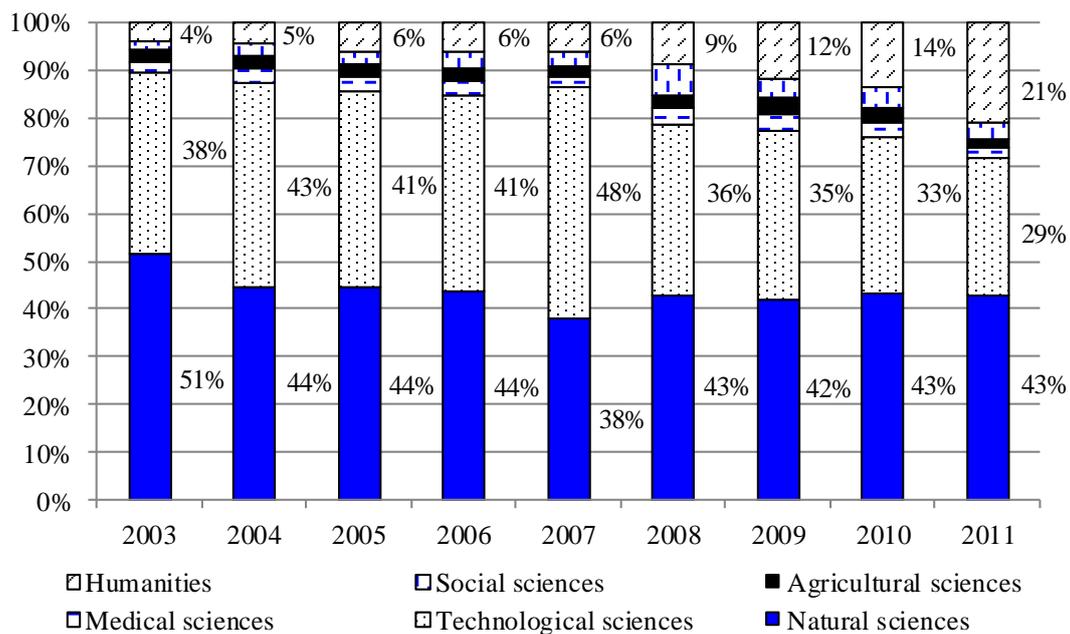
**Figure 12. Employees of organizations engaged in scientific R&D, 2000-2012**



Source: National Statistical Office of Armenia

Armenian science was traditionally oriented towards natural science, primarily physics and chemistry. This continues, although the share of funding going to natural and technological sciences declined from 89% to 82% over 2003-2011, largely accounted for by a corresponding increase in funding to the humanities from 4% to 21% (Figure 13).

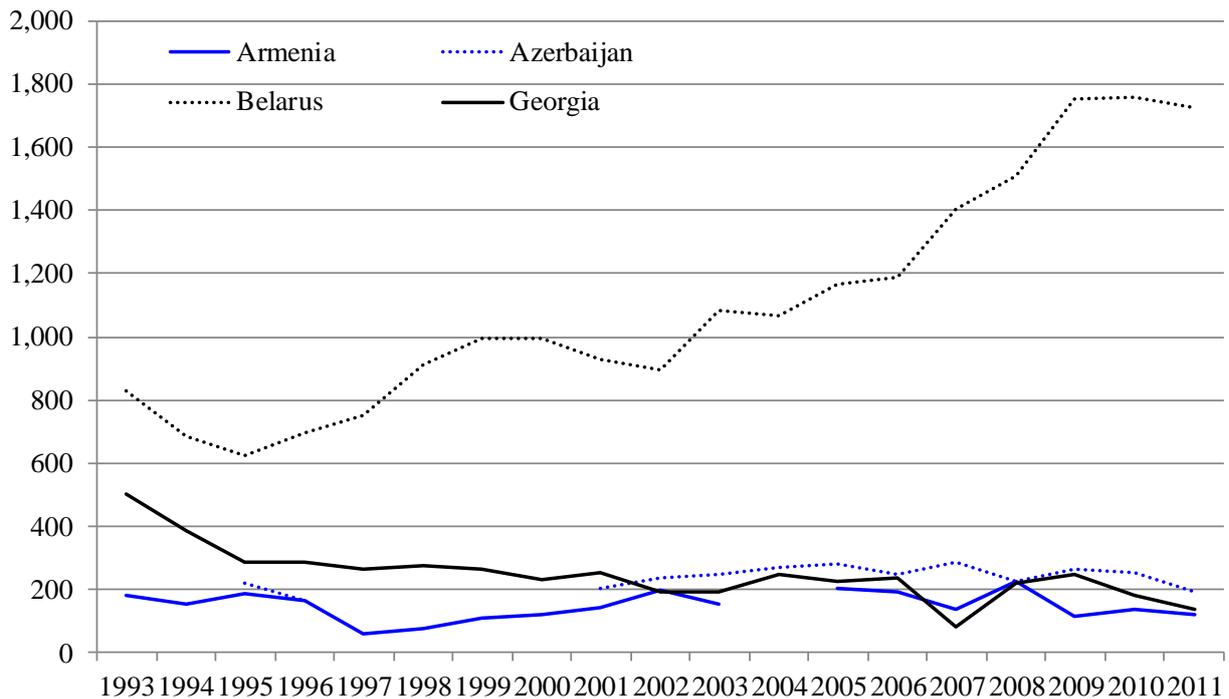
**Figure 13. Funding structure by scientific discipline, 2003-2011 (per cent)**



Source: National Statistical Office of Armenia

The decline in the funding and employment shares of technological sciences has been accompanied by relative stagnation in the number of patent applications by Armenian residents (Figure 14), also driven by very low levels of business R&D. This is in line with recent trends in Georgia and Azerbaijan, and contrasts with Belarus, where strong increases reflect the intensive efforts of domestic R&D institutes and parts of the business sector. There are also only very small numbers of non-resident patent applications, potentially weakening the technological capability of the Armenian business sector. This may be the result of a domestic market that is small relative to the costs of patent protection.

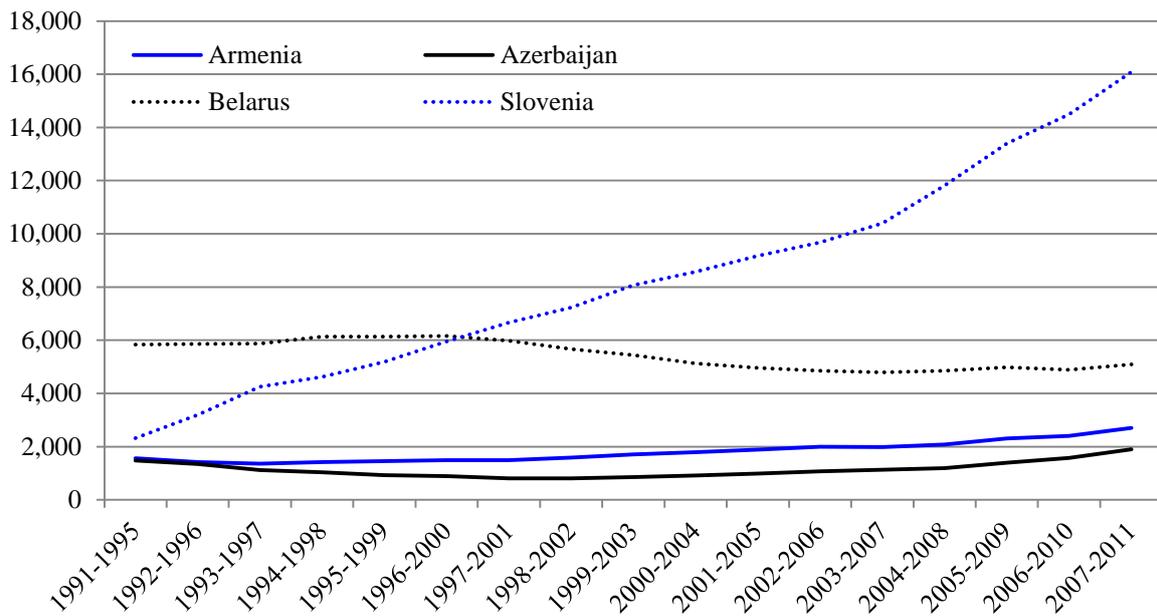
**Figure 14. Resident patent applications, 1993-2011**



*Source:* World Bank Development Indicators 2013

Compared to other CIS countries, Armenia has performed relatively well in terms of research output as measured by the number of international publications, which increased by 70% between 1991-95 and 2007-11. This compares to increases of 28% in Azerbaijan and 2% in Russia, and declines of 1% and 13% in Ukraine and Belarus, respectively. However, the science systems of CIS countries have remained relatively static, with only limited international integration. In the EU new member States (e.g. Slovenia), publications have increased significantly due to increased economic openness and integration in the European Research Area (Figure 15).

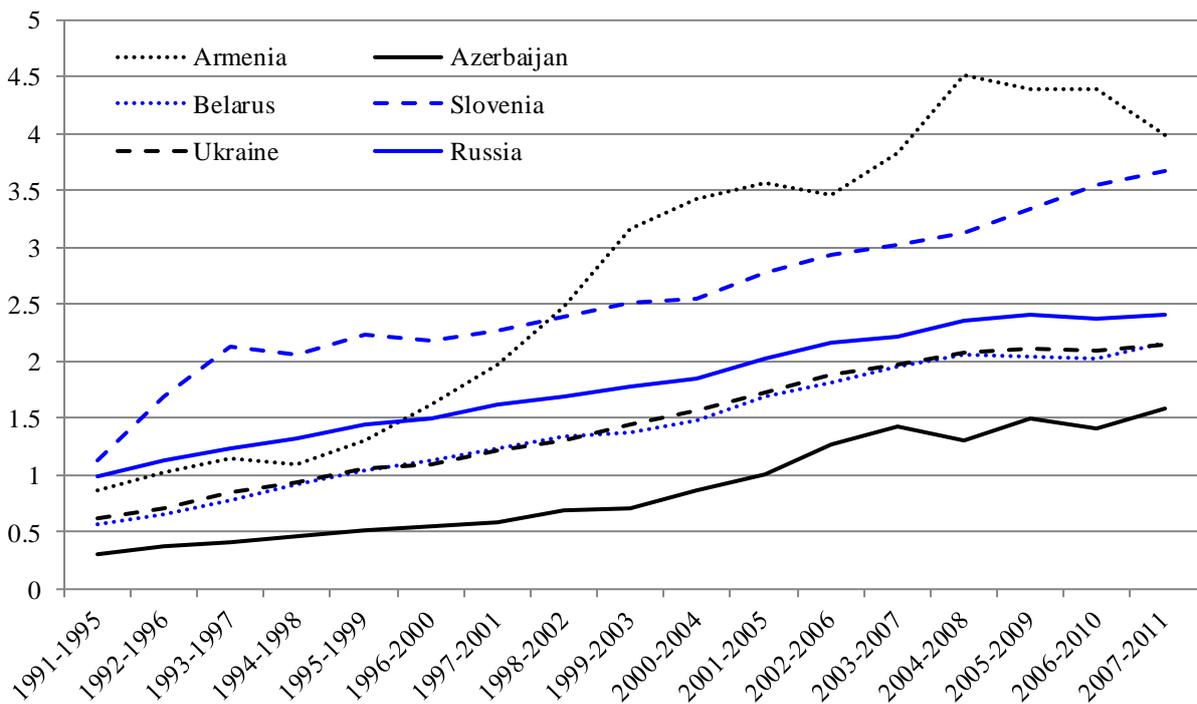
**Figure 15. Number of international publications, 1991-2011**



Source: Thomson National Science Indicators database

An increase in research output indicates quantity but not necessarily international excellence. Citations per paper are one measure of the impact and quality of scientific publications. Despite limited R&D resources, Armenia’s performance is particularly impressive in this regard, showing the strongest increase in impact between 1991-1995 and 2007-2011 (Figure 16). However, this may be partly explained by the disciplinary structure of Armenian science, with the increase in citations being driven by physics, where citation propensity is very high.

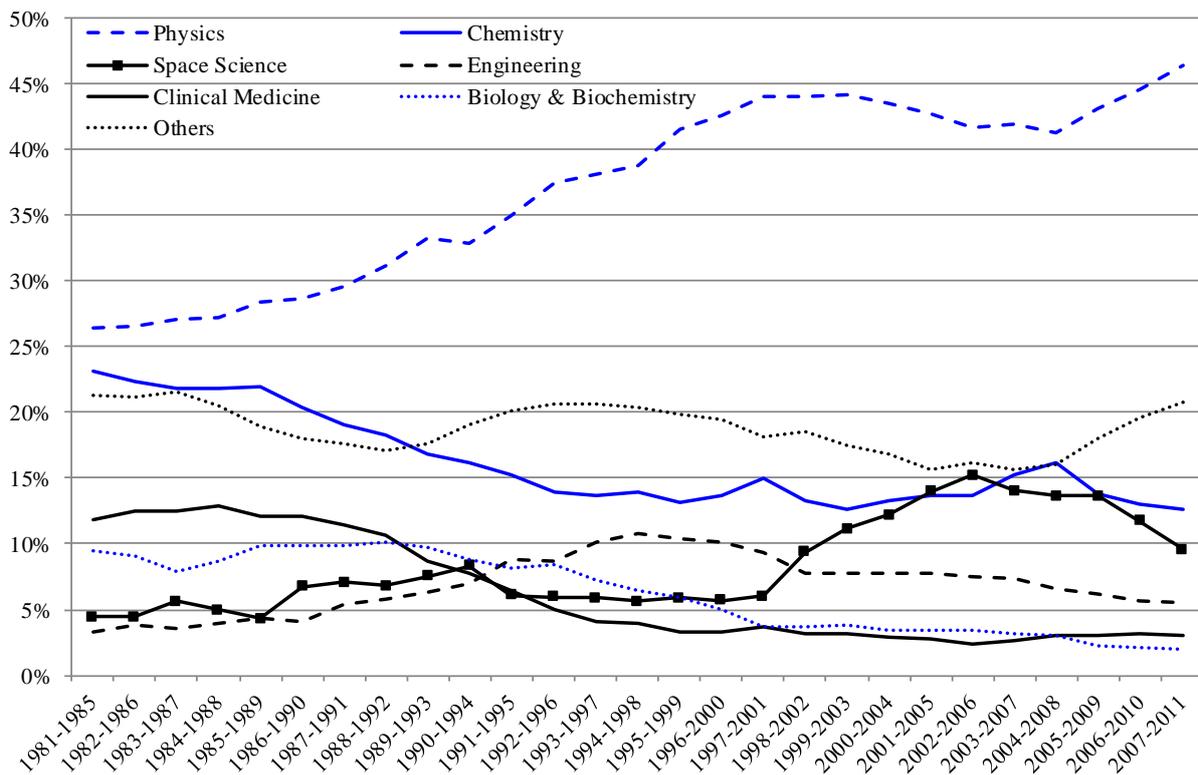
**Figure 16. Impact (citations per paper) of international scientific publications**



Source: Thomson National Science Indicators database

The international publications output of Armenian science is strongly marked by the dominance of physics, whose share in internationally recognized publications increased from 27% to 47% over the period 1981-2011 (Figure 17). This strong performance contrasts with relative decline in other areas of science, suggesting weak absorption capacity of Armenian science in these areas.

**Figure 17. International scientific publications by scientific domain, 1981-2011 (overlapping 5 year periods)**



Source: Thomson National Science Indicators database

### 4.3 Assessment: research, innovation and industrial policy

Armenia's growth over recent decades has largely been driven by the removal of allocative and technical inefficiencies from Soviet times. During the first decade of the 21<sup>st</sup> century, this catch-up process interacted with the low cost and availability of capital, boosting investment in finance, real estate and other services, but bypassing manufacturing and innovation-related activities. Since 2008, there has been a search for new, sustainable drivers of growth.

Continued structural reforms targeting improvements in corporate governance and the overall economic institutional environment are necessary, but not sufficient, to providing the basis for sustained growth and development. Armenia should develop a more explicit strategy for technological and industrial upgrading, including sector specific policies, to complement structural reforms. A number of recently adopted initiatives may facilitate policy learning, and provide the basis for further efforts to promote technological and industrial upgrading.

The challenges should not be underestimated, with Armenia's innovation system built as part of a Soviet Union wide division of labour. Legacy effects continue to impede restructuring, including an unbalanced and disconnected R&D system, a remaining handful of large firms that are poorly linked to the majority of small- and micro-enterprises of limited technological development, limited skills upgrading over the last two decades and weak integration with global value chains. Brain drain, as evidenced by remittance inflows of more than 10% of GDP, further limits Armenia's technological potential.

However, Armenia has certain niches of excellence based on accumulated skills, including IT, diamond processing, crystal growing, brandy, medicine and engineering services, which could drive future growth. Engineering competencies have been particularly driven by FDI (e.g. Synopsis and National Instruments), while the large diaspora is an important resource with potential to promote integration into global financial and knowledge networks and value chains. Armenia has been an active participant in international donor programmes, and has substantial experience of different policy approaches. The SME Development National Center, Enterprise Incubator Foundation, Armenian Development Agency and State Committee of Science are all enclaves of existing or potential policy competences.

Innovation and industrial policies are a post-2008 phenomenon in Armenia. Industrial policy operates through platforms for public-private collaboration (industry boards). In contrast, innovation policy is largely donor driven, with domestic initiatives significantly under resourced. The EU Seventh Framework Programme is the main international funding programme. Overall annual financing for industrial policy is around €0.6 million – very limited, even for a small country. The implementing body is the Armenian Development Agency, with resources disbursed through the Industrial Development Fund. The activities of the ADA reflect a new approach to industrial policy. In-depth sector assessments are followed by action plans based on collaboration between the public and the private sectors, with an agreed course of action supported by instruments including export development co-financing, road shows or product promotion campaigns and soft loans. The public-private industry boards are overseen by the Prime Minister, with policy support driven by companies that co-finance such activities alongside the State. These activities are very promising. Successful initiatives and policy models should be enlarged, and unsuccessful ones scaled down. The key is to continue to experiment, learn and upscale success stories based on the logic that policy itself is a “discovery process”.

The Enterprise Incubator Foundation is another important actor in innovation and industrial policy. Most of its initiatives are driven by donors or international organizations. EIF is funding incubation centres in cooperation with Microsoft, and a mobile communications laboratory hub for the Europe and Central Asia region with Nokia. The EIF has supported enterprises developing marketable mobile applications, as well as the Armenian-Indian IT centre that will focus on chip design and system engineering. EIF has accumulated significant experience in incubating new firms and merits further support (Chapter 3).

SME policy is probably the most developed segment of Armenian policies for industrial upgrading. SME Development National Centre agency trains entrepreneurs, and facilitates access to technology and markets. More than ten thousand entrepreneurs have taken part in their training programmes. Bad loans in its guarantee fund (worth around €1.6 million) are only 1%, and the survival rate of enterprises is 70 per cent within 3 years. Overall, there is the impression that SME DNC is rather successful in its task of promoting enterprise development, given limited resources (Chapter 2).

It may seem there are too many agencies targeting economic modernization and restructuring. However, while there may be opportunities for streamlining and enhanced coordination, a variety of organizations can also present a range of entry points for beneficiaries, and more diverse policy models. Seemingly efficient and streamlined public support systems may face insurmountable problems of irrelevance or high-level institutional failure. This is minimized when government agencies compete with one another to develop new policy initiatives. The major issue is not the number of organizations, but their degree of coordination, and leveraging between the public sector, private enterprises and other organizations.

A separation between science and innovation policies is to be seen in many countries, including Armenia. An alternative approach would be to integrate these two areas under one ministry (Chapter 2). However, innovation is an inter-ministerial issue, with full coordination not possible through a simple merger of R&D and innovation policy. Such a merger could also bring a risk of bias – support to only R&D based innovation and neglect of the non-R&D based innovation activities that are currently central to technological upgrading. Armenia has established the foundations of an effective innovation system, and should build on existing strengths. A future innovation system will emerge through a process of trial and error, which should involve all potential “agents of modernization”, including foreign investors, local new technology based firms, and competent public and non-public organizations. Policy should support the development of emerging niches of potential growth.

Policy models of limited local relevance should be avoided, in particular an exclusive focus on NTBFs and R&D-based innovation. NTBFs cannot ensure employment and long-term growth without sufficient domestic demand for R&D and innovation, which requires intensive technological upgrading of domestic firms. NTBFs can serve as specialized suppliers, knowledge providers and brokers in importing and adopting technology. In this respect, NTBFs are emerging as specialized suppliers where there are pockets of demand for technological knowledge and knowledge-intensive services, which should be generated by medium- and large-sized enterprises, both domestic and foreign.

Innovation generated by Armenian firms is largely non-R&D based. It results from the acquisition of new equipment, its adoption and customization, training and incremental improvements. Policymakers should recognize this, and broaden the notion of innovation beyond the “commercialization of R&D results”, acknowledging that the major sources of productivity improvements in Armenia for the foreseeable future will come from non-R&D innovation activities, often in low-tech sectors. The policy challenge is how to match Armenia’s R&D and innovative activity with absorption and adaptation of foreign knowledge.

A closely related issue is the role of big science in a small, lower-middle-income economy such as Armenia. Armenia has inherited strong research capacities, in particular in physics. However, R&D expenditures are very low for big science projects unless these projects are based on very strong international cooperation, foreign financial support and potential for commercial application. The CANDLER project is an example of a big science infrastructure project, whose viability will depend on skilled project management and extensive international networking in order to mobilize foreign funds.

The State Committee of Science, established in 2007, is responsible for R&D policy, and has driven significant improvements, including: competitive funding, policy prioritization on thematic areas, improved selection procedures, increased support to young researchers and international cooperation. Evaluation is an area that requires further attention, with regard to

both funding selection and appraisal, and evaluation expertise. An R&D tax credit was introduced in 2006, but uptake has been limited, given low levels of business sector R&D. R&D support could be evaluated alongside an overall review of R&D policies, including the balance between direct and indirect R&D support mechanisms.

Policy implementation is limited by very low R&D expenditures. Such limited funding allows for a continuation of the current “survival mode”, but not for a meaningful contribution by R&D to economic growth. There are six declared science and technology priorities:

- Armenian studies, humanities and social sciences;
- Life sciences;
- Renewable energy;
- Advanced technologies and IT;
- Space, earth sciences, sustainable use of natural resources; and
- Basic science for essential applied R&D.

However, these priorities are defined at an aggregate level, giving researchers scope to adapt their work to fit this broadly defined list with relative ease. Armenia lacks a well-defined policy for R&D and innovation in the business sector, although a separate source of funding for cooperation with the business sector was introduced in 2013. However, attempts to develop initiatives in this area will be constrained by a lack of statistics on business sector R&D. The terminology of the R&D funding system can be confusing: “targeted” projects are de facto applied, while “basic” and “thematic” projects can be of any kind.

Armenia is undertaking a number of initiatives to modernize its science system. These will involve differentiated funding of research institutes based on criteria such as publications, patents, number of researchers, grants and other factors. There is danger that funding criteria may become unduly skewed towards international excellence, while ignoring local relevance or local demand. The major challenge will be to ensure funding of not only internationally excellent but also of locally relevant R&D. The State Committee of Science has developed many useful initiatives, but with around 20 staff, faces strong challenges to continue modernization of an R&D system with a budget of around €18 million, including 81 organizations and 5,460 researchers.

#### **4.4 Recommendations**

Armenia’s development options are closely linked to transition towards a knowledge-based economy, influenced by a scarcity of natural resources and high transport costs due to its geographical position. Armenia’s main asset is its skilled labour force. However, neither the current educational system nor the system of vocational training is geared to the challenges posed by a development path that should rely on human capital. Despite some good training initiatives, companies encounter difficulties in finding qualified staff.

#### Recommendation 4.1

*The education system requires reforms that ensure the relevance of knowledge and its dissemination in the wider economy. The authorities could consider:*

- *Modernizing and evaluating curricula in order to ensure that the skills of its graduates correspond to the needs of technologically-driven growth. This is a medium-term target that should be embedded in a suitable strategy;*
- *Improving teacher training, particularly in the higher education sector, including through a programme of competitive grants to facilitate internationalization and access to foreign best practice;*
- *Differentiating between research and vocational universities, establishing separate objectives and evaluation methods for these two groups. Some R&D institutes could be integrated into research universities. Close linkages between both types of universities and R&D institutes should be established through doctoral and other educational programmes; and*
- *Strengthening linkages between vocational universities and the business sector, including foreign firms.*

The R&D expenditures needed for supporting innovation-based competitiveness are very low. Lack of data makes it difficult to form a clear view of R&D spending and innovation activities, particularly in the critical business sector. In addition to low R&D, shortcomings in engineering and innovation management constrain firms' innovation capacities. Low innovation demand does not create incentives for technological upgrading among companies.

#### Recommendation 4.2

*The authorities should aim to increase innovation activities in the country through a number of concerted actions that could include:*

- *Increasing public R&D spending and, in particular, encouraging higher spending in the business sector;*
- *Harmonizing R&D statistics with international standards and introducing innovation statistics, with appropriate coverage of the business and enterprise sector. Current twinning programmes in this area should be extended and Armenia should seek Eurostat assistance;*
- *Improving the innovation capacities of firms through support to engineering and innovation management, including through quality improvement programmes like those for implementing ISO9001 standards, ISO14000 environment standards and industry-specific international standards (such as Capability Maturity Model Certificates);*
- *Introducing innovation vouchers for the purchase of a wide range of innovation services to encourage innovation activities in SMEs and to help bridge the gap between the research sector and SMEs; and*
- *Using public procurement as a mechanism to promote technological upgrading while addressing the needs of Government agencies for solutions that meet their needs. The programme should provide early-stage financial support to high-risk innovative technology-based small firms with commercial promise, following the example of the US Small Business Innovation Research programme.*

There has been some restructuring of the R&D system, including mergers between some research institutes. However, more extensive changes are required to ensure the necessary increases in innovation investment are absorbed in an effective way.

#### Recommendation 4.3

*The authorities should provide a better basis for the allocation of resources to R&D by considering the following measures:*

- *Restructuring the system of R&D institutes, including through the reorientation of some of them to become technical institutes supporting knowledge-intensive SMEs. These institutes should rely on a combination of public and commercial funding and cooperate closely with technoparks;*
- *Evaluating R&D on the basis of multiple criteria, reflecting the diverse functions of different organizations. In addition to international excellence, which should be applied primarily to select institutes within the higher education system, local relevance should also be taken into account; and*
- *Introducing international evaluation of R&D organizations, which should serve as a basis for the integration of university R&D departments and R&D institutes and the gradual increase of educational expenditures.*

Foreign direct investment in Armenia is mainly driven by getting access to the market rather than increasing efficiency. There are some positive experiences where foreign companies have developed a network of local suppliers and contributed to technological upgrading. However, the potential for FDI to contribute to innovation and technological change in the wider economy remains largely untapped.

#### Recommendation 4.4

*In order to maximize the impact of FDI on technological upgrading, the authorities could consider:*

- *Integrating FDI and innovation policy to promote a shift towards FDI in technology, engineering and business support service centres. This would require coordination between the agencies involved in policy design and delivery in these areas; and*
- *Developing a programme to promote subcontracting as part of FDI support, so foreign companies incorporate Armenian suppliers in their value chains. The programme should include medium-sized and large companies (integrators) and SMEs based in Armenia. Integrators should monitor the implementation of the programme and encourage cooperation among participating companies. Funding should be provided on a matching basis to assist potential suppliers in raising their quality and productivity levels.*



## Chapter 5

### **INDUSTRY-SCIENCE LINKAGES AND COLLABORATION IN THE INNOVATION PROCESS**

This chapter assesses the role of the Government as a facilitator of industry-science linkages (ISLs), with particular emphasis on the legal framework, including intellectual property rights. It examines a number of initiatives to promote ISLs, describes the key actors and provides an assessment of the existing situation. Based on this assessment, the chapter makes a number of policy recommendations to improve the functioning of ISLs in Armenia.

#### **5.1 State facilitation of industry-science collaboration**

In 2006, the World Bank found Armenia to have “an extremely weak and fragmented system”, with a “lack of linkages among the productive sector, the universities and the research institutes.”<sup>33</sup> In the World Economic Forum Global Competitiveness Report (WEF GCR) 2013/2014, aside from the “market size” pillar (rank: 117<sup>th</sup>), Armenia also ranked only 103<sup>rd</sup> for “innovation”, versus an overall WEF GCR ranking of 79<sup>th</sup>. Specifically within the innovation pillar, Armenia ranked only 107<sup>th</sup> for university-industry collaboration in R&D, and 111<sup>th</sup> for Government procurement of advanced technology products, suggesting relative weakness in Government support for innovation. Nonetheless, since independence, framework conditions for innovation, including competition, regulation, and legislation have undergone significant reforms.

Armenian policy retains a supply-push perspective from the Soviet period. The loss of a large share of former innovation-related demand (e.g. the Soviet military-industrial complex and space industry) has been a significant challenge. Greater attention should be paid to the role of demand and end users in driving innovation, with a combination of supply- and demand-driven approaches to support ISLs and collaboration in open innovation networks. On the demand side, policy measures targeting businesses are crucial to encourage commercial innovation activities. If the private sector has little demand for innovation or is lacking the relevant capabilities, the innovation system cannot be effective.

#### ***Industrial Policy***

A key element of industrial policy is the Strategy of Export-led Industrial Policy (2011), which focuses initially on key export sectors, including:

- Brandy manufacturing;
- Pharmaceuticals and biotechnology; and
- Precision engineering.

These industries are good candidates for ISLs, being exposed to international competition, and the policy emphasizes the expansion of competitive production and new start-ups. To

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<sup>33</sup> Armenia: The Caucasian Tiger, Volume 1: Policies to Sustain Growth, World Bank, 23 June 2006, Washington, D.C, page 102.

these three sectors have been recently added textiles and shoe making, along with diamond processing and jewellery.

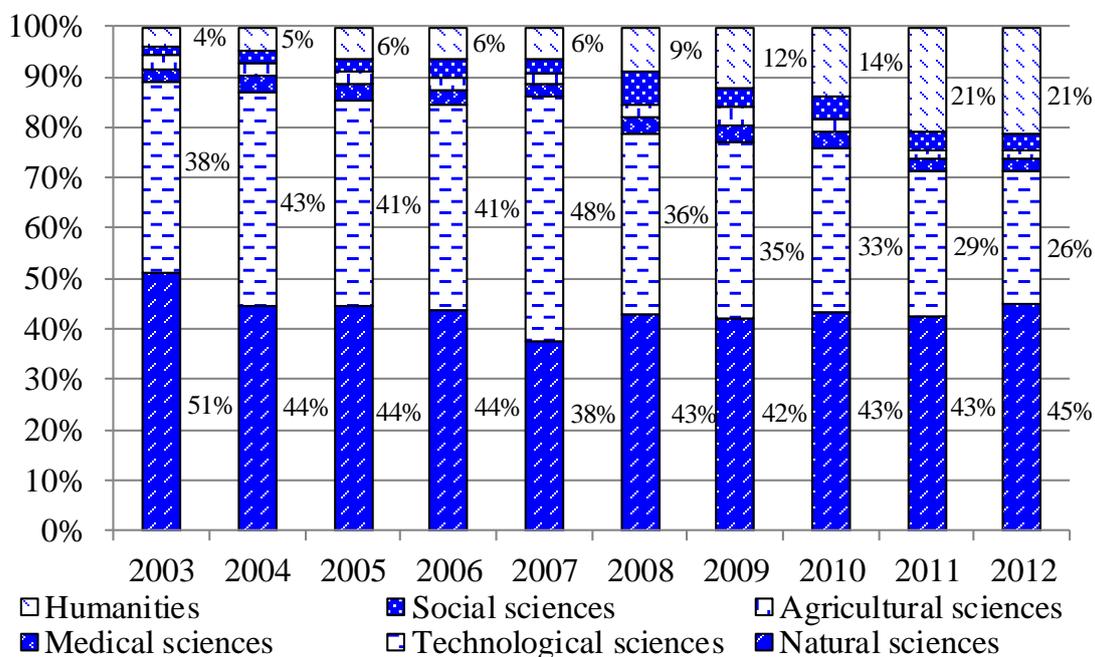
### ***Innovation Policy***

As discussed in greater detail in Chapter 2, the key recent policy development was the Concept Paper on the Initial Strategy for Formation of the Innovation Economy, 2011 (ISFIE), which broadened the interpretation of innovation, as well as the range of policy tools available. ISFIE takes a more systemic view than previously, setting out a clear strategy to 2020 for development of the NIS of Armenia, with a particular focus on becoming an R&D centre for MNCs, and promoting the internationalization of Armenian high-tech firms.

### ***Science Policy***

The Strategy on Development of Science for 2011-2020, adopted in 2010, targets a science-based economy that is competitive at the European level by 2020 in terms of basic and applied R&D. Medium term implementation of this strategy is through the Strategic Action Plan for the Development of Science for 2011-2015, adopted in 2011, with the Science and Technology Development Priorities for 2010-2014 also of key relevance. Policy documents emphasize the importance of commercialization and industry-science collaboration. However, budget allocations do not fully support this important goal. For example, the share of natural and technological sciences in the state budget decreased by eighteen percentage points over 2003-2012, with two thirds of this decline accounted for by the technological sciences (Figure 18). Agricultural sciences have a small share and have also been a loser in this structural shift.

**Figure 18. Gross expenditure on research by scientific field, per cent**



*Source:* Statistics on Science 2003-2012, Scientific and technological works section, <http://armstatbank.am>

### ***Legal regulations framing interactions***

Armenia has made significant efforts to build a modern legal system favouring knowledge-based development. These relatively new laws are preconditions for successful ISLs. More significant progress has been observed since 2006, although further refinement is necessary.

The Law on Scientific and Technological Activity (December 2000) regulates relations between R&D performers, state bodies and R&D customers. It outlines the general principles of state S&T policy, which it considers alongside innovation activities (Chapter 3, Article 12). The law makes provision for transformation of organizations, but the Charters of state scientific organizations require compulsory approval by the founder (Article 13), i.e. Government, which presents challenges for organizations looking to upgrade their ISLs.

The Law on State Support to Innovation Activity (May 2006) followed the Concept of Innovation Activity in the Republic of Armenia (January 2005). This law defines the legal and economic foundations for national innovation policy formation, and provides a legal basis for state support to innovation activities, in accordance with the Action Plan 2005-2010.

Of relevance to ISLs and collaboration, article 4 includes as innovation activities: technology transfer; acquisition and transfer of intellectual property rights, secret scientific, scientific-engineering and technological information; as well as financing and co-financing of innovation activity and investment in innovation programmes and projects.

### ***Laws on Intellectual Property Rights***

Armenia has its own Patent Office. Recent legal acts include the Law on Copyright and Related Rights (2006), the Law on Inventions, Utility Models and Industrial Designs (2008), the Law on Trademarks (2010) and the Law on Geographic Origins (2010), resulting in a sound legal environment for IPR protection. However, practical problems arise in relation to Patent Cooperation Treaty (PCT) patents and patenting abroad. As in many transition countries, the Patent Office does not have authority to issue PCT patents, acting only as a Receiving Office for Armenian PCT applications and advising on next steps. Where applicants wish to file a patent application abroad, the role of the Patent Office is generally limited to provision of basic information, for example on patent fees and patent attorneys.

The relatively new Armenian Patent Office has limited capacity to evaluate the world novelty of inventions. Patent registration abroad has high costs and uncertainty, with owners of Armenian registered patents unsure whether they will receive patent rights from key patent offices (e.g. US Patent and Trademark Office, European Patent Office and Japan Patent Office). This also makes licence agreements risky. Patent protection is therefore often limited to Armenia, with patentees facing the risk that their codified knowledge may be imitated abroad.

### ***Law on the National Academy of Sciences of Armenia***

According to this Law, enacted in 2011, the Academy is a self-governing, scientific not-for-profit organization with special status, operating within a governance system determined by the Government. Of relevance to spin-off activities, article 6.2 stipulates that the Academy can carry out business activities, in accordance with the provisions established by the Government and the available Academy resources. There is also provision for establishment

of joint scientific production centres in the Academy system.<sup>34</sup> Article 23 allows a potential financing role for the business sector: “Academy funds are composed of: the scientific and business activities of the Academy, including contractual works with Armenian and foreign legal entities and individuals, and income obtained from scientific industrial activities relating to the realization of its own products.” The law leaves open the question of whether Academy institutes can be involved in launching spin-offs or raising early-stage finance, as well as regulations regarding IPR related issues and technology transfer offices. More concrete regulatory provisions in certain areas could provide greater clarity.

The Academy is the official adviser to the Government on scientific matters, while there is a consultative role, upon invitation, for state administrative bodies in the Academy Presidium.<sup>35</sup> However, there is no equivalent adviser on innovation matters, and the Academy naturally represents the “science-push” model.

### ***Law on Higher Education (2004) and Law on Education (1999)***

There have been significant reforms in higher education, e.g. joining the Bologna process in 2005, granting semi-autonomy to state universities, allowing the establishment of private universities and introducing a quality assurance system. However, current legislation does not regulate the attribution of intellectual property rights in employment contracts in higher education institutions, the treatment of inventions or the establishment of technology transfer functions to support the creation of spin-off companies. HEIs are regulated not only by the Law on Higher Education but also by the 2001 Law on State Non-Commercial Organizations (SNCO). The World Bank has highlighted certain contradictions between these laws that limit organizational autonomy, including engaging in commercialization and ISLs. According to existing legislation, HEIs are separate legal entities, and neither the Ministry of Education and Science nor the founder (Government) can hinder their autonomy, while according to the Law on SNCOs, the founder makes final decisions related to HEI activities. Many state HEIs fail to exercise their autonomy. State HEIs are not legally required to follow a sample charter developed by the Ministry of Education and Science, which limits autonomy and academic freedom. However, most state HEIs adopted the sample charter without modification, as revisions require Government approval. Exceptions are the Yerevan State University, granted special autonomous status by the Law on Education, and the Armenian State Engineering University, which removed limits to autonomy from their charter<sup>36</sup>.

The Law on SNCOs constrains engagement in entrepreneurial activities to those with Government approval, limiting potential HEI revenues. There are a few exceptions, e.g. the Charter of Yerevan State Medical University (adopted by Government on 15 September 2005) allows university involvement in a wide range of business areas. While the Medical University earns 19 per cent of its revenue from sources other than state funding and tuition fees, and the Architecture and Construction University 28 per cent, two regional pedagogical universities earn less than one per cent, and even Yerevan State University earns only nine per cent from other sources.<sup>37</sup> The recent change in the legal status of the Agrarian University from an SNCO to a foundation has given the university the opportunity to diversify funding sources, namely to broaden their private sector linkages.

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<sup>34</sup> Article 9 (2.12).

<sup>35</sup> Articles 4(1) and 19, respectively.

<sup>36</sup> Para. 38, World Bank (2013), Addressing Governance at the Center of Higher Education Reforms in Armenia.

<sup>37</sup> World Bank (2013).

Overall, legislative changes have created the basic conditions for ISLs, but have not tackled a number of constraining factors. The World Bank (2013) concluded that the existing legislation “neither allows nor motivates HEIs to be actively engaged in research and development”. The engagement of HEIs in commercial activities is restricted to those that are specified in their charters. The Law on Scientific and Technological Activity does not clearly specify ownership of research outcomes.<sup>38</sup>

## 5.2 Mechanisms for industry-science interaction

Policy implementation is through action plans, annual programmes and other initiatives contained in the state budget. In the mid-2000s, it was hard to identify any ISL-related measures or incentives for business innovation. The World Bank (2006)<sup>39</sup> noted a lack of incentives for firms to develop their own technologies, with policy measures focused on supporting institutions carrying out S&T activities on behalf of industrial firms. There were no policy measures to support actions by firms themselves, such as grant-based mechanisms for technological activities (e.g. R&D, design, technological or managerial training, engaging consultants and technical specialists). Despite wider policy efforts, few measures relate directly to collaboration. However, recent efforts to promote new financial models, technology parks and commercialization training may support future collaboration, and the strength of the ICT sector’s development is encouraging industry-university collaboration.

One of the missions of the Strategic Action Plan for the Development of Science for 2011-2015 relates to ISLs, and states that “fundamental scientific organizations are to promote both economic output and applied research”. However, responsibility for policy implementation in relation to ISLs is divided among three governmental organizations: the State Committee of Science, the Ministry of Education and Science, and the Ministry of Economy. There is little emphasis on ISLs in existing programmes, with the exception of recent initiatives of the State Committee of Science, with limited budgets, including:<sup>40</sup>

- Implementation of specific programmes, including the principle of co-financing with the private sector;
- Business incubators and technology parks; and
- Software, conferences and exhibitions for research commercialization.

### *Main tools*

Public resources for innovation policy are very limited, with many programmes supported by foreign or international organizations. The main incentive for ISLs is budget support through policy programmes. Government has sought to improve transparency by publishing information on selection criteria and processes, but there is scope for improvement. Business involvement in programme development may help, but also brings risk of state capture in a small country with a limited number of competitors and independent evaluators.

The State Committee of Science, established in 2007, is one of the key actors. This Committee has 3% of the total science budget at its disposal. ISL relevant activities include:

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<sup>38</sup> Para 49, World Bank (2013).

<sup>39</sup> World Bank (2006) *The Caucasian Tiger*, pp. 105-106.

<sup>40</sup> Strategic Action Plan for the Development of Science for 2011-2015.

- Supporting research projects with innovative potential;
- Supporting commercialization of research outcomes; and
- Supporting infrastructure and equipment modernization projects.

Innovation projects with commercialization potential are co-financed with the private sector under these SCS programmes, with recent scientific projects in the following domains: <sup>41</sup>

- Electronics, engineering, small chemistry etc. (9 projects);
- Agriculture (5 projects); and
- Medicine and pharmaceuticals (3 projects).

The Innovation Fund mainly supports SMEs, although the SCS wishes to extend support measures to include larger enterprises. A support programme for patenting activity abroad is also under consideration. Overall, very limited non-budgetary resources are devoted to promoting ISLs, and originate largely from international grants and donations. While the development of public-private partnerships (PPPs) and cost-share projects are stated goals, there is limited information on the regulation of PPPs, incentives for cost-sharing and modalities for joint exploitation of research findings.

#### *Other tools for supporting ISLs*

Tools such as tax incentives can be important for promoting ISLs. On the demand side, innovative public procurement can be used to encourage collaboration. The Ministry of Finance establishes the criteria for public procurement, although innovation issues are not explicitly taken into account. The Ministry of Economy opened an office in Silicon Valley to promote Armenian products, signing contracts with Armenian firms. Free economic zones, intended primarily to attract FDI, may also have the desirable side effect of creating demand for new knowledge and supporting ISLs, with the first zone focusing on the IT sector.

Overall, Government programmes for ISLs remain limited, with linking or joint programming activities between different government actors lacking. This makes reaching critical mass for financing through co-programming and co-budgeting more difficult.

#### *Grand projects*

Although resources devoted to science, technology and innovation (STI) and ISLs are very limited, there are a number of grand projects (or “Mega Projects”), comprising a large share of the STI budget, including:

- CANDLE project (Center for the Advancement of Natural Discoveries using Light Emission) proposes the creation of a third generation synchrotron light source for fundamental, industrial and applied research in biology, physics, chemistry, medicine, materials and environmental sciences.

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<sup>41</sup> Data refer to 2011, Khiokoyan 2011 “National Innovation System and the Development of Scientific and Innovation Policy in the Republic of Armenia, *mimeo*.”

- Centre for Radiation Medicine: radiopharmaceutical preparations based on radionuclides and radionuclide diagnostics. The aim is to create a regional centre, catering also to foreign demand.
- Armenian Centre of Excellence in Oncology, including cyclotron.

### 5.3 ISL Implementation

In most technologically advanced economies, enterprises are the main implementers of innovation activities, including through collaboration with research organizations, thereby contributing significantly to both knowledge supply and innovation demand. Data on business expenditure on research and development are not available in Armenia, with disaggregation of business R&D by intramural and extramural activities therefore also problematic. Data on patenting by domestic firms may be indicative of both invention capabilities and absorption capacity. Table 15 shows the annual number of patent applications and of granted patents by type of patentee.

**Table 15. Yearly patent data by type of patentee**

	Patent Applications				Granted Patents			
	2009	2010	2011	2012	2009	2010	2011	2012
Higher education institutions	23	31	29	34	36	15	40	26
Institutes of NAS	9	5	4	4	11	4	6	3
Other institutes and domestic firms	12	10	15	9	15	19	12	17
<b>Total</b>	<b>44</b>	<b>46</b>	<b>48</b>	<b>47</b>	<b>62</b>	<b>38</b>	<b>58</b>	<b>46</b>

*Source:* Intellectual Property Agency of RA

Most patent applications were received from HEIs, with a smaller share from domestic firms and branch research institutes not linked to the NAS. There has been a decline in the number of patent application from NAS institutes, possibly due to IPR management issues.

#### *Industry*

Armenian domestic companies tend to be small and are often family owned. Limited managerial capacities and domestic competition reduce firms' incentives to innovate, and hence their demand for knowledge. Skilled expatriates, in addition to philanthropic donations and investments (e.g. IT and tourism), play a key role in building international linkages by supporting exhibitions, road shows and conferences – crucial given a limited domestic market. However, there has been a reliance on one-off contracts to help domestic companies in difficult economic conditions, with limited lasting commercial partnerships.

The Armenian innovation system, as in many post-socialist countries, is not yet business-centred. Generally speaking, there are three different types of industrial R&D: exploratory, exploitative, and imitative. Each type has potential to drive competitive advantage, with varying degrees of novelty, depending on a firm's capabilities and business strategy. The characteristics of collaboration according to the type of industrial R&D have a strong impact on possible ISLs. Table 16 summarizes the key characteristics of these collaborations.

**Table 16. Characteristics of cooperation by type of industrial R&D**

	<b>Exploratory</b>	<b>Exploitative</b>	<b>Imitative</b>
Modalities of collaboration	Research grants; Minority equity; R&D contracts; Joint R&D; Joint ventures; and Licensing	Customer-supplier technology exchange agreements; R&D contracts; Joint R&D; Joint ventures; and Licensing	Complementarities of partners
Technology exchanged	More tacit, embodied in people	Less tacit, embodied in artefacts or texts	Less tacit, embodied in artefacts or texts
Linkages with universities	Many and stronger	Few and weaker	Negligible

The sectoral structure of Armenian industry, as export data show, is largely traditional, with a high proportion of raw materials, food and beverages, and light industry. Limited business sector innovation is often focused on imitative R&D and technologies, resulting in few R&D linkages with universities or research institutes. The presence of MNCs has increased over recent years, but only a handful act as a driving force for innovation – a precondition for industry-science collaboration. Around 60% of companies are under Armenian ownership, with foreign ownership largely accounted for by North America (20%), Europe (10%), and Russia and CIS (8%).<sup>42</sup> Foreign affiliations are effective in certain high-technology and scientific fields, such as aerospace and ICT, where Armenia has maintained and developed its capacity to supply new knowledge to industry. In a few, often export-oriented sectors, foreign companies have linkages with Armenian scientific organizations (Box 2).

**Box 2. Foreign companies collaborating with a university or NAS institute**

In the ICT Sector, companies include Synopsys (chip design), Lycos Armenia (software), IBM, Cisco, Nokia and Oracle, while the instrument making and electrical/technical production sector includes the Armenian Branch of National Instruments. MIKA-Progresstech (Sukhoi airplane affiliation) is a key player in the engineering sector, while companies in the chemical industry include Nairit Plant, Vanadzor and Prometey Chimprom. Cooperation with universities includes:

- Interdepartmental Chair of “Microelectronic Circuits and Systems” established by LEDA Systems (acquired in 2004 by Synopsys Inc.) and the State Engineering University of Armenia (SEUA). The Chair, now part of the Synopsys University Program, supplies more than 60 Very Large-scale Integration (microchip VLSI) and Electronic Design Automation specialists each year. Synopsys later expanded this initiative by opening interdepartmental chairs at the Yerevan State University (YSU), Russian-Armenian (Slavonic) University (RAU) and European Regional Academy;

<sup>42</sup> Source: Armenian ICT Sector: 2012 State of Industry Report, EIF (underlying data).

**Box 2. Foreign companies collaborating with a university or NAS institute  
(continued)**

- Sun Microsystems Development and Testing Laboratory, founded by Sun Microsystems, EIF, and USAID to help supply quality professionals for the Armenian IT industry. Sun Training Labs established at SEUA, YSU, RAU and Gyumri IT Center;
- Gyumri IT Center, the first IT training centre in the city of Gyumri, established by the Fund For Armenian Relief and EIF in 2006;
- Armenian-Indian Center for Excellence in ICT, founded at YSU;<sup>i</sup>
- Microsoft Innovation Centre founded by Microsoft, EIF and USAID at SEUA; and
- Two-year undergraduate programme in Internet computing designed primarily by Lycos Armenia staff at two universities in Yerevan.<sup>ii</sup>

<sup>i</sup> USAID (2013), ICT Country Profile: Armenia (Regional Competitiveness Initiative).

<sup>ii</sup> World Bank (2006) The Caucasian Tiger, page 107.

These companies are more often involved in collaborative training programmes with universities, and associated staff recruitment, than in R&D linkages. However, given the small domestic market, an internationally open innovation model may hold promise, under which firms based abroad partner with domestic scientific organizations in international business-science networks. Cross-border ISLs have a certain tradition in Armenia, although the meaning of open innovation system is significantly different from the Soviet era ISLs' labour division, when Armenia was home to several leading R&D centres with firms in other Soviet republics as customers. Nonetheless, the international open innovation model can only be appropriate for certain sectors.

In the high-technology sector, outsourcing has been a distinct trend, with Armenian advantages including good engineers with lower salaries. According to several managers, around 70% of outsourced tasks are routine jobs and only 30% involve development, with industry generating limited demand for innovation. There is scope for Government to introduce incentives for industry to innovate, boosting demand for ISLs, and also to put innovation on the agenda for FDI policy. Broader international collaboration can facilitate the participation of Armenian scientific organizations in innovation networks. Upgrading norms and standards can also create demand for innovations, e.g. energy efficiency standards can result in increased demand for more advanced building technologies.

***Scientific institutions as potential collaborators***

Limited public funding for R&D (0.2% of GDP) is primarily allocated to the National Academy of Sciences, with universities receiving less public support for research. HEIs may be categorized by their focus: teaching, teaching & research, research & teaching, and entrepreneurial. All play a role in supplying a skilled labour force, and only HEIs exclusively focused on teaching are not relevant for any kind of industrial research collaboration.

Universities with research activities are strong candidates for ISLs, while R&D carried out in HEIs has several benefits, including a close connection to teaching that aids wider knowledge diffusion. As a legacy of the Soviet system, Armenia has a relatively weak HEI research system. Generally, HEIs may be partners for exploratory and exploitative research-based

innovations. Among universities with research activities, a distinction may be made between so-called *think-tank* and *do-tank* universities. For *think-tank* universities, focused on basic research, public funding, distributed according to academic excellence, is essential. Business collaborations are less frequent for this type of university, with potential partners being companies that are leading innovators in the relevant field, including foreign companies.

The role of *do-tank* universities is different. Their research is applied and/or practice-based, serving the needs of industry. In advanced countries, domestic industry has a key role in providing private funding for *do-tank* universities, which tend to follow industrial developments.<sup>43</sup> Although it is a continuous spectrum, some research universities lean more towards the *think-tank* model (e.g. YSU) and others towards the *do-tank* model (e.g. State Engineering University of Armenia and Armenia National Agrarian University). Armenia is lacking research-intense universities in the international sense, and there are few research-oriented universities. Most HEIs can be partners for industry in teaching, training and retraining, but a more select group are candidates for ISLs, including:

- Yerevan State University;
- Yerevan State Medical University;
- State Engineering University of Armenia;
- National University of Architecture and Construction of Armenia;
- American University of Armenia; and
- Armenian National Agrarian University.

There are no apparent differences in government initiatives or resource allocation between the different types of university, although thematic funding tends to favour research-oriented universities.

NAS institutes are largely dedicated to fundamental research, remaining the main R&D performers in Armenia, but also contribute to training young researchers and industrial innovations. They are the traditional sites for conducting the fundamental research typically carried out in HEIs in many advanced economies. The institutes of the Academy can be partners for exploratory *think-thank* and exploitative *do-tank* research-based innovations.

In many countries, other institutes are the key technology-supporting institutions, with strong business linkages. In several countries (e.g. Japan, Korea), technology-supporting institutions are important facilitators of innovative SMEs. They are potential partners for exploitative research- and imitation-based innovations. In Armenia, research institutes independent from the NAS are typically successors of Soviet era sectoral research institutes, significantly reformed and presenting a diverse picture. The level of scientific performance can vary greatly within institutes. A number of laboratories have strong international reputations and partnerships, with support from sources such as the NATO Science for Peace and Security Programme, or the EU Enterprise Network. Such collaborations provide access to up-to-date scientific literature and knowledge, but almost all laboratories require modernization of equipment.

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<sup>43</sup> D.M. Cooper, 2009, A new university mission of social responsiveness? Critical perspectives on a “second academic revolution”, presented at the American annual congress, Association for the Study of Higher Education, Vancouver, 4-7 November 2009.

### ***IPR management in scientific organizations***

Currently, varied arrangements are in place regarding IPR management, with no legal obligation for research organization to specify internal rules or terms in employment contracts regarding IPR governance. A requirement to specify IPR ownership rules, without detailed prescriptions, would not conflict with institutional autonomy. At the State Engineering University of Armenia, the university is the owner of inventions, but is obliged to mention the name(s) of the inventor(s). Where a company has contracted the research, the applicant (and the owner) of the patent is the firm, but in the application it must mention the inventor's name, who retains the right to scientific publication. Where inventions result from a collaborative research project, the ownership issue is not yet regulated. The Yerevan State Medical University distinguishes between inventions originating from university research, in which case the university is the owner, or from other research. The NAS Institute for Physical Research (an SNCO) has incorporated IPR-related issues into its standard employment contracts (Box 3).

#### **Box 3. IPR-related issues in employment contracts at the NAS Institute for Physical Research**

The standard employment contract at the Institute includes the following IPR-related rights and responsibilities of the relevant parties, namely the “Executor” (typically head of the relevant scientific department undertaking the research), and the “Corresponding body” nominated to represent the Institute’s management (in practice, the Institute’s Director):

- The right to receive a patent (licence) for professional invention, useful model or industrial sample created by the Executor during execution of his professional duties belongs to the Corresponding body. The Executor is obliged to maintain confidentiality before the relevant applications are submitted.
- In the case of commercial application of a professional invention, useful model or industrial sample created by Executor (and co-authors), the amount, conditions, and order of royalties payment must be settled by a separate agreement between the author(s) and Corresponding body.
- Any publication (article, report, professional presentation, etc.) by the Executor, which contains full or partial disclosure of professional invention, useful model or industrial sample created in the Institute, must be pre-approved in advance by the Corresponding body of the Institute.
- Any publication (article, report, professional presentation, etc.) by the Executor must reference the Institute.
- The Executor acknowledges and recognizes that any sponsored (e.g. grant funded) research taking place at the Institute must be presented in advance to the Scientific Council of the Institute for approval, and the Corresponding body has the right to recover administrative, facilities and other costs related to these works.

## **5.4 Technology transfer and other match-making organizations**

Commercialization of scientific results can take various forms, e.g. licensing agreements, spin-offs, joint ventures and partnerships to share the risks and profits of bringing new technologies to market.

### *Technology Transfer Office*

It will be a process of trial-and-error to find the relevant type(s) of technology transfer office (TTO) to fit the Armenian NIS. A distinction can be made between two types of offices: TTOs at the science-performing organizations and independent (or stand-alone) for-profit or not-for-profit entities. At the research institute or university, the TTO is a service dedicated to the management and licensing of the intellectual property created, combining knowledge of research assets and forthcoming inventions with intellectual property, licensing, business development, marketing and other technology transfer related legal expertise. The Institute for Physical Research has recently created a TTO (Box 4).

#### **Box 4. TTO regulations of the NAS Institute for Physical Research**

The TTO serves as the authorized body of the Institute concerning Articles 5-7 of the researcher (“Head of Laboratory”) labour contract, which relate to the ownership of intellectual property arising from research.

##### Working Procedure

The TTO works with research laboratories and individual researchers to identify outputs with commercial potential. Selected research outputs are described on a “Technology ID” template by the inventor, including information such as: technological background, market need, patent applications already filed, current stage of development, rival technologies, previous collaborations or attempts to commercialize, and funding requirements.

Depending on the sensitivity of the application, the TTO may request some restrictions on dissemination of findings (Article 7(6)) of the Labour Contract of the Head of Laboratory (researcher). Disclosure restrictions are listed in the Confidentiality Agreement signed by TTO and the author(s), and approved by the Director of the Institute.

##### Assessment and evaluation

The TTO team evaluates the commercial potential of each filed research output by performing comprehensive IP and domestic/foreign market analysis, with the TTO able to involve other experts, if necessary. In this case, a Non-Disclosure Agreement is to be signed by the TTO and expert(s).

##### Intellectual property management

Based on this assessment, the TTO implements the most appropriate IP management (patenting, know-how, etc.). A corresponding agreement is prepared for signature by the author(s)/inventor(s) and the Institute Director, clearly stating the share of revenue for author(s)/inventor(s) and the Institute in the case of commercialization. IP filing for inventions originating in the Institute can be initiated only after passing the previous stages.

##### Negotiations and licensing

The TTO is authorized by the Institute to manage negotiations with possible investors and industrial partners, oversee licensing negotiations and appraise the options of on-site production at the Institute’s facilities or creation of spin-off companies.

### ***Stand-alone technology transfer organizations***

Self-standing technology transfer infrastructure, often with state support, can also help serve ISLs, typically closer to commercialization. Examples include the Viasphere, Gyumri and Andron technoparks, and the Innovation Centre in Vanadzori. Support for commercialization does not always require physical infrastructure, e.g. Enterprise Incubator Foundation and the Technology Transfer Association (TTA). The TTA, operating since 2001, connects Armenian science with business organizations using the regular tools of the “science-push” innovation model, establishing links between technology owners and organizations seeking innovative solutions. TTA members are knowledge producers with advanced technologies, mainly from the natural sciences and engineering-related fields. TTA collaborates with a range of other domestic and foreign organizations, including business consultants and technology designers.

The TTA maps all Armenian research groups, excluding military related, to form a complete list of existing and new technologies in the pipeline. The assessment procedure for proposed technologies comprises five steps, namely assessments of: (1) scientific value, (2) market potential, (3) practicality of production, (4) financial profitability, and (5) human resources. The TTA employs experts from Armenia and CIS countries, the latter proving less expensive than Western expertise but with weaker knowledge of marketing and implementation issues. According to the TTA’s assessments, the technologies that are the best candidates for commercialization are found at the Institute of Physical Chemistry, Institute of Molecular Biology and Institute of Material Science. TTA has limited staff, and is funded from success fees. The Distributed Science Technological Park (D-STEP) is a new concept, conceived as a “technopark without walls”. On the basis of this concept, the International Innovation Center was established in Yerevan in 2012, co-founded by the SCS and ADA.

## **5.5 Industry-Science linkages**

In countries where ISLs are weak, the main challenge for universities is typically establishing the preconditions for ISLs: advancing research methods, and improving organizational structure, research governance and education. It is crucial to provide a well-educated labour force with the knowledge and skills required by industry. Armenian HEIs have been upgrading their teaching curricula, often in collaboration with employers. Many universities training technical specialists offer business options, although areas such as innovation management require more attention. A small number of universities also provide courses in management, entrepreneurship, marketing and IPR management, which could be adopted by more HEIs. Teaching of foreign languages such as Russian and English are also considered extremely important for the development of a quality technical and managerial cadre.<sup>44</sup> ICT training has improved significantly in recent years.

According to the “science-push” innovation model that remains strong in Armenia, research institutes and universities seek companies for commercialization, with information gathering and knowledge dissemination important functions at research-oriented institutions. For financial reasons, many academic employees have one or more additional jobs in industry, with positive side effects for ISLs and knowledge dissemination.

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<sup>44</sup> Armenian ICT Sector 2012 State of Industry Report

Table 17 summarizes the types of ISLs, with Armenian examples. The type and function of ISLs characterize the depth of collaboration. Deeper collaborations (e.g. on R&D) are typically the most durable. “Archipelago” and arm’s length collaborations are more frequent, in contrast with the trend towards more complex modes of collaboration (e.g. triple helix) observed in developed countries. However, early signs of the triple helix type collaboration may be found, particularly at the research-intensive universities.

**Table 17. Type, function and depth of industry-science collaborations**

Depth	Type of collaboration	Function	Armenian examples
Isolated (Archipelagos)	Ad hoc firm consultations at universities	Information gathering	Conferences to build linkages, typically in specific sectors (e.g. ICT, medical)
	Regular university/industry discussions on specific issues		
	One-off purchase of university research		
	University lectures by firm employees	Knowledge dissemination	YSU / Faculty of Radiophysics - Synopsys lecturers trained staff
	Lectures by academics at firms		
Far distance & Arm’s Length Cooperation	Employing faculty members as regular consultants	Information gathering	Joint working as academics and in industry (e.g., YSMU, SEUA and YSU)
	Coaching of firm employees by university researchers	Knowledge dissemination	YSU / Faculty of Radiophysics – Synopsys PhD students conducting research
	Training of firm employees by professors		
	Joint supervision of theses by university/industry staff		
	Joint publications	R&D	
	Joint patenting and intellectual property protection		
Triple Helix (Horizontal)	Formal R&D cooperation - joint R&D	R&D	YSMU / Pharmacology Faculty - Dental research firm, Garni - Arpimed Pharmaceuticals
	Regular acquisition of university research		
	Formal R&D cooperation – outsourcing		
	Sharing of specialized equipment between industry and university	R&D infrastructure	YSEU – National Instruments, IBM, Nokia
	Investment in universities’ facilities		
		The types included in the Triple Helix (horizontally-deep) group often include R&D collaborations	Knowledge dissemination & information gathering

*Source:* modified version of A. Inzelt 2004 “The evolution of University-Industry-Government relationships during transition” *Research Policy*, Vol 33. issue 6-7, pp. 975-995.

Even basic or shallow forms of ISLs can lead to progressively deeper collaboration. While firms are generally quite reluctant to participate in ISLs, development aid plays an important role in mobilizing foreign MNCs to invest in university facilities. Examples include: laboratories at SEUA; Internet and web technology laboratories established by Lycos Europe, EIF, and Sourcio CJSC at SEUA and YSU in 2005; and a Regional Mobile Application Laboratory founded in 2011 for Eastern Europe, South Caucasus and Central Asia under a

joint project of InfoDev, the Government of Finland and Nokia. A previously ministry-controlled sectoral institute, the Yerevan Computer Research and Development Institute, became a joint stock company. Its majority share was purchased by a Russian company, which was itself a successor of a former Soviet research institute. Although not eligible for basic funding from Government, this institute can be a contractor for state-funded projects. Box 5 provides examples of ISLs at leading Armenian universities.

#### **Box 5. Examples of ISLs for commercialization**

A number of Armenian universities maintain close cooperation with private businesses.

**Yerevan State University** has significant collaboration with Synopsys, which has a branch in the Faculty of Radiophysics, providing educational programmes at all levels, including for doctoral students, and professors working for Synopsys. MIKA-Progresstech, a branch of the Russian Sukhoi airplane company, also works directly with students of the university, while the Central Bank works with students and staff of the Faculty of Commerce.

**Yerevan State Medical University** works with the Ministry of Defence on military medicine, although commercialization potential remains unclear. Other ISLs include a Garni located dental research firm, and contracts with clinics such as military hospitals and universities. The university has its own pharmaceutical company, with which faculties collaborate. The Department of Pharmacy Management has conducted a “Study of pharmaceutical markets” with the International Society for Pharmacoeconomics and Outcomes Research (USA). The Department of Pharmacy and Arpimed pharmaceutical company are collaborating in identifying compounds in Armenian plants and herbs.

The **State Engineering University of Armenia** hosts research centres for IBM, Nokia and Oracle. National Instruments collaborates on research supervision and providing supporting software. The company’s Armenian office has a mission to support linkages between National Instruments and Armenian scientific organizations and small firms.

## **5.6 Barriers to industry-science linkages**

Framework conditions for ISLs have improved in recent years, thanks to various Government initiatives. However, measures are not always coordinated, and budget allocations for promoting linkages, collaboration, and networking are limited. Management of scientific work, collaborations and commercialization at research organizations remains weak. In Armenia, the current legal regime is not fully supportive of creation of spin-off companies for commercialization by research organizations. The recent Law on the National Academy of Sciences gave greater freedom to institutes relating to ISLs than HEIs have. The Ministry of Education is able to grant special Charters to universities on an individual basis. Existing regulation concerning patenting or licensing is well designed at several organizations, but unclear at others. Without more general clarification regarding the ownership of inventions or patents, potential business partners are reluctant to participate in this type of ISL.

Scientific institutes and governmental organizations still often think in terms of the “science-push” model, while research capabilities have limited commercial visibility. Very few HEIs or research institutes have devoted attention to the management of technology transfer,

including the necessary human resources, with establishment of invention-based spin-offs viewed as a separate matter for science and technology parks. Human capacity problems, outdated infrastructure and an ageing workforce are significant challenges for scientific organizations.

Barriers in industry include a lack of interest and capacity for innovation. Industry is lacking intramural and extramural R&D activities, and there is little invention-based entrepreneurship. Cross-border ISLs offer potential rewards, but despite some grass root initiatives, it is not easy to scale up sufficiently for participation in internationally open innovation networks.

## 5.7 Recommendations

Linkages between science and industry are rather poor. Successful research commercialization could bring important benefits to both the organizations conducting the research and the wider economy, including an increased ability to retain scientific talent and the upgrading of scientific capacities. Improving industry-science linkages (ISLs) requires the coordination of multiple policies, including those on science, innovation, foreign direct investment and industrial development. Transparency is crucial to the success of all programmes and calls for tender.

### Recommendation 5.1

*Innovation policy should emphasize the importance of ISLs and introduce relevant programmes to improve the current situation. Public initiatives could include:*

- *Developing instruments that target links between industry and science, where the provision of public financing depends on the existence of collaboration;*
- *Encouraging higher education graduates to establish start-ups, so new firms linked to science emerge;*
- *Co-designing FDI policy and science, technology and innovation policy to attract more foreign investors employing Armenian scientific assets; and*
- *Promoting cross-border linkages between Armenian science and innovative foreign companies, thus creating a source of income and facilitating access to global networks of knowledge.*

Despite progress, scientific and innovation management capabilities remain weak in all relevant organizations: business, research institutes, and public administration. New intellectual property rights legislation provides an opportunity to manage commercialization of research results, but technology transfer functions are not well defined in scientific organizations. There is a need to substantially upgrade management capabilities in order to support research commercialization. Building ISLs is a time-consuming, costly and risky process. Public support is necessary to overcome shortages in skills and financial resources and to facilitate the development of appropriate strategies in relevant organizations.

### Recommendation 5.2

*Substantial public support is required to promote ISLs at the early development stages, with initial public funding necessary before technology transfer activities can become profit making. In order to encourage the development of the necessary capacities and facilitate commercialization, the authorities could consider:*

- *Facilitating the development of technology transfer functions or offices within scientific organizations, including through training on licencing and research contracts and intellectual property related issues;*
- *Designing a scheme to support patenting that includes advice on whether to seek international protection and grants to partly cover the associated costs; and*
- *Strengthening the capacity of the Intellectual Property Agency to offer broader services to its clients.*

The current legal framework does not support or encourage closer industry-science linkages. Scientific organizations do not have sufficient autonomy to engage in commercial activities. In addition, there are no clear regulations to facilitate the effective use of the autonomy that has been granted. This absence of guidelines creates a vacuum, placing an additional burden on research organizations seeking to develop these linkages.

### Recommendation 5.3

*The authorities should extend the economic autonomy of higher education institutions (HEI) and the National Academy of Science's research institutes, undertaking the necessary legal reforms while encouraging them to develop internal regulations concerning technology transfer. Legal reforms could include:*

- *Harmonizing the Law on HEI and the Law on state non-commercial organizations in order to remove legal barriers to ISLs;*
- *Providing equal opportunities to different organizations to revise their Charters so they can engage in entrepreneurial activities;*
- *Putting in place an appropriate framework for the creation of spin-off companies emerging from research and educational organizations, clearly addressing all relevant issues; and*
- *Developing guidelines on intellectual property issues to be included in employee contracts and guidelines on the management of technology transfer offices.*

Industry-science linkages are influenced by the level of economic development and historical and institutional traditions of individual countries. Armenia can learn from advanced countries but also from successful developing economies and, in particular, from other countries with economies in transition. However, these lessons cannot be applied without a deep understanding of the national situation. A systemic review of the current legislation and the existing practices on ISLs is necessary to identify the main barriers and opportunities and assess policy impact. Armenia has been gradually introducing the evaluation of research organizations, which is a good starting point.

*Evidence-based policy making and the development of a strategy for research organizations requires well-developed evaluation initiatives. The authorities should promote both internal and external evaluation of government agencies and research organizations according to the following principles:*

- *The results of evaluation should lead to decisions on strategy formulation and policy changes, with clear impact on the allocation of financial support;*
- *Evaluation of scientific organizations should be carried out on a periodic basis, covering scientific performance, scientific assets, physical and human capabilities, governance and management, and linkages with industry; and*
- *Technology transfer offices receiving state support should be evaluated periodically to assess whether such assistance should continue.*

## Chapter 6

### **FINANCING INNOVATIVE ENTREPRENEURS**

This chapter discusses the framework conditions, drivers and current state of innovative entrepreneurship in Armenia. It presents current and possible future policy measures, including initiatives that have general implications for business innovation performance. The chapter concludes with a number of policy recommendations.

#### **6.1 Framework conditions for business**

Armenia has made significant progress in improving its business environment in international comparisons, particularly in terms of formal regulatory arrangements, although there remains scope for more effective application. Armenia ranked 37<sup>th</sup> (of 189 economies) in the Doing Business report 2014<sup>45</sup> on ease of doing business, a strong position within Eastern Europe and Central Asia (average rank: 71). Starting a business (ranked 6<sup>th</sup>) and registering property (ranked 5<sup>th</sup>) are areas of strength, largely due to online and “one stop shop” services and a well-function real estate cadastre,<sup>46</sup> although basic infrastructure is more problematic (getting electricity: 109<sup>th</sup> and obtaining construction permits: 79<sup>th</sup>).

Getting credit and protecting investors were evaluated as slightly above average, with improvements regarding access to information on and for transacting parties (lenders, borrowers and shareholders). The credit information system is well developed, and includes both private and public credit registries. A system of state registration of leasing rights and pledges on movable property was introduced in 2004.

Weaknesses include paying taxes (ranked 103<sup>rd</sup> in 2014),<sup>47</sup> in particular the time required for compliance, although the number of payments is comparable to the OECD average, and tax rates below average. The World Bank Enterprise Survey<sup>48</sup> also finds changing tax regulations, together with favouritism by government officials for well-connected individuals, as the most commonly cited legal and regulatory constraints in Armenia. Other frequently cited obstacles to setting up or operating a firm are commonly found in developed countries, and include: recruiting highly-skilled employees, market risks and uncertainty, and access to finance.

Given a landlocked location and small domestic market, the costs of trading across borders are significant. The documentation and time required for exports and imports have decreased

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<sup>45</sup> Doing Business 2014: Understanding Regulations for Small and Medium-Size Enterprises, World Bank and International Finance Corporation, 2013, <http://www.doingbusiness.org/>.

<sup>46</sup> Armenia also removed minimum capital requirement and the need for obtaining approval from the National Police Department to prepare a company seal, while company registration fees were eliminated. The requirement to conduct an environmental impact assessment was removed for small-scale construction projects. Getting electricity was somewhat eased by streamlining procedures and reducing connection fees.

<sup>47</sup> Tax compliance for firms has recently been eased by reducing the number of payments for social security and corporate income, property and land taxes, as well as mandatory electronic filing and payment of major taxes.

<sup>48</sup> World Bank Enterprise Survey Database, <http://www.enterprisesurveys.org/>.

over recent years.<sup>49</sup> Costs, however, have increased: for exports in 2013, they were more than double the OECD average. As with paying taxes, administrative changes, including towards electronic systems, have not been accompanied by effective systemic improvements that bring measurable benefits to entrepreneurs. The Global Competitiveness Report 2013-2014 found the burden of customs procedures to be very high in Armenia, which ranked 123<sup>rd</sup> of 171 countries on this indicator. Low contract enforceability remains a persistent issue (ranked 112<sup>th</sup>). Conditions for resolving insolvency (ranked 76<sup>th</sup>) are assessed somewhat more favourably, possibly reflecting recent reforms to simplify bankruptcy procedures, and set time limits. Re-starters are not restricted in their access to business support schemes or public procurement tenders, and quicker debt settlement is supported by ensuring tax liabilities have a lower priority than secured creditors.<sup>50</sup>

The World Economic Forum's Global Competitiveness Report includes a qualitative assessment of framework conditions for entrepreneurship, on the basis of the annual WEF Executive Opinion Survey.<sup>51</sup> Armenia ranked 80<sup>th</sup> of 132 countries in 2006/2007, the period for which data are first available, compared with a ranking of 79<sup>th</sup> of 171 countries in 2013/2014, i.e. moving from the lower to the upper half of the rankings. Armenia scores better in basic requirements (4.5), compared to more advanced efficiency enhancers (3.9) and innovation and sophistication factors (3.4). Among basic requirements, the quality of institutions is considered weak (4.0), as well as infrastructure (3.8). Principal institutional weaknesses include independence of the judiciary, the legal framework, irregular payments and favouritism, and the burden of government regulation, while auditing and reporting standards together with property rights protection are assessed more favourably, but still weak by international standards.<sup>52</sup> The macroeconomic environment and health and primary education pillars are areas of relative strength.

## 6.2 Efficiency enhancers

Efficiency enhancers represent more specific preconditions for the effective use of available factors of production. In terms of human resources in Armenia, the WEF GCR makes a distinction between quantity (5.2) as opposed to quality (3.8) of higher education, with particular issues regarding the quality of management schools (3.4), while mathematics and science score higher (4.2). During this review, interviewees highlighted a lack of highly-skilled specialists, despite an adequate number of tertiary graduates, suggesting quality issues in higher education that should necessitate greater investment in on-the-job training. However, Armenia scores poorly in this field (3.5), both regarding availability of specialized business services and extent of staff training.

These issues are further aggravated by persistent “brain drain”, meaning limited capacity to retain or attract talent (2.6, ranked 116<sup>th</sup> globally). A number of initiatives by both domestic and foreign organizations seek to develop business opportunities in Armenia, including in

<sup>49</sup> A series of reforms were introduced to make trading across borders easier. The Electronic Data Interchange Direct Trader Input system enables customs brokers to directly submit customs declarations to Customs offices. Self-declaration desks were introduced at customs, and the number of goods requiring inspection reduced.

<sup>50</sup> OECD, et al. (2012), SME Policy Index: Eastern Partner Countries 2012: Progress in the Implementation of the Small Business Act for Europe, OECD Publishing, Paris.

<sup>51</sup> World Economic Forum, Global Competitiveness Report 2013-2014.

<sup>52</sup> Armenian banks find reporting and auditing standards to be low, especially in the case of smaller companies and/or in rural areas, making access to loans and other financial services difficult.

knowledge-intensive sectors, but capacity losses from emigration outweigh the considerable benefits of diaspora activities in the homeland.

Demand side efficiency enhancers are evaluated in terms of competition and technology intensities (scoring 4.3 and 3.7, respectively). Competition intensity in Armenia is limited by the small scale of domestic and foreign markets. The quality of business demand is evaluated somewhat more favourably, but buyer sophistication is below average (3.5), while government procurement of advanced technology products and services as well as ICT use indicators fall behind considerably (3.0). While the role of FDI in technology transfer is an area of relative strength, the availability of latest technologies and firm-level technology absorption are weak (around 4.4).

### *Financial conditions*

Financial market development corresponds to the WEF GCR average for Armenia, with an aggregate score of 3.9 (see Table 18). Trustworthiness and confidence, in particular the soundness of banks, score better than efficiency indicators, as confirmed by interviews and other surveys.<sup>53</sup> According to a survey conducted by the EBRD, Armenian banks hold the most positive views in the CIS region in relation to their regulator (the Central Bank of Armenia), with nearly all banks (strongly) agreeing that the regulator is fair and impartial, and able to enforce its decisions.<sup>54</sup> The legal and regulatory framework has improved over recent years, in particular regarding cadastre and credit information services.

**Table 18. Financial market development indicators in Armenia**

	2006	2007	2008	2009	2010	2011	2012	2013
<b>Financial market development</b>	<b>3.4</b>	<b>3.6</b>	<b>3.7</b>	<b>3.8</b>	<b>3.6</b>	<b>3.8</b>	<b>4.0</b>	<b>3.9</b>
<i>Efficiency</i>	2.7	3.2	3.2	3.1	2.9	3.0	3.4	3.3
Affordability of financial services	-	-	-	-	3.6	4.1	4.5	4.4
Availability of financial services	-	-	-	-	3.5	4.0	4.5	4.6
Venture capital availability	2.4	2.1	2.0	1.9	1.8	2.1	2.4	2.4
Ease of access to loans	2.2	2.0	2.3	2.2	2.0	2.5	2.8	2.6
Financing through local equity market	2.8	2.6	3.0	2.7	2.0	2.5	2.7	2.5
<i>Trustworthiness and confidence</i>	4.1	4.0	4.1	4.5	4.3	4.5	4.6	4.5
Regulation of securities exchanges	3.1	3.1	3.1	3.2	3.6	3.6	3.5	-
Soundness of banks	4.7	5.0	5.2	5.1	5.0	5.2	5.5	5.3

*Source:* WEF Global Competitiveness Index data platform, [www.weforum.org/issues/competitiveness-0/gci2012-data-platform/](http://www.weforum.org/issues/competitiveness-0/gci2012-data-platform/), retrieved 30 September 2013.

The supply of financial services and instruments was evaluated as low (availability and affordability of financial services) or even very low (venture capital, ease of access to loans, financing through local equity markets). This unfavourable assessment is confirmed by other sources, specifically pointing to the problems of SMEs and/or start-ups in accessing finance,

<sup>53</sup> EBRD, Banking Environment & Performance Survey II Country Profile: Armenia, 2012 (Survey 2010-2011).

<sup>54</sup> Central Bank measures aimed at consolidating the sector, strengthening supervision, introducing new corporate governance regulations and enforcing penalties for non-compliance with prudential norms.

particularly in rural areas.<sup>55</sup> More specifically, the World Bank Enterprise Surveys (2009) indicated that share of Armenian firms identifying access to finance as a major constraint is close to the global average (around 30%), but higher in the periphery and the retail sector.

While small- and microlending programmes are available through banks, specialized microfinance banks and other credit institutions, other sources of financing such as leasing and private equity are underdeveloped. However, impressive progress has been made in relation to the availability and affordability of financial services, with Armenia moving from 104<sup>th</sup> and 121<sup>st</sup>, respectively, in 2010, up to 50<sup>th</sup> and 63<sup>rd</sup>, respectively, in 2013.

According to Ameria Group,<sup>56</sup> around 80,000 SMEs currently operate in Armenia, accounting for roughly 40% of GDP. In 2013, the Government allocated AMD 150 million to develop the sector. Armenia's commercial banks provide around 70% of loans to SMEs in the local currency. The average credit amount is AMD 8.5 million, at an annual interest rate of 18.5%. Remaining loans were extended in US dollars, with an average loan of \$130 thousand at a 14.5% interest rate. Aside from the cost of funding lending activities, a challenge facing local lenders is the scarcity of local currency in the domestic market, and increased dollarization. A significant share of liquidity is in foreign currency, exposing smaller players, including microlenders, to foreign exchange risks. Foreign lending has grown twice as fast as lending in the local currency.<sup>57</sup>

Regarding the microfinance business environment, Armenia's international position worsened in 2013, falling to 26<sup>th</sup> of 55 countries (from 18<sup>th</sup> in 2012) in the Global Microscope on the Microfinance Business Environment 2013, although its overall score remained the same (47.4). The institutional framework is a strong point, but weaknesses in terms of political stability, and particularly the regulatory framework and practices, pull the overall ranking down. In terms of microfinance institutions' gross loan portfolio as a share of GDP, within the Global Innovation Index, Armenia was ranked in 7<sup>th</sup> position globally (6.8% in 2011).<sup>58</sup>

Supervisory authorities have the capacity to monitor lending activities, including microcredit, but the major concern is risk management and the provision of appropriate collateral rather than credit growth. There is an absence of specific legislation for microfinance, with prudential requirements applied across the financial sector without specific regard for the risks associated with microfinance. Consumer protection ranks highly among emerging markets, with a high degree of transparency demanded by authorities in relation to credit pricing. Smaller microlenders struggle to compete with larger banks targeting the same client segments, while deposit taking in Armenia remains restricted to banks. Microlenders therefore rely on external funding and retained earnings to fund their credit portfolios. Existing microlenders cannot lend to non-registered businesses. Non-regulated legal entities are not allowed to engage in microfinance activities, and conversion from a non-governmental organization (NGO) to a microfinance institution remains relatively difficult in practice, with

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<sup>55</sup> OECD, et al. (2012), SME Policy Index: Eastern Partner Countries 2012: Progress in the Implementation of the Small Business Act for Europe, OECD Publishing.

<sup>56</sup> Cited in <http://www.panarmenian.net/eng/news/171330/>, retrieved 15 October 2013.

<sup>57</sup> Global microscope on the microfinance business environment 2013, Economist Intelligence Unit, <http://www5.iadb.org/mif/en-us/home/knowledge/developmentdata/microscope.aspx>, retrieved 15 October 2013.

<sup>58</sup> INSEAD, Global Innovation Index, 2013, <http://www.globalinnovationindex.org>.

non-bank financial institutions that provide microcredit facing relatively demanding minimum capital and reporting requirements.<sup>59</sup>

While interest rates on loans are high, Armenian banks report insufficient credit demand as their main constraint, particularly from applicants with adequate credit histories and cash flow. Lack of financial transparency among SMEs, particularly in agriculture, has led to banks mistrusting even audited financial statements, and relying heavily on collateral. Commercial banks impose stringent collateral requirements, although SMEs and recipients of group (community) loans can benefit from the flexible collateral requirements that apply to microlending. Legislative gaps have prevented the development of various specialized financial products, such as trade finance and factoring.

The banking sector in Armenia is small and fragmented, with domestic credit accounting for only 38.6% of GDP at the end of 2012. Although financial intermediation grew over 2006-2012, it remains below levels reported in Eastern Europe. The banking system is the major actor in the Armenian financial system, accounting for 90.2% of total assets.<sup>60</sup> At the end of 2012, there were 21 commercial banks and one development bank in Armenia, of which the largest four held almost 40% of assets. The share of non-resident participation in the statutory capital of the banking sector reached 73.3%. Banks offer largely simple credit products, mainly in three sectors: trade (20.1%), industry (23.4%), and consumer lending (18.5%).

Other financial institutions included 32 credit organizations with 100 branch offices (8.1% of financial assets), nine insurance companies (1.4%), nine investment companies (0.9%) and other financial institutions (1.5%). According to the IMF, the non-bank sector in Armenia is underdeveloped, with a small but growing insurance sector and a tiny capital market. Its development is a priority for the authorities, as pension reform and other policy measures are being taken to promote the institutional investment and product innovation.<sup>61</sup>

Securities market legislation is well developed with the Law on Securities Market Regulation enacted in 2007, but remains weakly enforced. The Armenian Stock Exchange was established in 2000, and has various listing options. However, the equity market remains small and illiquid, with a market capitalization of 1.3% of GDP as at end 2012.<sup>62</sup> The Venture Capital and Private Equity Country Attractiveness Index<sup>63</sup> ranked Armenia 94<sup>th</sup> of 118 countries in 2013 in terms of its subindex for “Depth of Capital Market”, representing a significant underperformance relative to other subindexes. Performance is somewhat better in terms of initial public offerings.

The private equity sector is underdeveloped, with very limited interest from international private investors. A number of international financial institutions (EBRD, IFC, BSTDB and FMO) have jointly provided financing to the Caucasus Growth Fund – an equity fund. The first investment agreement, worth \$2 million, was signed in April 2013. Legislation on risk capital has been in force since January 2011, with the Law on Investment Funds. However, a

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<sup>59</sup> Global microscope on the microfinance business environment 2013.

<sup>60</sup> Armenian Financial System 2012, Development, Regulation, Supervision. Central Bank of Armenia, 2013.

<sup>61</sup> Republic of Armenia: Financial System Stability Assessment. International Monetary Fund, 2013.

<sup>62</sup> World Development Indicators Database, World Bank, retrieved 30 September 2013.

<sup>63</sup> IESE Business School, <http://blog.iese.edu/vcpeindex/ranking-2013/>, retrieved 30 September 2013.

difficult business environment persists, with investment opportunities and exit options limited, contributing to underdevelopment of private equity finance (OECD, 2012).

Leasing is developing as an alternative source of SME financing. The legal framework is defined by the Civil Code and the Law on Credit Organizations, with regulation by the Central Bank. A specific law on leasing activities is currently under consideration. There are only a few leasing companies operating in Armenia (including ACBA leasing, Unileasing and Agroleasing), and the scale of leasing operations is relatively small.

Remittances play a significant role in financial development and investment, contributing to the availability of loans and other financial instruments, and provide a secondary source of income to support access to bank credit. Armenia ranks among the countries with the highest remittance inflows, at 21.4% of GDP in 2012.<sup>64</sup> A significant correlation between migration and the presence of a family business in Armenia suggests that migrant earnings can provide scarce capital for business investment and contribute to private sector development in the region.<sup>65</sup> The results of a survey conducted by the Central Bank of Armenia (2006) showed that households in urban areas receiving remittances annually over \$15 thousand spent 25% of the money on business activities, versus a 1.2% average for all recipients.<sup>66</sup>

The majority of remittances flow not through bank accounts, but through informal channels. In 2012, the EBRD launched a new initiative on financial inclusion – the Financial Literacy to Remittance Recipients programme in Armenia. With the support of five Armenian banks, the aim is to develop the personal finance skills of remittance recipients, enabling them to leverage their funds to obtain mortgages or loans to start a small business.<sup>67</sup>

### 6.3 Innovative entrepreneurship

We compare the position of Armenia in the Doing Business Survey (DB) Database 2013 with the indicator of business entry density published in the World Bank Entrepreneurship Database (2004-2011),<sup>68</sup> and defined as the number of newly registered, limited liability companies in the formal sector per 1,000 working age population aged 15-64. The countries included in the comparison (Table 19) are those ranked immediately above and below Armenia in DB 2013, with the addition of Georgia (ranked 9<sup>th</sup> in DB 2013), and excluding Cyprus. New business entry density in Armenia has declined since 2007, and is relatively weak among this sample of countries – higher only than in Austria.

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<sup>64</sup> Annual Remittance Data Inflows, World Bank Database. 85% of remittances originated from Russia.

<sup>65</sup> Within the former Soviet Union, Armenia and Georgia had the highest emigration rates and relatively high migrant skill levels after independence, Z. Dermendzhieva (2011), Emigration from the South Caucasus: who goes abroad and what are the economic implications? Post-Communist Economies, No. 3, pages 377-398.

<sup>66</sup> L. Karapetyan and L. Harutyunyan (2013) The Development and the Side Effects of Remittances in CIS Countries: the Case of Armenia, European University Institute.

<sup>67</sup> Only 17% of people over the age of 15 have an account at a financial institution and 1% keep savings in a bank (World Bank Financial Inclusion index), <http://www.ebrd.com/pages/news/press/2013/131010b.shtml>.

<sup>68</sup> See <http://www.doingbusiness.org/data/exploretopics/entrepreneurship>, retrieved 30 September 2013.

**Table 19. New business entry density, 2004-2011**

	2004	2005	2006	2007	2008	2009	2010	2011
<b>Lithuania</b>	1.53	1.82	2.14	2.65	2.19	2.18	n.a.	n.a.
<b>Switzerland</b>	2.17	2.19	2.25	2.34	2.40	2.33	2.41	2.52
<b>Austria</b>	0.59	0.64	0.67	0.64	0.65	0.58	0.61	0.56
<b>Portugal</b>	3.54	3.68	4.02	4.39	4.51	3.92	n.a.	n.a.
<b>Netherlands</b>	2.26	2.64	3.30	3.15	3.44	3.16	3.05	3.20
<b>Armenia</b>	1.26	1.13	1.37	1.72	1.65	1.22	1.19	1.12
<b>Belgium</b>	2.38	2.36	2.70	3.00	2.87	2.52	2.46	3.00
<b>France</b>	2.77	2.85	3.03	3.52	3.51	3.06	3.14	3.13
<b>Slovenia</b>	2.18	2.37	2.75	3.52	4.41	4.10	3.81	4.04
<b>Chile</b>	2.04	2.22	2.48	2.68	2.76	2.87	3.23	4.13
<b>Israel</b>	n.a.	4.57	4.41	4.57	4.46	n.a.	n.a.	n.a.
<b>Georgia</b>	1.12	1.35	1.92	2.31	2.84	2.56	3.61	4.49
<b>Median</b>	2.18	2.37	2.73	3.08	3.16	2.87	3.05	3.13

*Note:* Median excludes Armenia and Georgia. Source: World Bank Entrepreneurship Database, 2012.

Standardized statistics on business start-ups and survival rates are not generally available for transition economies. According to an EBRD survey in 2010,<sup>69</sup> attempts to start a company and successful business start-ups comprised only 7.5% and 3.5% of the total population, respectively, which was the lowest across the survey sample of EBRD member countries. The share of so-called latent entrepreneurs also comprised only 17% of the labour force, compared to an average of around 25% for the Europe and Central Asia region.

According to the 2012 World Bank Entrepreneurship Survey, around 60% of start-ups were based on modifications to existing products or services, with the remaining 40% new to the market. The main source of funding for start-ups (almost 92%) were founders' own savings, in a small proportion of cases combined with bank financing (18%). Companies in high-tech sectors tend to have greater access to external funds. Firms consider new and/or high-quality products and services to be most important for maintaining competitiveness, while R&D activities, including external knowledge collaboration, are considered less important. The most important sources of knowledge for exploring new business opportunities were clients, sales to the domestic market, in-house knowledge capacities and competitors.

In terms of growth performance, key factors included company strategy (based both on cost advantages and product uniqueness), innovation activity, and founders' industry experience. Factors important for innovation propensity included founder expertise, international sales, R&D activity and product uniqueness in company strategies, and competitors' innovation activities. External funding did not play a significant explanatory role in either case.

The WEF GCR differentiates between two groups of indicators approximating innovation supply: one relating to business sophistication and the other to innovation capacity and performance (Table 20). These scores have diverged over time, with economic crisis a

<sup>69</sup> E. Nikolova, F. Ricka and D. Simroth (2012), Entrepreneurship in the transition region: an analysis based on the Life in Transition Survey, EBRD, WP No. 141.

possible cause of stagnating innovation activities. In terms of business sophistication, only local supplier quality has improved significantly since 2006, with production process sophistication rated as particularly weak. Competitive advantage is evaluated as relying largely on cost advantage rather than new products or services, with narrow value chains, limited marketing and underdeveloped clusters. Innovation capacity scores worse, with intramural business R&D expenditure consistently low, although external knowledge linkages score somewhat better. University-industry collaboration in R&D has increased, but the quality of scientific research institutions was assessed as having declined.

**Table 20. Innovation and business sophistication indicators in Armenia**

	2006	2007	2008	2009	2010	2011	2012	2013
<b>Innovation and sophistication</b>	3.2	3.1	3.0	3.0	3.0	3.1	3.3	3.4
<i>A. Business sophistication</i>	3.4	3.3	3.3	3.3	3.3	3.4	3.7	3.8
Local supplier quality	3.5	3.5	3.8	3.8	3.8	3.9	4.1	4.2
State of cluster development	2.9	2.7	2.4	2.6	2.6	2.9	3.6	3.6
Nature of competitive advantage	3.5	3.5	3.6	3.7	3.9	3.6	3.7	3.8
Value chain breadth	3.6	3.3	3.1	3.0	2.9	2.9	3.4	3.6
Production process sophistication	3.1	3.0	2.9	2.9	3.1	3.3	3.5	3.5
Extent of marketing	3.0	2.9	3.0	3.1	3.1	3.3	3.5	3.8
<i>B. Innovation</i>	3.0	2.9	2.8	2.7	2.6	2.7	2.9	3.0
Capacity for innovation	3.2	3.0	3.1	3.0	3.0	3.1	3.2	3.4
Quality of research institutions	3.7	3.5	3.4	3.2	3.0	3.0	3.0	3.1
Company spending on R&D	2.6	2.6	2.7	2.5	2.4	2.6	2.7	2.8
University-industry R&D cooperation	2.6	2.5	2.5	2.8	2.8	2.7	2.9	3.2

*Source:* WEF Global Competitiveness Index data platform, available online [www.weforum.org/issues/competitiveness-0/gci2012-data-platform/](http://www.weforum.org/issues/competitiveness-0/gci2012-data-platform/), retrieved 30 September 2013.

In 2012, the World Bank surveyed 300 companies founded between 2002 and 2010 in selected priority sectors – generally those with better growth prospects, which also tend to be more innovative – with around 85% of the sample being SMEs. These sectors included: metals and machinery, chemicals, garments and retail.<sup>70</sup> Innovation activities are classified as product or process innovations introduced in the previous three years (67% and 75% of companies, respectively), investing in R&D (23%), and licensing technology from foreign-owned companies (40%). Companies in the sample introduce new products and processes with similar intensity, but small companies invest less in R&D and technology licenses, i.e., their innovations are more often non-technology based, also reflecting sectoral differences (about 50% of companies in chemical and machinery sectors invest in R&D, compared to only 10% in the garment and retail sectors). Innovating companies were found to export and provide training more frequently than non-innovators, but also to have more problems with corruption and favouritism. Export, training or foreign ownership characteristics were not, however, found to predict innovation activities among Armenian firms.

<sup>70</sup> Fostering Entrepreneurship in Armenia. World Bank, 2013. Sectors included food, chemicals, machinery and equipment, electronics, information technology, transport, pharmacy, telecom, and hotels and restaurants.

A survey of small and medium-sized enterprises by Ameria Group Management Advisory<sup>71</sup> focused on financing, banking and business services requirements and factors influencing SME development, including regulatory measures and innovation performance. This survey found limited innovation activities that are strongly related to firm size, with implementation by 28% of micro businesses (up to 10 employees), 43% of small businesses (up to 50 employees) and 60% of mid-size companies (up to 250 employees). Innovation in production and marketing were implemented in only 14% and 13% of Armenian SMEs, respectively (compared to 21% and 16%, respectively, in Russia). The share of SMEs introducing new products for domestic or foreign markets were even lower (6% and 1%, respectively, compared to 14% and 8% in Russia).

Within the government support programme for the information technology sector, industry specific data have been collected, including on development prospects and barriers.<sup>72</sup> The sector's competitive advantages combine technical knowledge in engineering, computer science, physics and mathematics with low labour and operating costs. The long-term strategy to 2030 is to transform the Armenian IT industry from a provider of low-end outsourcing services focused on cost advantages to an R&D powerhouse offering higher value added research, development and engineering services in specialized technology segments. Main barriers to growth identified by responding firms (80% of which had an annual turnover less than \$100 thousand) include access to finance (around 50% of respondents), problems entering international markets (45%), lack of qualified technical workforce, brain drain and labour costs (40%), customs and tax procedures (39% and 28%, respectively).

The knowledge intensity of the IT sector in Armenia, both in terms of inputs and outputs, has been increasing, with around 41% of total revenues generated by own products and services, although in the case of companies established in 2011-2012, the proportion increases to 62%.

#### **6.4 Support for innovative entrepreneurship**

There are numerous programmes and projects supporting innovative entrepreneurship in Armenia. Some of these include an innovation dimension, particularly those targeting SMEs, knowledge-intensive industries (most notably information technologies) or other growth sectors. Individual support activities are small scale, without clear coordination or evaluation strategies. Support includes capacity building (training, consulting) or infrastructure provision and funding instruments, such as loan guarantees or microlending. Only in October 2013 was the first venture capital fund, Granatus, set up on a public-private match funding basis. Private equity funding instruments remain at the conceptual stage. One study<sup>73</sup> estimated demand for equity investment in Armenia over the next five years as being in the \$7.5 to 9 billion range, versus available resources of only \$50 million, of which 95% provided by international financial institutions. With total capital and credit investments by international financial institutions in Armenia in 2012 amounting to only \$150 million, pension funds, global equity

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<sup>71</sup> Ameria Group (2013), Small and Medium Entrepreneurship in Armenia, Current state, expectations, preferences, 1,000 businesses surveyed May-June 2013.

<sup>72</sup> The survey included 360 companies in the software and services segment with total turnover of \$244 million, see EIF, Armenian Information and Communications Technology Sector, State of Industry Report 2012.

<sup>73</sup> Arka News Agency press release, Grant Thornton study finds the demand for equity investment in Armenia in next five years may range from \$7.5 to \$9 billion, 25 September 2013.

funds, insurance companies and local and international organizations are key potential sources of equity investment.

The concept of innovative entrepreneurship and its funding was only recently added to the national development framework.<sup>74</sup> The pioneer government initiative was linked to the IT sector, for which the venture capital seed fund is to provide a new growth impetus. The second initiative is the SME strategy, including a number of new activities over 2012-2015. Development strategies regarding export or foreign investment also have an impact on innovative activities. Policy coordination of support for business development, including innovative aspects, falls under the Ministry of Economy, with three key implementing agencies, the Small and Medium Entrepreneurship Development National Center, Enterprise Incubator Foundation, and Armenian Development Agency.

Entrepreneurship support in Armenia has a strong international aspect, including international development organizations and diaspora activities abroad and in Armenia. USAID, UNDP and EBRD play particularly active roles in business development, cooperating closely with the aforementioned national support agencies. According to OECD statistics, Armenia received around \$1.3 billion of foreign aid between 2005 and 2011, although inflows have decreased over time. The diaspora is considered to play an important role in the country's development,<sup>75</sup> in particular thanks to its strong business acumen.

## 6.5 National and sectoral development framework

In the Medium-Term Public Expenditure Framework, priorities related to innovative entrepreneurship include support to SMEs and the IT sector. The Medium-Term Public Expenditure Framework for the period 2014-2016 confirmed and updated current priorities. Between 2002 and 2012, around AMD 3 billion were allocated to SME support from the state budget, of which AMD 300 million in 2011-2012, and AMD 150 million in 2013. State support to the ICT sector amounted to AMD 160 million over 2011-2012.<sup>76</sup>

The Law on State Support to Small and Medium-sized Enterprises was adopted in 2000, with priorities including a favourable legal environment, financial and investment support and the provision of guarantees, creation and development of supportive infrastructure, information and consulting, internationalization, favourable tax policy, staff training and retraining, streamlined systems of statistical reporting and accounting, support regarding state procurement and implementation of modern technologies.

The SME DNC Fund was established in 2002 to support SMEs, using both financial and non-financial instruments. SME DNC activities, delivered through its network of regional branches and representative offices, are only partly funded from the state budget, with the organization drawing on other resources, both national and foreign, and cooperating, among

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<sup>74</sup> Law on State Support for Innovation Activity (2006) prioritized: (a) creating a favourable legal environment for venture and investment fund formation and innovation activity; (b) financial and investment support, provision of guarantees; (c) provision of rights for use of state assets; (d) developing innovation infrastructure (innovation-research centres, business incubators, technology parks, innovation funds) and (e) specialist training.

<sup>75</sup> Migration Policy Institute, Washington, D.C.: K. Newland and D. R. Agunias (2012), *Developing a Roadmap for Engaging Diasporas in Development: A Handbook for Policymakers and Practitioners in Home and Host Countries*; K. Newland and H. Tanaka (2010), *Mobilizing Diaspora Entrepreneurship for Development*.

<sup>76</sup> Medium-Term Public Expenditure Framework 2014-2016, Government of Armenia, pages 417 and 432.

others, with the UNDP<sup>77</sup>, Enterprise Europe Network and Asian Development Bank. SME DNC activities are quite wide ranging and ambitious, divided into five priorities in the public expenditure framework. These are further specified in the National Strategy of Small and Medium Entrepreneurship Development for 2012-2015, which includes specific outcome indicators for increased value-added of existing SMEs in country GDP, and newly created jobs and start-ups (56,000 and 13,000, respectively), with a focus on local economic development, particularly in peripheral and rural areas. Besides capacity building and infrastructure support, financial assistance for SMEs, including start-ups, includes loan guarantees, equity financing, seed capital, and subsidies on loan interest. Financial support instruments are implemented through partner commercial banks and credit organizations.<sup>78</sup> The development strategy aims to build a state support system for SMEs to facilitate access to finance.

In terms of financial support for start-ups, the number of eligible business plans and the total value of guarantees and loans saw a marked increase in 2012 (Table 21). Support for existing SMEs has recovered since the crisis, but lags behind peak values seen in 2007. In 2013, the SME DNC Fund earmarked AMD 778 million for SMEs. In addition, the SME Investment Universal Credit Organization (UCO) will allocate AMD 6.6 billion for this purpose.

**Table 21. Guarantees for SME loans (values in ADM million and numbers)**

<b>Start-ups</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Guarantee value	5.0	30.2	44.8	109.4	53.5	37.4	268.4
Loan value	4.3	25.3	37.4	91.5	44.8	31.2	262.6
Number of funded plans	6	35	41	65	30	17	120

<b>Existing SMEs</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Guarantee value	342.2	375.7	213	246.5	63.5	52.1	179
Loan value	628.1	722.7	391.1	435.2	136.3	90.9	315.5
Number of funded companies	87	94	56	57	13	11	30

*Source:* SME DNC Annual Report 2012, pages 7 and 17.

The total value of lending to SMEs in Armenia is not available, although some of the key banks provide data differentiating between large enterprises and SMEs. In 2012, total lending to private businesses by Armenian banks reached almost AMD 910 billion. For the largest banks, around 35% of lending was to SMEs.<sup>79</sup>

Development of the IT sector was identified as a Government priority in December 2000, with the Strategy for Development of the ICT Industry, based on the ICT Master Plan, approved in May 2001. The Information Technologies Development Support Council, chaired by the Prime Minister, was created in July 2001. In 2002, the Enterprise Incubator Foundation

<sup>77</sup> A joint project with the UNDP has been implemented since 2004 which included all the key segments of SME DNC agenda: Support to SME Development in Armenia. One of the segments of the project was evaluated in R. Ackermann (2010) Evaluation of SME DNC/UNDP joint project Support to SME Development in Armenia.

<sup>78</sup> Loan guarantees as well as credits for start-ups, approved by SME DNC, are provided by selected partner banks and UCOs, equity financing by SME Investment UCO.

<sup>79</sup> ARKA news agency, press release 15 February 2013, <http://www.ambanks.am/en/2013/02/15/48014/>.

was established by the Government and World Bank to support IT sector development. The Government adopted a new 10 year industrial development strategy in 2008 focused on building infrastructure, improving the quality of IT graduates, and creating venture and other financing mechanisms for start-ups. Expectations regarding financing instruments, however, proved quite unrealistic, with around \$100 million of public and private resources for venture capital expected by 2013.

## **6.6 International financing of innovative entrepreneurship**

A range of initiatives, of both direct and indirect relevance to innovation, have enjoyed strong private and/or international participation. These include: projects of the World Bank, USAID and UNDP; support initiatives for technology and other innovative start-up activities; and activities of international financial organizations in funding entrepreneurship through local lending measures (especially for micro- and SMEs).

### *Capacity development projects and new funding instruments*

The World Bank E-Society and Innovation for Competitiveness Project was approved in 2010 and runs until the end of 2014, with \$30 million budget, focusing on infrastructure services for private sector development, micro- and SME support, technology diffusion, and administrative reforms. The project includes creation of the seed and early stage fund Granatus Ventures, the Gyumri technology center and incubator, a planned technology center in Vanadzor and capacity-building for internationalization of enterprises.

Granatus Ventures (GV), the first venture capital fund in Armenia, was launched in 2013. It is focused on investing in and helping start-ups achieve success by leveraging international value chains, the Armenian diaspora, and a global network of advisers, mentors, and partners. Government investment is expected to total \$3.3 million, with private investment in GV's capital of \$3 million. GV funding instruments include ideas grants of between \$2 thousand and \$10 thousand to fund business plans and feasibility studies, innovation matching grants of between \$10 thousand and \$150 thousand to convert promising research into commercial applications, innovation grants (up to \$50 thousand) planned under the new Strategy of Export-led Industrial Policy, and innovation brokerage to incubate investment ideas and secure growth capital. GV targets seed stage, start-up and spin-off investments in the \$50 thousand to \$1 million range with at least a working prototype or beta. GV aims to take strategic minority interests with clear exit prospects and a mandatory board seat, and achieve growth by partnering with local or regional investors. Companies' core activities should be in Armenia, with scope to build international value chains. Investment from diaspora entrepreneurs will be targeted, as well as building international networks of experienced technology entrepreneurs. Priorities include IT, enterprise software, consumer internet, mobile, engineering and systems. GV will also have a capability-building programme. The Granatus Acceleration Program will provide training on various aspects of business and entrepreneurship.

The USAID funded project Enterprise Development and Market Competitiveness (EDMC) was launched in 2011 and will run to 2016, with a budget of \$8 million.<sup>80</sup> EDMC seeks to

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<sup>80</sup> The preceding project Competitive Armenian Private Sector (CAPS) was completed in February 2011 after five years. It included four components: building industry clusters (IT, tourism, pharmaceuticals), strengthening

promote SME development, employment, exports and income growth. Actions are taken to encourage innovations enhancing value chain competitiveness, develop managerial and other skills, help companies expand existing markets and enter new ones, and develop draft amendments to laws and regulations to improve the business environment and streamline administrative procedures. There is a particular focus on building capacities of public institutions in the high tech, pharmaceuticals/biotechnologies, food processing and hospitality sectors. Access to finance is enhanced by partnering with local banks to provide services to SMEs in the target sectors. Through this access to finance component, the EDMC identifies priority SME projects for the Caucasus Growth Fund.

The Caucasus Growth Fund was launched in 2012, with the aim of investing around \$60-70 million in private equity, sponsored by Small Enterprise Assistance Funds,<sup>81</sup> primarily in the target countries of Georgia, Armenia and Azerbaijan in the SME sector. The fund is financed by the EBRD, IFC, Development Bank of Austria, Entrepreneurial Development Bank of the Netherlands and the Black Sea Trade and Development Bank. The fund invests money in consumer and business services, agriculture, energy and retail trade sectors.

The new USAID project Finance for Economic Development was launched in 2013, with a budget of \$3.7 million over four years. It aims to improve financial services and intermediation for microenterprises and SMEs, including in rural areas. Activities will also focus on improving the regulatory and institutional framework for the financial sector, including related pension reforms.

The Women's Entrepreneurship Support Sector Development Programme, funded by the Asian Development Bank (budget: \$40 million), will be implemented over 2013-2017. Armenia has a lower share of women in managerial and enterprise ownership positions than the regional average, and the programme will promote gender inclusive growth by improving the enabling environment and capacity of women entrepreneurs and micro- and SMEs. The programme includes two components: (1) a loan (\$20 million) supporting reforms related to improving the business environment for women; and (2) a financial intermediation loan (\$20 million) through the German-Armenian Fund, in which medium-term local currency loans will be made by participating financial institutions to micro- and SMEs, at least half of which will be in female ownership.

Productive Work for Youth in Armenia - Supporting Young Entrepreneurs was launched in 2013 by UNIDO, with financial support from the Austrian Government, to help young entrepreneurs start and expand enterprises through both financial and training services. This targets 18 to 35 year olds, particularly young families and women. As part of this project, the Armenia Youth Entrepreneurship Fund will be established by SME DNC, with initial contributions of €200,000 from UNIDO and SME DNC to create a revolving fund providing loans to young entrepreneurs to convert ideas into businesses. It is expected that more than 300 potential and existing young entrepreneurs, of which 50% female, will receive tailored entrepreneurship training, and up to 80 youth-led businesses and start-ups will receive access to (reimbursable) funding from the Armenia Youth Entrepreneurship Fund. Post start-up

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business capacity, development of policy and advocacy capacity with government, associations and think tanks, enhancement of workforce and skills development.

<sup>81</sup> SEAF is a global investment management firm based in Washington, DC that provides risk capital to SMEs in emerging markets, and has been active in Eastern Europe, Latin America and Asia since 1989.

support will be provided in the form of training, mentoring and coaching to mitigate the risk of failure.

### *Innovative start-ups*

A growing number of competitive initiatives seek to encourage prospective entrepreneurship projects in Armenia, based on innovative solutions and sometimes targeting specific groups, particularly youth and women, and providing valuable networking opportunities.

The Science and Technology Entrepreneurship Program (STEP), created in 2006 by the EIF and US Civilian Research and Development Foundation, helps engineers, researchers and scientists enter business. STEP encourages effective partnerships with established companies through the targeted research competition From Idea to Market, and workshops, trainings and conferences. It facilitates knowledge transfer from research institutions to SMEs through collaborative research and organizes training programmes, staff exchanges and secondments. Grantees must seek agreement with their business partners for cost share (minimum 10% cash contribution) with Government match funding from the host country.

StartUp Cup is a global network of locally driven business model competitions open to any type of business idea. StartUp Cup is a featured event of Global Entrepreneurship Week, held annually around the world. The first StartUp Cup took place in the US in 2007, and in Armenia in 2012. StartUp Cup is an Official Partner of the US State Department's Global Entrepreneurship Program, an effort to promote and spur entrepreneurship around the world.

Microsoft Innovation Center in Armenia organizes several contests with international outreach. Imagine Cup is an annual worldwide series of student technology competitions that challenges teams to develop innovative software applications and present practical solutions to real world problems. Hackathon[YAN] is a contest festival of innovative ideas and projects. In 2011, it aimed to solve problems in Yerevan through new technologies encouraging user engagement, e.g. web and mobile applications.

Smart Solutions for Smart Countries was the 2013 theme of the international DigiTec Business Forum in Armenia. The organizing company was founded in 2005 by the Union of Information Technology Enterprises (UITE), one of the key stakeholders in the Armenian IT sector. Armrobotics, the Armenian Robotics Development and Support Program, has been implemented by the UITE since 2008, and included contests such as Robots in Everyday Life, Minesweeper Robots and Unmanned Aerial Vehicles.

Orange Labs are the worldwide innovation network of the Orange France Telecom group. In 2010, Orange Armenia created an Innovation Prize for Armenian students. Students are awarded a paid internship of up to six months in Orange Labs, on the basis of a competition of innovative ideas and projects in the telecommunications field.

The Social Innovation Camp (Mardamej) is organized by Eurasia Partnership Foundation, UNDP and the Alternative Resources in Media Program in cooperation with Social Innovation Camp (SIC) Ltd. SIC is a group-thinking format bringing together software developers with people who understand a social problem to build web and mobile based solutions. Regional outreach meetings identify social problems requiring solutions. The most

promising ideas (6 of 70 in 2012) are selected for the SIC, where they are further elaborated. Two winners are selected for financial assistance, one by public vote and one by jury.

Following the experience with SIC in Armenia, UNDP and the United Nations Children's Fund (UNICEF) started a social venture incubator (Kolba Labs) for initiatives conceived, designed and led by young people. The ambition is to turn social innovators into social entrepreneurs by developing core competencies, and making connections with social investment finance post incubation.

The winners of the Armenian Technology Startups (ATS) award, founded in 2012, are announced by the Association of Technology Start-ups of Armenia and USAID EDMC. There is an award ceremony covering the year's start-up related activities, and acknowledging the best Armenian IT start-up businesses, included from the abovementioned initiatives.

### *International Financial Institutions*

The most important funding resource for SMEs in Armenia is provided by foreign or international banking organizations, mostly channelled through local banks or credit unions.

The current Armenian strategy of the European Bank for Reconstruction and Development was approved in May 2012 for three years, with financial sector development and access to finance key priorities, especially for micro- and SMEs. 46% of EBRD's Armenian portfolio of €270 million is to the financial sector, often for on-lending to SMEs.

The World Bank Access to Finance for Small and Medium Enterprises Project was funded to the value of \$50 million over 2009-2012, although total lending provided through participating financial institutions was almost \$100 million, with use of revolving funds. The project was designed to help SMEs during the global financial crisis. The project was implemented by the German-Armenian Fund. More than 7,400 loans were provided to SMEs through 13 banks and two non-bank financial institutions, of which around 70% was for working capital, 20% for investments and 10% for mixed purposes.<sup>82</sup>

The Asian Development Bank approved five-year loans within the SME Finance Programme in 2011 which extended debt facilities of up to \$65 million to Armenian banks for on-lending to SMEs, with the aim of providing longer-term financing, particularly to businesses outside the capital and with attention to gender equity.

## **6.7 Assessment**

The role of innovative entrepreneurship in Armenia remains limited, with the IT sector a notable exception. There are multiple initiatives either explicitly or implicitly related to innovative entrepreneurship, but a holistic evaluation is problematic, with many initiatives very recent and limited resources committed to evaluation of activities.

Individual support initiatives, projects and programmes are relatively uncoordinated, with awareness among potential recipients often low. However, there are strong networking and

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<sup>82</sup> World Bank, Implementation Completion and Results Report No. ICR00002704 (IBRD-76570), 24 June 2013.

partnership activities across a number of sectors, and a vibrant business environment with investment opportunities, especially where initial capital outlays are low and can be met with own resources, including the available, high-skilled human capital.

Entrepreneurial support activities are mainly basic, e.g. networking, mentoring and training with support to access funding including loan guarantees and/or loans with soft interest rates or collateral requirements (e.g. for start-ups). Peripheral regions and disadvantaged groups are receiving increasing attention. The most representative support organization is the SME DNC, especially after the new medium-term strategy was launched in 2012. SME DNC works with a very limited contribution from the state budget, but has been successful in developing new international cooperation programmes and securing additional external resources. SME DNC has significant outreach, but does not explicitly target innovative entrepreneurship.

The Armenian diaspora is a valuable source of expertise, motivation and funding for domestic innovative entrepreneurship. While brain drain indicates a lack of opportunities for the most educated and entrepreneurial, the diaspora represents an asset of networks and resources, with many of its members involved in various initiatives in Armenia.

Overall, the assessment of innovative entrepreneurship in Armenia is rather positive, despite challenging conditions, notably a small domestic market with low knowledge intensity of demand. Institutional quality of the business environment is a weakness, despite continued reforms, which are yet to yield their full impact. Resources available for a policy of active support are very limited, but there are examples demonstrating that with sound governance by competent agencies, combined with international expertise and accountability, results can be impressive, although there is scope to raise awareness among potential recipients of support.

## 6.8 Recommendations

There are multiple initiatives to support, directly or indirectly, innovative entrepreneurship in Armenia. Anecdotal evidence shows some of them to be rather successful. However, there is limited data to assess current trends regarding entrepreneurship in Armenia or the impact of the measures being implemented. Potential beneficiaries are also not fully aware of the different ways in which they can find support. This general lack of information severely constrains the ability to design effective policies to encourage innovative entrepreneurship.

### Recommendation 6.1

*The authorities should make efforts to develop better information regarding entrepreneurship and support initiatives, which should be widely shared. The following actions could be considered:*

- *Learning lessons from entrepreneurship support initiatives, identifying good practices, factors explaining their success and the conditions required to scale-up or expand the scope of these initiatives. This would require a strengthening of analytical capacities and the development of robust impact evaluation methodologies;*
- *Joining the Global Entrepreneurship Monitor surveys would provide a basis for making comparisons between business activities across time and in relation to other countries. These data would facilitate analytical and evaluation efforts; and*

- *Developing information and awareness campaigns, with the support of entrepreneurial associations and other stakeholders, to ensure that potential beneficiaries are aware of the possible forms of support and how to access them.*

Initiatives to support entrepreneurship have different targets and are implemented by different agencies. This fragmentation partly reflects attempts to address the needs of different clients. However, fragmented initiatives and limited connections between various programmes lead to a lack of strategic direction in efforts to support entrepreneurship, and limited synergies in programme implementation.

### Recommendation 6.2

*The authorities should strengthen their efforts to provide a strategic orientation for entrepreneurship support. The following actions could be considered:*

- *Defining strategic targets, which are regularly evaluated and updated. The implementation of the strategy should envisage clear responsibilities, allocation of resources and coordination mechanisms;*
- *Involving beneficiaries and other sources of expertise, such as the diaspora, in determining the strategic orientation;*
- *Setting up a body with clear responsibilities and competencies for implementation and monitoring of the strategy; and*
- *Identifying synergies and complementarities among various programmes. Coordinated approaches should introduce schemes that build on previous experiences or seek to complement different programmes.*

The Armenian diaspora is a potentially important resource for the development of entrepreneurial activities in the country. It provides access to external knowledge networks that can support the internationalization of domestic companies. Members of this diaspora, who have become successful entrepreneurs abroad can contribute both expertise and financing to the development of new ventures in Armenia, while helping overcome the limitations of the domestic market.

### Recommendation 6.3

*The authorities could explore further ways to tap into the potential of the Armenian diaspora to support innovative entrepreneurship in the country. Initiatives that could be considered include:*

- *Awareness and information campaigns targeting the diaspora in existing and planned research programmes as a source of potential business opportunities;*
- *Development of a framework for business angel financing which takes into consideration cross-border aspects, so it can attract resources from the diaspora; and*
- *Involving the diaspora in the design and implementation of mentoring and coaching schemes for entrepreneurs and, in particular, those originating from educational and research organizations.*



## Chapter 7

### ***THE ROLE OF INNOVATION IN INTERNATIONAL ECONOMIC INTEGRATION***

This chapter considers the international dimension of innovation and its link to international economic integration. Firstly, it analyses the institutional framework for international cooperation in innovation, including trade and investment flows. Next, flows of knowledge and human capital are considered from the perspective of the internationalization of education and research. Finally, the chapter considers the key actors and barriers for international research cooperation. This analysis serves as the basis for a number of policy recommendations.

#### **7.1 Internationalization of the economy and innovation**

##### ***Institutional framework for international cooperation in innovation***

An overarching framework for international trade and innovation cooperation is provided by the WTO, to which Armenia acceded in 2002. Armenia's largest trading partner is the EU, and the Government finalized negotiations for a Deep and Comprehensive Free Trade Agreement (DCFTA) in July 2013. This process had already led to various regulatory changes to meet EU standards. However, in September 2013 there was a presidential announcement of plans for Armenia to join the Customs Union with Belarus, Kazakhstan and Russia.<sup>83</sup> The EU has declared that a DCFTA would be incompatible with membership of the Customs Union, and that the DCFTA agreement will be neither initialled nor signed.<sup>84</sup> The EU will continue cooperation with Armenia in all areas compatible with this choice, but the DCFTA would have facilitated FDI from the EU and exchanges with innovation leaders from these countries.

Armenia now aims to join the Customs Union with Belarus Kazakhstan and Russia, which would lead to harmonized import tariffs with these countries. In the longer run, further integration leading to free movement of goods, capital and labour should be achieved in the framework of a Common Economic Space. Armenia is also a member of the CIS, facilitating cooperation with countries of the former Soviet Union. The country has concluded free trade agreements with Georgia and all CIS countries, with the exceptions of Azerbaijan and Uzbekistan.<sup>85</sup>

Importantly, Armenia has critically assessed its economic potential, in particular how economic growth could be driven by increased exports. In 2011, the Strategy of Export-led Industrial Policy was adopted by the Ministry of Economy. According to this strategy, the share of knowledge-intensive exports will be significantly increased in the years to come.

<sup>83</sup> Kommersant (2013), Значительная часть внешнеторгового оборота Армении завязана на России и странах СНГ, see <http://www.kommersant.ru/doc/2271206>, retrieved 5 September 2013.

<sup>84</sup> See <http://eeas.europa.eu/armenia/>, retrieved 20 October 2013.

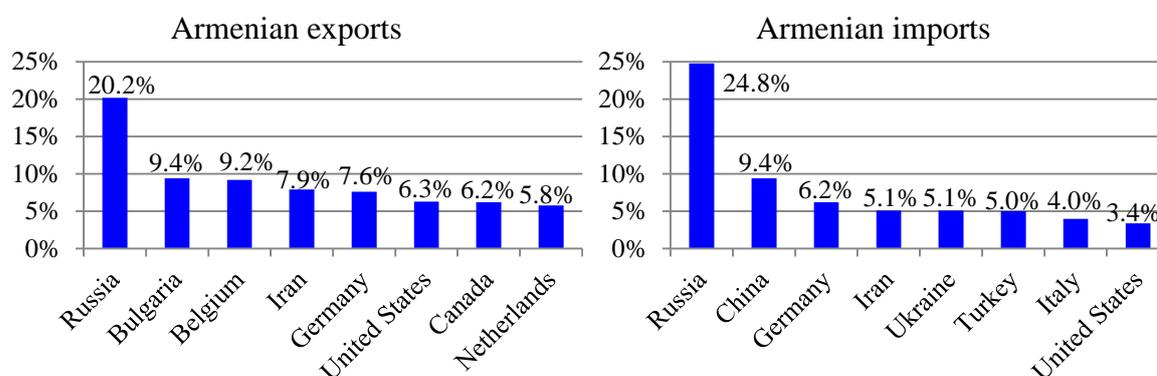
<sup>85</sup> Ministry of Economy (2011), Strategy of Export led Growth, page 7.

### Trade flows

Armenia is a landlocked country, with trade relations additionally limited by political issues in the region. Relations have been difficult with some of its neighbours, in particular Azerbaijan and Turkey, while conflicts among its neighbours have also had a strong influence on external trade. For example, the conflict between Georgia and Russia in 2008 disrupted land transport routes to key Russian and European markets.

Russia is the most important trading partner as a single country (Figure 19). In 2012, Russia accounted for 20% of Armenian exports, while 25% of Armenian imports, largely energy related, came from Russia. The EU is the largest export market for Armenia, accounting for 37% of exports, compared to 23% for the CIS region. In the case of Armenia imports, the positions are reversed, with CIS countries accounting for 31% of Armenian imports, and the EU for 26% of imports.

**Figure 19. Armenian export and import shares, 2012**



Source: Tables 316 and 317, Statistical Yearbook of Armenia, 2013, <http://www.armstat.am/en/?nid=45>

The most important Armenian export sectors include mining, alcoholic beverages and diamond processing, which together account for around 70% of exports.<sup>86</sup> These export sectors, as well as those with a high proportion of foreign ownership, such as the financial sector, tend to be the highest productivity sectors.<sup>87</sup> High tech exports remain very low, and amounted to only 1% of exports in 2008.<sup>88</sup>

The Strategy of Export-led Industrial Policy identified promising sectors for export and subsequent economic growth. They were divided into three categories:

- Resource-based sectors, including: food production (particularly brandy making, canned food production, wine, mineral water and juice production, fish breeding, fruit and vegetables), metal and non-metal mining and processing, tourism and related cultural products;

<sup>86</sup> Ministry of Economy (2011), Strategy of Export-led Industrial Policy of the RA, page 4.

<sup>87</sup> Economy and Values Research Center, EV Consulting CJSC (2012), National Competitiveness Report of Armenia, p. 12.

<sup>88</sup> A. Mkrtchyan (2010), Armenia: Innovation performance (PowerPoint presentation, Helsinki).

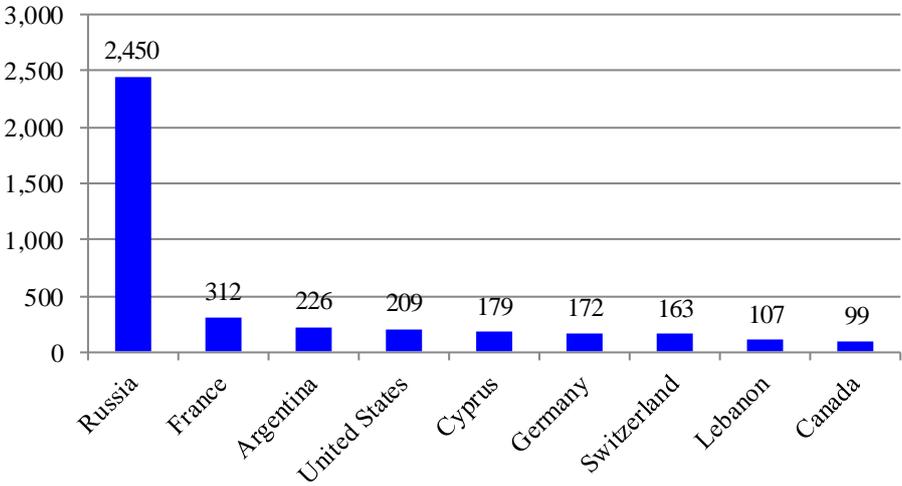
- Skills-based sectors, including: diamond processing, jewellery manufacturing, watch manufacturing, pharmaceuticals, light industry (textile industry), health services, medical equipment and materials; and
- Knowledge-based sectors, including: precision engineering (machine building, instrument making, electrical and optical production), information technologies, engineering services, applied physics and biotechnologies.

These latter, knowledge-based sectors will be targeted as “new drivers of growth” in the medium to longer term, with an initial policy horizon of 2011-2020. Focus has been placed in first instance on precision engineering. Innovative fields have been identified and specific sector strategies developed. Such a systematic and profound analysis of technologies and services, and of potential research and business players in these fields, will be useful for a targeted promotion of the innovative sectors of the future.

**Foreign Direct Investment**

As at end 2012, net FDI stocks were dominated by Russian investment, which reached \$2.45 billion or 53% of the total (Figure 20). Russian investment has been especially directed towards the energy, mining and telecommunications sectors. France was in second position with \$311 million or 7% of FDI stocks, with remaining countries below 5%. FDI sources reflect to some extent the countries with significant Armenian diaspora communities (with exceptions being Cyprus, Germany and Switzerland).

**Figure 20. Net FDI stocks as at end 2012, \$ million**



Source: Table 322, Statistical Yearbook of Armenia, 2013, <http://www.armstat.am/en/?nid=45>

FDI figures fluctuate significantly from year to year. In 2012, the largest source of gross FDI inflows was France, accounting for 39% of the total, or \$230 million, primarily due to a major investment in the telecommunications sector by French operator Orange. The second largest investor was Russia, with 15% of FDI or \$91 million, followed by Argentina and Germany,

each accounting for around 8.5% of gross FDI inflows.<sup>89</sup> The main sectors for investment were communications with 50% of FDI in 2012, mining with 16%, real estate with 10% and agriculture with 6%.<sup>90</sup>

Framework conditions are particularly relevant for FDI in Armenia, with the small market size and complicated geopolitical situation limiting the country's attractiveness for investment. The economy as such is quite open: there are no restrictions on ownership and capital movement, foreign investment is protected, and foreign employees can be brought into Armenia. Visa requirements for EU citizens were lifted in 2013.

The World Bank Doing Business rankings provide a benchmark for framework conditions across countries. Among 189 countries ranked, Armenia is rather well placed and climbed from 40<sup>th</sup> in 2012 to 37<sup>th</sup> in 2013<sup>91</sup> – comparable to EU member States such as Belgium (36) or France (38).<sup>92</sup> It is the highest ranked among CIS countries, although Georgia (8) and the Baltic ex-Soviet Union republics are more highly ranked. It is possible that other, particularly resource-based, economies in the CIS experience less pressure to improve their business climate. Armenia performs particularly well in terms of the low cost and short time needed to establish a business, although trade across borders (transport costs, required documents), getting electricity and contract enforcement, all of which are crucial for FDI, are more problematic. Corruption in business, official and political spheres is an issue specifically highlighted by international partners, and remains another major obstacle to FDI.<sup>93</sup>

### ***Good practice: ICT sector***

The ICT sector is the primary destination of FDI into knowledge intensive industries in Armenia where investment, particularly from the USA, has helped establish a flourishing industry. Also significant for FDI are the finance, telecommunication, mining and tourism sectors. Investments are often initiated by members of the Armenian diaspora.

Major multinational companies, such as Microsoft or Synopsys, are present in the Armenian ICT sector with research labs and production units, and foreign investment has led to the creation of Armenian spin-offs and start-up companies. The ICT sector has the advantage of low fixed costs, which may discourage investment in other sectors in the CIS region. In 2012 there were 360 companies operating in the Armenian ICT sector, of which 42% were foreign owned. Almost half of these companies were US or Canadian, about a quarter from Europe and nearly 20% from Russia and the CIS. The revenues of the ICT software and services sector amounted to 3.3% of Armenia's GDP (around \$320 million), employing more than 9,300 people. Exports amounted to \$120 million, or 8% of total Armenian exports, with the main destinations being the USA and Canada with 54% of ICT exports, Europe with 31%, Russia and the CIS with 6%, and other countries accounting for 9% (Figure 21).<sup>94</sup>

<sup>89</sup> Table 322, Statistical Yearbook of Armenia, 2013, <http://www.armstat.am/en/?nid=45>.

<sup>90</sup> ADA, <http://www.ada.am/eng/for-investors/fdi-statistics/foreign-direct-investments-by-sectors/>, retrieved 15 October 2013.

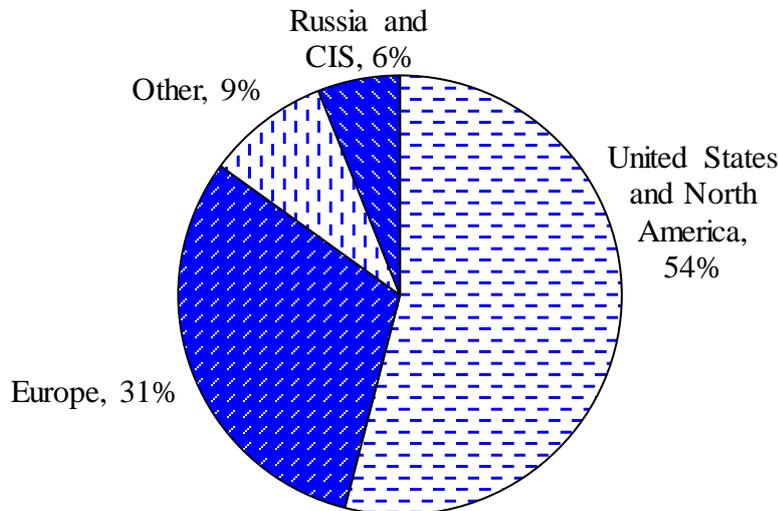
<sup>91</sup> Rankings for all economies in Doing Business 2014 are benchmarked to June 2013.

<sup>92</sup> World Bank, <http://data.worldbank.org/indicator/IC.BUS.EASE.XQ>, retrieved 20 October 2013.

<sup>93</sup> See for example US Department of State (2013), Investment Climate Statement – Armenia, <http://www.state.gov/e/eb/rls/othr/ics/2013/204593.htm>, retrieved 17 October 2013.

<sup>94</sup> Armenian ICT Sector, State of Industry Report 2012.

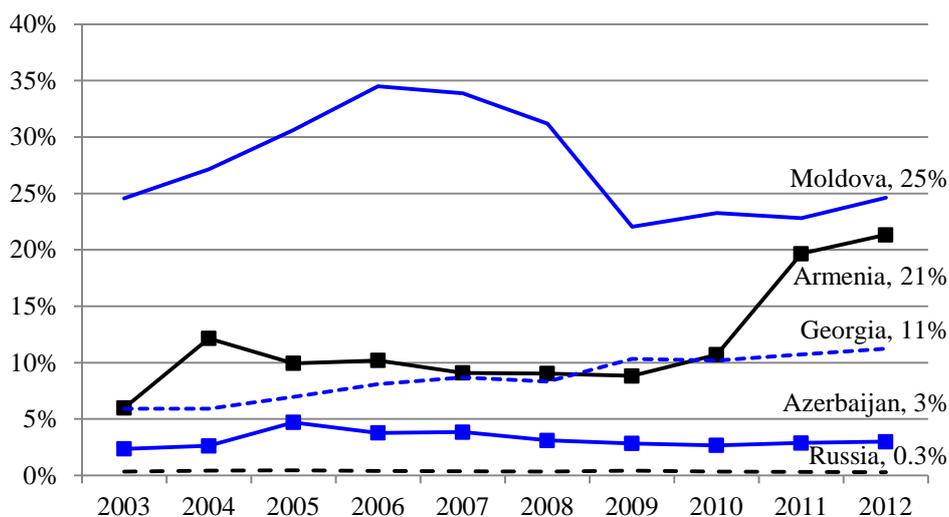
**Figure 21. Export destinations of the Armenian ICT sector**



Source: Armenian ICT Sector, State of Industry Report 2012

Remittances from abroad are crucial important to the Armenian economy, comprising around 10% of GDP over 2005-10 (Figure 22). However, remittances have increased significantly since 2010, to reach over 20% of GDP or \$2.1 billion<sup>95</sup> by 2012, ranking Armenia eighth globally in terms of remittances received as a share of GDP. Other comparator countries in the CIS, such as Azerbaijan and Russia, receive significantly lower levels of remittances. Appropriate instruments to channel remittances could include public-private co-funding schemes for introducing innovations to the market or for establishing SMEs (a similar funding scheme was introduced by the Moldovan SME agency ODIMM).

**Figure 22. Personal remittances received, per cent of GDP**



Source: World Bank, 2014, <http://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS>

<sup>95</sup> World Bank, 2014, <http://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT>

### *Role of trade and innovation facilitators*

Several agencies and initiatives have been established in Armenia to attract investment, facilitate economic development and stimulate innovation activities. International organizations and development agencies (e.g. World Bank, USAID) are active, and either support existing agencies (e.g. World Bank) or run their own programmes (e.g. OSCE). Given the small size of the country, a more coherent and coordinated approach to these initiatives could be both feasible and useful.

The Armenian Development Agency promotes exports and FDI. It is a governmental agency that has been operating for 15 years. It is the lead implementing agency of the Strategy of Export-led Industrial Policy, and has thus far focused on the priority sectors highlighted for immediate support: wine and brandy making, pharmaceuticals, and precision engineering (including IT, electronics and engineering). Jewellery and textiles will be added as priority sectors in 2014.

The Enterprise Incubator Foundation, co-sponsored by the Ministry of Economy and World Bank, caters specifically to the ICT sector. It organizes ICT related training together with international companies (e.g. Cisco Networking Academy). Together with USAID and Microsoft, it has established an Innovation Center, which supports start-ups, and offers IT training and resources. EIF also launches competitions for grants with international partners, e.g. the “From Idea to Market” competition, run jointly with CRDF-Global from the USA.

The Small and Medium Entrepreneurship Development National Center provides export support and international matchmaking to SMEs. It became a member of the Enterprise Europe Network in 2008 and offers Armenian business proposals in its database.<sup>96</sup> This network provides a partnering platform for businesses from EU member States as well as several other countries.

The Technology Transfer Association was established in 2001 by five applied research institutes of the National Academy of Sciences. It is a non-commercial NGO with around 25 members, facilitating matchmaking with foreign investors interested in Armenian technologies. The TTA also undertakes technology assessments for the International Science and Technology Center (ISTC) and for Armenian governmental bodies.

Free Economic Zones are a new tool introduced in 2013 by the Ministry of Economy. A first zone was opened close to Yerevan airport, managed by the Russian company Sitronics and seeking to attract foreign companies. Incentives include profit tax, value added tax and customs duties exemptions for companies in the zone.

## **7.2 Internationalization of education**

The 63 HEIs in Armenia include four universities based on intergovernmental agreements: the American University of Armenia, the Russian-Armenian (Slavonic) University, the Eurasia International University, and the French-Armenian University. Furthermore, there are nine branches of foreign universities in Armenia, mainly from Russia, Ukraine and the USA.<sup>97</sup>

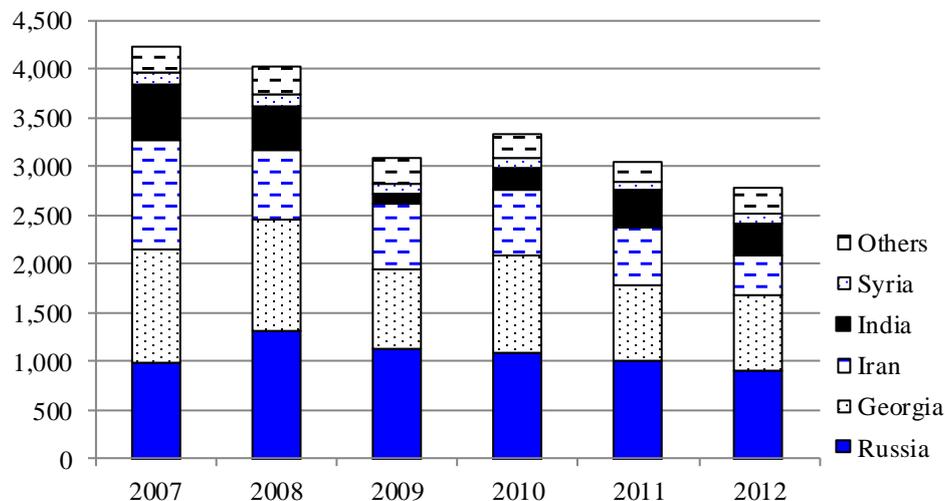
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<sup>96</sup> See <http://een.ec.europa.eu/tools/services/SearchCenter/Search/ProfileSimpleSearch>

<sup>97</sup> Data on the HEI sector provided by Ministry of Education, 2013.

According to the National Statistical Service, around 3% of students in Armenia come from abroad. In absolute figures, the number of foreign students is declining – as is the number of Armenian students. In 2012, there were 2,775 foreign students from a total of 90,145 students.<sup>98</sup> The main countries of origin include CIS countries (particularly Russia, Georgia and Ukraine), as well as certain countries in Asia (India) and the Middle East (Iran, Syria) (Figure 23). Foreign students from the Armenian diaspora are an important group. At Armenia's largest university, Yerevan State University, foreign students comprise 2.7%, or around 500, of the total 18,000 students. However, around 50% of these foreign students are from the diaspora.<sup>99</sup>

**Figure 23. Main countries of origin for foreign students**



*Source:* Table 105, Statistical Yearbook of Armenia, 2013, <http://www.armstat.am/en/?nid=45>

A number of factors may have contributed to the decline in foreign student numbers: continuing economic crisis and political turmoil in certain countries of origin, but also deteriorating educational standards in Armenia. The country remains competitive in terms of living costs and tuition fees, with fees amounting on average to \$1,000 – 1,200 per annum, depending on the university and programme. For example, fees tend to be higher at the Yerevan State Medical University while, across disciplines, fees tend to also be higher for Engineering and Science, Economics, Law and International Relations.

Measures have been taken to attract foreign students. An English language web portal providing information on the higher education system for foreigners is available at [www.studyinarmenia.org](http://www.studyinarmenia.org). While the quality of education remains good in the main public and private HEIs, it is not assured across the whole education system. Nonetheless, in the Global Competitiveness Report, higher education and training are one of the fields where Armenia scores significantly better relative to other criteria (e.g. innovation), being placed

<sup>98</sup> The Ministry of Education indicates at its website <http://studyinarmenia.org> (last accessed on 18/10/2013) a higher share of students overall and of foreign students in particular: according to this source overall 117,000 students include around 7,000 foreigners. This amounts to a share of 6% of foreign students.

<sup>99</sup> Yerevan State University (2013), Institutional Self Evaluation Report, pp. 3-5.

76<sup>th</sup> among 142 countries, although this has been a slight decline of three positions since 2005, and there remains scope for improvement.<sup>100</sup>

Exact data on mobility of Armenian students abroad are unavailable. Discussions with the Ministry of Education indicate that students move mainly to the EU (Eastern European countries such as Poland, Romania, Bulgaria and Slovakia, and also the UK), the USA (supported by strong connections in the Armenian diaspora), to CIS countries (Russia, Ukraine), and to China. Around 1,000 scholarships are made available by the Government for students to study abroad each year. The public Luys Foundation offers a scholarship programme for degree studies at the 10 top-ranked universities globally, selected on the basis of international university rankings. In 2013, this comprised universities in the USA and UK only. Annually, 10 scholarships are allocated to each of the 10 top-ranked universities, and students must be accepted at the relevant university prior to the scholarship. The Luys scholarship programme seeks to train an elite that will bring international know-how back to the country, with participants signing agreements to return to Armenia after their studies.

Cooperation and resources have been attracted to HEIs from foreign companies or foreign public partners, notably in the IT sector. Major investors such as Synopsis and National Instruments have established laboratories and educational programmes, and contribute to curriculum development at universities (e.g. Yerevan State University and the State Engineering University of Armenia). An international public-public partnership was established in 2011 in the form of the Armenian-Indian Center for Excellence in Information and Communication Technologies.<sup>101</sup> Such collaborations should be used as a template for potential partnerships in other fields, and for expanding close-to-market education beyond IT.

### *Examples of good practice*

One of the most active universities in international cooperation is the Yerevan State Medical University, with around 20% of its 5,000 students coming from abroad. Traditionally, most foreign students come from India, with significant numbers also from Sri Lanka and Iran. Representative offices have been established in India (New Delhi and Chennai), Russia and the United Arab Emirates, and conduct admissions tests and interviews for prospective students. Accommodation in student residences is made available for foreign students and tuition fees for those studying in Armenian and Russian, although typically between ten and twenty-five per cent higher than domestic students, depending on faculty, remain competitive, ranging from around \$1,750 per annum for pharmacology, to around \$2,500 for medicine or dentistry. Students may choose to be taught entirely in English at a faculty for international students, with higher tuition fees, for example around \$4,000 for medicine and dentistry.<sup>102</sup>

Equipment has been upgraded and purchased using a cost-share model, with the State covering 50% and the other 50% covered by members of the Armenian diaspora. International cooperation programmes are actively pursued by Yerevan State Medical University, for example the introduction of a new faculty for Public Health and associated Masters

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<sup>100</sup> Economy and Values Research Center, EV Consulting CJSC (2012), National Competitiveness Report of Armenia, p. 11.

<sup>101</sup> See <http://www.aipc.am/>

<sup>102</sup> Data and information based on tuition fees for 2012-2013 at <http://www.ysmu.am/en/admission2/university-fees2>, last accessed 20 October 2013 and on interviews at the university.

curriculum in 2011 as part of a TEMPUS project. New equipment has been purchased and courses will be taught mainly in English, although also in Armenian and Russian. The project is implemented in cooperation with EU partners from Romania, Sweden and the UK.

The American University of Armenia provides another example of good practice. Established in 1991 with support from the Armenian diaspora and the USA, the university operates according to US standards and is affiliated to the University of California. It offers mainly graduate courses, but also undergraduate courses since autumn 2013. Courses are taught only in English. Its faculty is composed of foreign staff and representatives of the diaspora, mainly from the USA, and of Armenians trained abroad.

The EU's TEMPUS and ERASMUS Mundus programmes are well used in Armenia for student and faculty mobility, and for joint curricula development with EU partners. Over the period 2008-2012, 22 projects or measures with Armenian participation have been funded under the TEMPUS IV programme. The most successful HEIs were the Yerevan State University (13 participations) and State Engineering University (eight participations).<sup>103</sup>

Armenia joined the Bologna process in 2005 and implementation is well advanced. The three cycle system has meanwhile been implemented in most fields of study. The European Credit Transfer and Accumulation System is used by more than 75% of institutions and programmes.<sup>104</sup> Such international recognition significantly increases Armenia's attraction to foreign students. The potential of the diaspora is already well used, for example by inclusion in faculty at HEIs in Armenia, to attract foreign students and for temporary or short term visits of faculty from abroad (e.g. lecturers at YSMU), and this should continue. There is a strong tradition of higher education in Armenia, but course quality, student infrastructure, equipment, etc. all require significantly increased investment. Policy makers are aware of the need to make resources available for this future oriented sector.

### **7.3 Strategic framework for research internationalization**

The Strategy on Development of Science 2011-2020 sets ambitious targets for international scientific cooperation – including, by 2020, that Armenia will have a knowledge-based economy, be competitive within the European Research Area in terms of fundamental and applied research, and be a prime location for scientific specialization within the European Research Area. The Strategic Action Plan for the Development of Science for 2011-2015 includes objectives for the general development of international RTD cooperation, to set up programmes for cooperation, to establish joint laboratories and research centres, and to attract foreign researchers to collaborate with Armenian colleagues. These ambitions need to be seen in the context of current levels of R&D spending, where Gross Domestic Expenditure on R&D (GERD) has been around 0.2% of GDP over recent years – lower than other countries such as Moldova and Russia. Such limited expenditure will make it challenging to achieve these long-run objectives.

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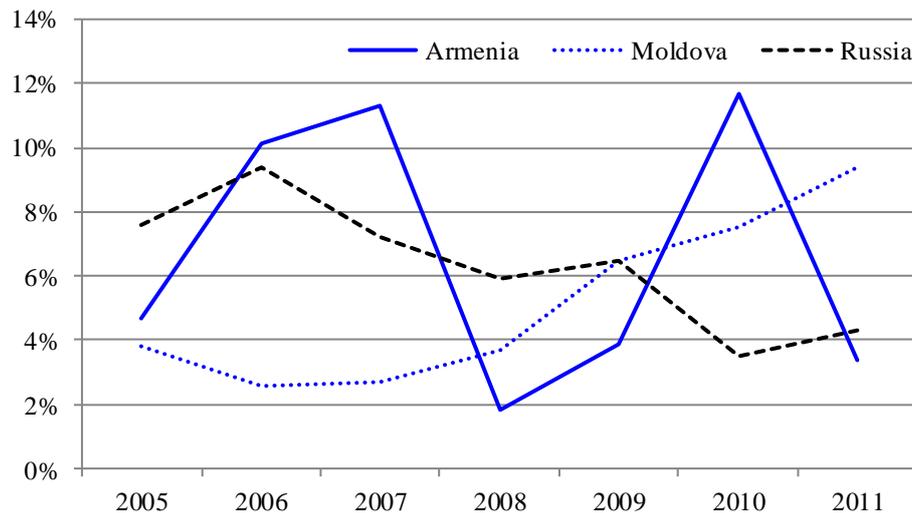
<sup>103</sup> European Commission (2012), Higher Education in Armenia, p. 12,

[http://eacea.ec.europa.eu/tempus/participating\\_countries/overview/armenia\\_tempus\\_country\\_fiche\\_final.pdf](http://eacea.ec.europa.eu/tempus/participating_countries/overview/armenia_tempus_country_fiche_final.pdf)

<sup>104</sup> Ibid, page 10.

GERD financed from abroad fluctuates significantly from year to year,<sup>105</sup> and has ranged between 1.7% in 2008 and 11.7% in 2010 in recent years (Figure 24). In 2011 the 3.4% GERD financed from abroad was in absolute figures equivalent to \$887 thousand (AMD 342 million).

**Figure 24. GERD financed from abroad, per cent of GDP**



Source: UNESCO-UIS, 2013, <http://stats.uis.unesco.org>

Public R&D funding is increasingly distributed through competitive funding programmes introduced by the SCS over recent years, with internationalized evaluation of project proposals drawing particularly on expertise in the Armenian diaspora. This is an important development, as evaluation by a narrow circle of national experts can lead to reduced competition for the award of funding. However, the share of R&D and innovation funding channelled through competitive schemes remains limited, with scope for increase so as to focus resources on internationally competitive groups and thematic priority areas.

The SCS reports that around 60% of co-publications of Armenian researchers are with colleagues from the EU, in particular from Germany, France and Italy. Other important publication partners include the USA and Russia.

## 7.4 International cooperation agreements

### *Bilateral cooperation agreements*

Since its establishment in 2007, the SCS has strived to establish several bilateral S&T cooperation programmes. Programmes are in place with Belarus, France, Germany and Russia. These help channel funds through international evaluation processes with foreign partners, while supporting internationally competitive research groups. These programmes are

<sup>105</sup> Data from UNESCO Institute of Statistics (UIS), <http://stats.uis.unesco.org>, last accessed on 15/10/2013, exchange rate calculated according to Central Bank of Armenia as at 30 December 2011, US\$1 = AMD 388.77 <https://www.cba.am/EN/SitePages/Default.aspx>

thematically broad, but small scale in terms of budget, generally covering mobility costs. For example, in the bilateral programme with Germany, researchers from Armenia receive €5,000 from the State Committee for one year, while the German partner receives €10,000 from the Federal Ministry of Education and Research.<sup>106</sup> Such exchanges with EU partners may act as a stepping stone for participation in Framework Programme projects.

The Academy of Sciences has a broad network of cooperation agreements with partner academies in countries including Russia, Georgia, Belarus, Ukraine, Hungary, China and Romania. However, due to financial constraints, only the agreement with Russia has resulted in significant activities, with funding provided by the Russian partners.

In that which follows, we briefly discuss bilateral cooperation with the main partner countries, although there is cooperation with several other countries on a more modest level. Universities cooperate at the institutional and researcher levels with a wide range of countries.

### *Russian Federation*

There are strong linkages with Russia, mainly focused on research cooperation and facilitated by the scientific diaspora in Russia and traditional ties that provide strong incentives for cooperation and joint support programmes, as well as widespread knowledge of Russian in Armenia. A bilateral programme of the State Committee with the Russian Foundation for Basic Research was established in 2013, with 17 projects funded annually under this cooperation. With the Russian Foundation for Humanities a joint programme has been in place since 2011 supporting seven projects per year.<sup>107</sup>

Armenia has been a member of the Joint Institute for Nuclear Research (JINR), situated in Dubna near Moscow, since 1992. Around 20 Armenian scientists work permanently at the JINR, while Armenian scientists attend conferences and research stays there. Armenian partner organizations include the Yerevan State University, the Russian-Armenian (Slavonic) University, the Yerevan Physics Institute, the Institute for Informatics and Automation Problems, and the Institute for Physical Research.<sup>108</sup>

Efforts to also enhance innovation cooperation with Russia have been undertaken, but have yet to lead to significant results. An agreement on cooperation with Armenian scientists and enterprises was concluded between the State Committee and the Russian Skolkovo high-tech foundation in April 2013.<sup>109</sup> Joint projects are under discussion and selection. Russia has initiated innovation cooperation within the CIS framework, as discussed below.

### *Other CIS countries and Georgia*

Among other CIS countries, only with Belarus has a joint research funding programme been established, with the Belarusian Foundation for Fundamental Research as the partner in Belarus. The programme has been operational since 2011, with 17 grants allocated annually.

<sup>106</sup> See for the German-Armenian call 2012 <http://www.bmbf.de/foerderungen/19462.php> (in German).

<sup>107</sup> Data on bilateral cooperation programmes provided by State Committee of Science, 2013.

<sup>108</sup> Joint Institute of Nuclear Research (2013), [http://jinr.ru/section.asp?sd\\_id=48&language=rus](http://jinr.ru/section.asp?sd_id=48&language=rus), (information in Russian only), last accessed 20 October 2013.

<sup>109</sup> See <http://ininc.jinr.ru/page.php?id=233>, last accessed 20 October 2013.

With Georgia, scientific contacts are traditionally established at the institutional and researcher level, but both countries invest limited financial resources in R&D and no cooperation programme is currently in place.

### ***United States of America***

The USA is an important partner, most notably in innovation activities. It has made significant investments in establishing IT as an important knowledge-intensive sector of the economy. In education, US partners are involved in several universities, while several Armenian universities have agreements with US partners (e.g. University of California). In the research field, researchers and research institutes cooperate with US partners. Previously, support has been provided for research projects by CRDF Global of the USA, although its support now focuses on innovation stimulation and cooperation measures. Business Partnership Grants and business training for scientists are implemented in cooperation with the Enterprise Incubator Foundation. In addition, CRDF Global jointly supports a Virtual Scientific Library with Armenian partners.<sup>110</sup>

### ***Cooperation with European countries***

France, Germany and Switzerland stand out in terms of bilateral cooperation. The State Committee together with the French CNRS supports three joint laboratories, one joint research group, and 10 travel grants per year, while 11 grants for joint projects will be allocated annually with the German Federal Ministry of Education and Research from 2013. Joint projects are supported through the unilateral SCOPES programme of the Swiss National Science Foundation, which supported six projects with eight Armenian researchers (and teams) over 2009-2012. The SCOPES programme has been extended for 2013-2016, and will again be open to cooperation with Armenia.<sup>111</sup> The German DESY and Switzerland's Paul Scherrer Institute are strongly involved in the Armenian CANDLE project.

### ***Multilateral cooperation with the EU***

The Eastern Partnership (EaP) is a framework provided by the EU for cooperation with Armenia and five other countries of the Former Soviet Union – Azerbaijan, Belarus, Georgia, Moldova and Ukraine.<sup>112</sup> A new Research and Innovation Panel has been established, and was convened for the first time in mid-November 2013. It will allow for a biregional policy dialogue, gathering officials and experts from EU member States and the six EaP countries.

### ***FP7 and Horizon 2020***

The main programme for research and innovation cooperation with the EU is the Framework Programme for Research and Technological Development, which is also the largest international R&D and innovation cooperation programme in which Armenia can participate. 45 Armenian researchers or research teams have participated in projects funded under the FP7 from 2007-2013 (Figure 25). These participants have received €3.2 million from the EU.

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<sup>110</sup> See <http://www.crdfglobal.org/> and <http://www.eif.am/eng/projects/step/>, last accessed 19/10/2013.

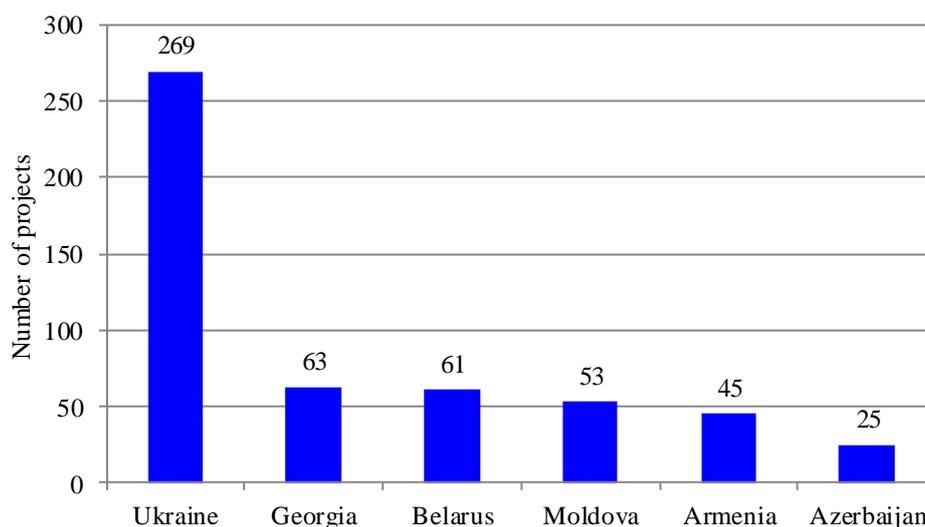
<sup>111</sup> Swiss National Science Foundation (2013),

<http://www.snf.ch/E/international/europe/scopes/Pages/default.aspx>, last accessed 20/10/2013.

<sup>112</sup> See [http://eeas.europa.eu/eastern/index\\_en.htm](http://eeas.europa.eu/eastern/index_en.htm)

Most participants were funded under the FP7 subprogrammes International Cooperation – IncoNet (14 participants), the International Research Staff Exchange Scheme (8), Infrastructure (6), ICT (5), and Nanosciences, Nanotechnologies, Materials and new Production Technologies (3).

**Figure 25. Eastern Partnership countries' participation in FP7 funded projects**



*Source:* Thierry Devars, Eastern Partnership: cooperation status in FP7 and perspectives in Horizon 2020, presentation at EEP 2013 Lithuanian Presidency Conference, Vilnius, 30 September 2013

In July 2013, Armenia expressed its interest in becoming associated to the follow-up programme to the FP7, the Horizon 2020 programme (2014-2020). Moldova became the first country of the former Soviet Union, after the EU Baltic states, to gain associated status on 1 January 2012, with negotiations on Armenia's association ongoing. Association would require a financial contribution from the country to Horizon 2020. In return, Armenia would receive a status similar to EU member States: its researchers would be able to initiate and coordinate projects under Horizon 2020, and Armenian representatives could participate in EU management committees for Horizon 2020 (although, unlike EU member states, without voting rights). Without association Armenian researchers could still participate in Horizon 2020 projects and receive funding by the EU. The advantages of the association have therefore to be assessed against the required financial contribution from Armenia, which would be significant for a small country with rather low GERD, and with no guarantee of fully recovering this contribution through funding from Horizon 2020 projects. Association would certainly give added impetus to internationalization of the research community, and allow a contribution to shaping policy for R&D and innovation at the EU level. There is also scope to redirect EU financial support to research and innovation if these areas can be formulated as priority cooperation fields for Armenia. Financial support through the European Neighbourhood Policy Instrument, Technical Assistance (TAIEX) and Twinning needs to be used for research and innovation cooperation. Efforts need to be made to involve businesses and other innovation players in such cooperation.

Also under FP7, European Research Area Networks (ERA-NETs) bring together research and innovation funding organizations in various thematic fields or with interests in cooperation with certain regions. The aim of such ERA-NETs is the joint funding of calls for research

and/or innovation projects. These are then mainly funded by the relevant national organizations, with financial support provided by the EU to facilitate the cooperation or as a top-up to the national call budget. Armenia has already participated in the Black Sea ERA-NET, implemented in 2009-2012. However, only one Armenian research team received funding across the 11 research projects supported.<sup>113</sup> It is worthwhile for Armenia to explore further participation in ERA-NETs. An advantage is that thematic areas and conditions of calls are specified by the participating funding organizations, although the administrative effort can be rather high relative to the number of projects funded. Increased participation would necessitate some assessment of potential participations, by screening the topics of international projects where Armenian researchers are involved and matching them with the available ERA-NETs.

Armenia is not yet member or associated member of the EU innovation support network EUREKA or of the Eurostars funding programme for innovations in SMEs. Eurostars is jointly funded by the EU and the EUREKA network of 33 countries. EUREKA and Eurostars participation should be considered, as it would offer an opportunity to identify promising innovative projects in the business sector, together with international partners and quality control. This would target innovation activities and be complementary to Horizon 2020 association. Policymakers need to be aware that funding has to be made available mainly by national authorities, and many projects are unlikely in the short run. Only within Eurostars is co-funding provided by the EU.

The Black Sea Basin Cross Border Cooperation is another EU-funded programme and supports projects, some relevant to innovation, in the environmental, trade facilitation and other domains.<sup>114</sup> Armenian teams have received funding for 18 from a total of 53 projects funded under this regional programme.

The European Cooperation in Science and Technology (COST) networking programme supports mobility of researchers. As at May 2013, researchers from Armenia were participating in four COST initiatives – a similar level to Azerbaijan, but slightly behind Georgia's participation in six initiatives.<sup>115</sup>

The International Association for the promotion of cooperation with scientists from the independent states of the former Soviet Union (INTAS) was an EU-funded programme operational from 1992 until 2010. It was more accessible to Armenian researchers than other international programmes, being well-adapted to the needs of the research community in the country for smaller scale collaborative projects below €500,000 in total size, and with project consortia comprising four to five partners. During 1994-2004, 162 Armenian research teams received more than €2.8 million grants via research projects and other support instruments. In the following years to 2007, an estimated €1 million was allocated, including in a co-funded INTAS-South Caucasus Collaborative Call.<sup>116</sup>

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<sup>113</sup> See <http://www.bs-era.net/main/index.php>, last accessed 20/10/2013.

<sup>114</sup> See <http://www.blacksea-cbc.net/index.php/eng>

<sup>115</sup> COST overview July 2013, <http://www.cost.eu/>, last accessed at 15/10/2013.

<sup>116</sup> See <http://www.increast.eu/en/144.php>

### *Multilateral cooperation within regional initiatives*

In the framework of the Organization of the Black Sea Economic Cooperation (BSEC), Armenia coordinates a range of economic policies with both neighbouring and wider regional partners (e.g. Greece, Russia).<sup>117</sup> Working Groups and Ministerial Meetings on issues including trade and economic development, banking and finance serve as cooperation forums. BSEC includes working groups on S&T and on SMEs, where innovation related issues are discussed, although in practical terms BSEC activities do not go far beyond policy dialogue and limited coordination. As a result of the S&T working group's action plan for 2012-2014, a summer school for young researchers has been established. Otherwise, the action plan refers mainly to EU instruments for cooperation; particularly those supported under the FP7, e.g. Black Sea ERA-NET, ERA.Net RUS, or the Research to Innovation projects.<sup>118</sup> In the working group on SMEs, innovation and entrepreneurship have been prioritized, and programmes on promoting innovation and entrepreneurial culture in the BSEC member States are under consideration, as well as a BSEC Network of Incubators for SME start-ups.<sup>119</sup> However, the financial support to implement these programmes is yet to be confirmed.

The International Science and Technology Center, largely funded by the USA, EU, Canada and Japan, has been a major source of foreign funding for research, with the aim of converting military to civilian research in the former USSR. 473 projects with Armenian participants were submitted for review to the ISTC over 1995-2013, of which 170 projects were financed for a total of \$41.6 million, shared with project partners from other countries of the former USSR. The Yerevan Physics institute has been by far the most active Armenian institution, participating in 37 of the 170 financed projects, and receiving around \$10 million.<sup>120</sup> ISTC support for research commercialization has included the organization of business forums to bring together researchers and business people. Three such forums were organized, with results including application of biotechnology results in medicine and cosmetics. Training on intellectual property rights, business plan preparation and other issues was also offered.

The relevance of the ISTC has declined over recent years as funding has decreased. Russia's withdrawal from the ISTC was announced by presidential decree in 2010, with activities in Russia to be wound down by 2015, and the main ISTC office to be located in Kazakhstan. In 2012, only three projects were funded in Armenia, and in 2013 two projects. The ISTC has provided funding to the R&D sector during a difficult time of downsizing, and helped conserve niches of research excellence, notably in physics. Multilateral cooperation support has also been provided by the NATO Science programme, mainly for upgrading research infrastructure and equipment, but has also been downsized over recent years.

### *Cooperation in the CIS framework*

Russia has sought to establish mechanisms for innovation cooperation among CIS countries over recent years. While progress to date has been modest, Armenia has participated actively in this process.

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<sup>117</sup> See <http://www.bsec-organization.org/Pages/homepage.aspx>

<sup>118</sup> BSEC Working Group on Cooperation in Science and Technology (2012), Plan of Action 01.07.2012-30.06.2014.

<sup>119</sup> BSEC Working Group on SMEs, Press release on the meeting of 10-11 October 2013, Istanbul.

<sup>120</sup> International Science and Technology Center (2013), ISTC in Armenia, p. 3.

The ambitious Interstate Programme on Innovation Cooperation of CIS countries until 2020 has been under development since 2008,<sup>121</sup> and comprises five subprogrammes:

- Cooperation – support of innovation projects and matchmaking;
- Potential – support of research projects and coordination of research programmes;
- Personnel – improving qualifications of R&D and innovation personnel;
- Infrastructure – developing innovation infrastructure, e.g. Technology Transfer Centres; and
- Regulation – coordination of R&D policy and harmonization of regulations.

The programme concept includes elements familiar from the Russian Federal Targeted R&D and Innovation funding programmes (e.g. support measures for R&D personnel) and from the EU Framework Programme for RTD (e.g. Technology Platforms). The concept was approved by the CIS cooperation council in 2011, with the Russian Skolkovo Foundation nominated to manage the programme in 2012. However, most CIS partners, including Armenia, have limited R&D financing and innovation support available and significant funding, possibly from Russia, would be needed for implementation. Armenia submitted around 40 projects in 2011, covering nanotechnologies and materials, life sciences, ecology and sustainable development, ICT, aviation and space, R&D personnel development and economic development.<sup>122</sup> No project had been approved for support as at autumn 2013.

An International Innovative Nanotechnology Centre of the CIS was established on the basis of the JINR in 2009,<sup>123</sup> with Armenia and seven other CIS countries as founding members and financial support from Rusnano, the Russian state corporation for support of nanotechnology projects. The Centre's activities are for the moment focused on the training of young scientists. A competition for grants was launched in May 2013, although results were not available as at autumn 2013.

## 7.5 Key projects and actors for international cooperation

### *Research infrastructure projects with international outreach*

In 2001, Armenia embarked on constructing a major new piece of research infrastructure with the CANDLE project, the Center for the Advancement of Natural Discoveries using Light Emission.<sup>124</sup> The Armenian Government provided office buildings and land, the US Department of Energy a planning grant of \$500,000 and the main partners are the German DESY and Switzerland's Paul Scherrer Institute, which provide equipment and advice. A genuinely international venture, it is to be financed 25% from Armenian sources and 75% by international partners. It follows a strong tradition of Armenian physics research, but has a multidisciplinary approach, including life and material sciences and the environment. The project was assessed by an international panel and its regional importance highlighted. The first construction phase is planned to be completed in 2013 and parts of the infrastructure will become operational. This investment needs to be considered in the context of the scarce

<sup>121</sup> See <http://ruseng.rs.gov.ru/en/taxonomy/term/96?page=6>

<sup>122</sup> S. Arutyunyan (2011), State Committee of Science: Cooperation perspectives of Armenia with other countries in science, high technologies and innovation (PowerPoint presentation, Russian).

<sup>123</sup> See <http://ininc.jinr.ru/index.php>

<sup>124</sup> See <http://www.candle.am/>

resources available for R&D and innovation in Armenia. While investment in research infrastructure is certainly essential, CANDLE will need to prove its usefulness for applied as well as basic research, and also for the business community. Planned international outreach and users need to be assured.

### ***Important actors in international research cooperation***

The State Committee of Science is the main policymaker in research and in international research cooperation. It also has responsibility for policy implementation and has established and manages the financially low-scale bilateral cooperation programmes, which are important for the international networking of the Armenian scientific community.

The National Academy of Sciences is the largest scale participant in international research cooperation. It hosts the National Contact Point for the EU's FP7 programme, as well as the contact point for the ISTC in Armenia. The academy has three departments dealing with international cooperation: an International Affairs Department, an International S&T Programmes Department and a Diaspora Department. It has three joint laboratories with the French CNRS, as well as joint laboratories with Russian partners. It participates in several projects supported under the FP7, including projects to enhance S&T policy dialogue and coordination such as the IncoNet EaP. Some of its institutes, particularly although not exclusively in the field of physical sciences, are among the most internationally linked Armenian research institutions, and have received several grants in the FP7. The Institute of Physical Research of the Academy, situated in Ashtarak, receives around one third of its annual budget from international grants. Armbiotechnology, an applied biotechnology research centre, and the Institute of Radiophysics and Electronics, both also have significant international outreach and cooperate with foreign companies (e.g. the latter with a number of Korean companies in relation to semiconductors). However, the academy's international cooperation remains focused on basic research, with applied research and commercialization activities being more limited.

The main higher education institutions are also increasingly involved in international research cooperation, and have received international research grants. Non-governmental and not-for-profit foundations play an important role in Armenia's international cooperation. In the health sector, the Fund for Armenian Relief organizes continuing professional development for medical doctors in Armenia, and science-based training in Austria, with trainers from leading US and European university hospitals.<sup>125</sup> Meanwhile, the Analysis Research and Planning for Armenia Institute<sup>126</sup> based in Los Angeles, finances research equipment and organizes an annual invention competition for students of the natural sciences.

### ***Barriers to international cooperation***

A difficult geopolitical environment and limited options for cooperation with immediate neighbours increase the importance of exploiting international cooperation possibilities in research, education, trade relations, and associated innovation activities. The Armenian

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<sup>125</sup> See <http://farcme.am/about.html>

<sup>126</sup> See <http://www.arpainstitute.org/About.html>

diaspora, with an estimated 7 million living abroad, plays a crucial role.<sup>127</sup> A strong attachment to the home country, know-how and financial resources give great potential for developing the country, which has a history of openness to international cooperation.

While the country is rather well-linked internationally, in many respects due to its strong diaspora, there remain significant weaknesses that limit further integration. Lack of financial resources restricts mobility programmes for Armenian researchers, as well as the attraction of foreign scientists. Weak infrastructure is another major barrier, both from the point of view of up-to-date research equipment, and housing and working conditions for researchers from abroad. Many Armenian researchers and innovators have also emigrated, attracted by access to modern infrastructure and higher salaries. While this weakens the innovative capacities in the country, it also creates opportunities for cooperation between the scientific diaspora and researchers in Armenia. Language remains to some extent a barrier, but the younger generation possesses the required language skills for international cooperation.

## 7.6 Recommendations

Armenia has limited natural resources and a small domestic market. Opportunities for trade with neighbouring countries are limited by transport and geopolitical factors. Production and export of innovative goods is rather limited. These challenges require focused efforts to enhance the contribution of trade to the innovation capacities of the country.

### Recommendation 7.1

*The authorities should develop initiatives to increase and support the potential of trade to improve innovation performance in the country, building on existing efforts. They could consider:*

- *Extending the existing Strategy of Export-led Industrial Policy to include other knowledge-intensive sectors beyond ICT. Promising sectors should be identified systematically through appropriate screening, the assessment of potential niches and foresight studies. Specific sectoral strategies should be elaborated and implemented;*
- *Identifying and prioritizing sectors where the procurement of innovative goods and services from abroad is most important, and facilitating access to them; and*
- *Improving the linkages between companies from promising export sectors and research organizations, including through support to joint projects that serve to better use the research potential and encourage collaboration.*

The Armenian diaspora is a strong asset for national economic development, being a source of financing, expertise and contacts. There are multiple initiatives in the country enjoying the support of members of the Armenian diaspora, including in areas relevant for innovation such

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<sup>127</sup> The Armenian Development Agency estimates the overall number of Armenians at slightly more than 10 million, see <http://www.ada.am/eng/about-armenia/general-info/basic-country-data/>, last accessed 22 October 2013. The largest diaspora communities are living in Russia with 2.2 million, in the USA with 1.2 million, in France and Georgia with 0.5 million, and in Ukraine with 0.4 million; see Armenian Ministry of Diaspora, presentation at the International Dialogue for Migration 2013, Diaspora Ministerial Conference, International Organization for Migration.

as the relatively knowledge-intensive ICT sector, education and research. Further initiatives should be developed to build on existing achievements.

### Recommendation 7.2

*The authorities should continue the promising efforts to involve the diaspora in innovation-related initiatives, in line with national priorities. In particular, the following measures could be considered:*

- *Developing mobility schemes for temporary stays of diaspora researchers in Armenia and establishing international research groups between diaspora researchers and colleagues in Armenia;*
- *Targeting, in particular, cooperation with diaspora researchers who are active in applied research and have good experience with innovation; and*
- *Attracting students from the diaspora communities to study in Armenia through enhanced information and promotion measures.*

The university sector can attract foreign students. Competitive advantages include moderate living costs, affordable student fees and a solid, well-established reputation for teaching quality in certain areas such as medicine. Good efforts have been made to make degrees comparable and internationally recognized through links to US and Russian universities, and by joining the Bologna process. In a competitive landscape, developing existing potential and preserving current strengths requires further effort.

### Recommendation 7.3

*In order to tap into the potential offered by the internationalization of education, the authorities could consider the following initiatives:*

- *Improving the quality of education, through upgrading of equipment, investment in infrastructure, and curricula development, including through cooperation with international partners or companies;*
- *Addressing the educational needs of particular branches of industry, in cooperation with industry representatives, building on the experiences of the ICT sector; and*
- *Broadening efforts to attract foreign students beyond medicine to include other promising areas, such as natural sciences.*

Armenia embraces and encourages international R&D cooperation. There have been efforts to internationalize evaluation, including the establishment of a database of diaspora scientists. Instruments to support bilateral R&D so far concern mainly small-scale mobility initiatives for researchers. Some international grant programmes have been discontinued or reduced, with the main source of international funding being the EU Seventh Framework Programme. Association to the EU's Horizon 2020 programme has been envisaged. The experiences of CIS countries can be a source of valuable lessons when designing and implementing innovation instruments. The CIS Innovation Programme would provide new cooperation opportunities with countries that share common problems and enjoy strong cultural and scientific linkages. However, specific skills need to be developed to take advantage of the opportunities created by international cooperation.

#### Recommendation 7.4

*In order to reap the benefits of international cooperation in research and innovation, the authorities could contemplate undertaking the following initiatives:*

- *Prioritizing research and innovation in Armenia's cooperation with the EU, leading to more intensive use of instruments such as the European Neighbourhood and Partnership instrument, the Technical Assistance and Information Exchange instrument (TAIEX) and Twinning;*
- *Developing skills and mechanisms to make good use of the opportunities opened by a possible association to the EU's Horizon 2020, including information and training for researchers and innovators, matchmaking and networking and use of mobility programmes to prepare Horizon 2020 projects;*
- *Joining EUREKA and Eurostars and participating in selected European Research Area Networks (ERA-NET) projects and other EU instruments;*
- *Building closer links with the innovation agencies of the countries of the Customs Union (Belarus, Kazakhstan and the Russian Federation), including the possibility of developing bilateral funding instruments with these agencies;*
- *Studying the experience of other CIS countries in innovation support, in particular in areas such as start-up funding, attracting remittances for public-private co-funding schemes, technology transfer and innovation vouchers.*
- *Screening participation in international programmes and informal research cooperation in order to identify niches of excellence and the existence of competitive teams in certain areas. This screening should form the basis for a strategy to nurture and develop these niches; and*
- *Upgrading infrastructure and equipment to make domestic research institutions more attractive for international research cooperation.*

*Annex****PROSPECTIVE INNOVATION-DRIVEN INVESTMENT  
PROJECTS AND INFORMATION SOURCES*****1 Introduction**

Armenia was a significant hub for applied scientific research in the Soviet Union, including military applications. The number of scientists has declined significantly since that time, although this has been partially offset by increased demand for technical specialists in the private sector.

The first priority following independence was to determine the key capacities to be preserved, with second but of increasing importance being to (re-)establish international linkages – essential for a small and increasingly open economy. A key recent goal has been to achieve integration into the European Research Area, with Armenia signing around 30 international agreements over the last four years.<sup>128</sup> The importance of the diaspora is formally emphasized in the policy framework, e.g. the Strategy of Export-led Industrial Policy, and most prominently by the existence of a Ministry of Diaspora of the Republic of Armenia. Remittances play an important role in financing Armenia's economic development. There are a range of networking platforms between private individuals, business people and academics, increasingly facilitated by technology and becoming more important over time. Related to this is an important role for exhibitions and networking in the business community, both in Armenia and internationally. These have been especially notable in the high-tech and IT sectors, although more recently also in the healthcare and medical sectors.

The Law on Foreign Investments<sup>129</sup> contains a number of important safeguards and benefits for foreign investors:<sup>130</sup>

- Protection of foreign investors against nationalization or expropriation, other than in cases of natural or state emergency, and with full and mandatory compensation.
- Compensation of foreign investors for damages and losses resulting from unlawful acts of State authorities or officials, or improper performance of their duties.
- Non-discrimination for foreign investors: laws applied to foreign investors cannot be less favourable than the laws governing the property rights and investment activities of citizens and legal entities of Armenia, with the possibility of additional legislative privileges, although with scope to restrict foreign investment in order to protect national security.
- No restrictions on foreign investor participation in economic activities in Armenia.

<sup>128</sup> Presentation during fact-finding mission, June 2013.

<sup>129</sup> Law of the Republic of Armenia “On Foreign Investments”, President of the Republic of Armenia 31 July 1994.

<sup>130</sup> Source: Page 60, Investment Guide: Armenia 2013.

- Profits and revenues, after payment of taxes and other legislated fees, remain at the disposal of the foreign investor, who is free to repatriate profits and property legally resulting from their investment.
- No restrictions on the ownership share a foreign investor can acquire in a local business, or on staff recruitment.
- Foreigners able to exploit natural resources through concessions granted by Government.
- “Grandfathering” clause: when legislation changes, a foreign investor may request that the law as it stood at the time of the investment be applied for up to 5 years from the date of the investment.
- Import of goods included in a list established by the Government and directed at supplementing the charter capital is exempted from custom duties. The same applies to property imported on an international contractual basis as a foreign investment, and property imported by foreign employees of firms with foreign investment and intended for personal use.

Armenia is also a signatory to the International Convention on Investment Disputes, allowing dispute resolution by the International Centre for the Settlement of Investment Disputes. R&D expenditures are 100% deductible from pre-tax profits.

Although foreign investors can only lease land, companies registered by foreigners as Armenian business entities do have the right to acquire land. Long-term leases are also a possibility, with concessions for the use of Armenian natural resources possible with the participation of an Armenian company.<sup>131</sup>

## **2 Priority focus areas for innovation activity**

Clear priorities have been set by Government in the S&T sphere. Science and Technology Development Priorities for 2010-2014<sup>132</sup> include:

- Life sciences;
- Renewable energy, new energy sources;
- Advanced technologies, information technologies;
- Space, earth sciences, sustainable use of natural resources;
- Basic sciences for key applied researches; and
- Armenian studies, humanities and social sciences.

This is part of a wider Strategy on Development of Science 2011-2020 that was approved at the same time. This sets a high-level objective for Armenia, by 2020, to be a country with a knowledge-based economy and competitive within the European Research Area in terms of its level of fundamental and applied research. One of the key targets in delivering this objective is the creation of an integrated system of education, science and innovation.<sup>133</sup> Such an approach necessitates a central role for private sector investors. This is particularly the case

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<sup>131</sup> Source: <http://www.ada.am/eng/for-investors/why-armenia/> retrieved December 2013.

<sup>132</sup> Approved by Government 27 May 2010.

<sup>133</sup> Presentation: Reforms in research and development sector of Armenia: 2008-2012, Mr. Vardan Sahakian, Head of Department for Science Policy, State Committee on Science.

with regard to the objective to increase the commercialization of research results. Strategic policy trends in relation to research commercialization include:<sup>134</sup>

- Development and implementation of target programmes targeting knowledge-based production, e.g. Strategic Action Plan for the Development of Science for 2011-2015 and Low-tonnage Chemistry Development Action Plan for 2012-2013.
- Involvement of private sector in R&D in the basis of cofinancing, e.g. 17 programmes on public-private cofinancing basis from 2011.
- Creation of innovation infrastructures at universities and research institutes.
- Creation of research universities.
- Implementation of scientific and technological projects of regional/international significance.

Of particular relevance is the emphasis now placed on private sector cofinancing, and the potentially important role of the private sector in innovation infrastructures to be established at research institutes and emerging research-oriented universities. These are developments that will be of particular interest to potential investors in innovative investment projects.

Prior to this, the Law of the Republic of Armenia on State Support for Innovation Activity (2006) set the broad goal for innovation policy as being the provision of economic, legal and organizational conditions for innovation activity.<sup>135</sup> Policy aspects of particular relevance for private investors included financial and investment support and guarantees, a favourable legal environment for the establishment of legal and venture funds to support innovation activities, rights for the use of state assets, training for innovation specialists, and innovation substructures such as innovation-research centres, business incubators, technology parks and innovation funds. Article 11 of this law also allowed foreign persons and legal entities to found joint innovation organizations in Armenia, in accordance with national legislation. The private sector, including foreign investors, is given an important role in the implementation of innovation policy in Armenia.

Another key policy document is the Strategy of Export-led Industrial Policy of the Republic of Armenia (2011), developed by the Ministry of Economy.<sup>136</sup> While not an innovation policy per se, it is highly relevant to potential private sector investors in innovation projects. It prioritizes improvements in the business environment, cluster development and the sophistication of company strategies and operations. More specifically, the strategy identifies promising sectors for export and subsequent economic growth. These are broadly divided into resource-based, skills-based and knowledge-based sectors, and specific sector strategies are discussed in greater detail below. Broadly, knowledge-based sectors will be targeted as “new drivers of growth” in the medium to longer term, but there is scope for innovation even in resource-based sectors (e.g. brandy manufacturing). The initial policy horizon is 2011-2020. SME development is also prioritized as part of this strategy, although there is also an objective to attract transnational corporations. There is close cooperation with the private sector in elaboration and implementation of sectoral development strategies.

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<sup>134</sup> Ibid.

<sup>135</sup> Article 6.1, Law of the Republic of Armenia on State Support for Innovation Activity.

<sup>136</sup> Strategy of Export-led Industrial Policy of the Republic of Armenia, Ministry of Economy, Yerevan 2011.

### 3 Public sources of information on investment and innovation projects

#### “MEGA” projects

Certain large-scale, policy-driven projects provide useful focal points for private sector investors. These so-called “MEGA” projects include CANDLE (Center for the Advancement of Natural Discoveries using Light Emission), which aims to construct a third generation synchrotron light source for fundamental, industrial and applied research in biology, physics, chemistry, medicine, materials and environmental sciences. Planned “MEGA” projects also include a Centre for Radiation Medicine, focused on radionuclide diagnostics, and an Armenian Centre of Excellence in Oncology, including cyclotron. These large-scale projects should be viewed in the context of other policy developments, with research-intensive universities such as the Yerevan State Medical University, the State Engineering University of Armenia and a planned research-oriented Technological University looking set to benefit. These “MEGA” projects are applied in nature, and will help build both international cooperation and industry-science linkages, leading to collaboration opportunities for private investors.

#### Armenian R&D potential

As discussed elsewhere in this review, Armenia retains a strong scientific base, and is also developing new areas of scientific expertise. It enjoys a wide research base, and still has strong linkages with CIS R&D institutions. There are 72 R&D institutions in Armenia.<sup>137</sup> Science and engineering organizations in Armenia are diverse, and work in areas including chemistry (organic and inorganic, chemical physics, polymer chemistry), electronics (various sectors), molecular biology, biotechnology, microbiology, biochemistry, optical physics, physics, radio physics, materials science, machine tools, mathematics, information technologies, mechanics, hydroponics, geophysics, botany and other areas.<sup>138</sup>

#### *National Academy of Sciences*

The Academy includes around 35 research institutes and centres. The Academy has five divisions on specific areas of science, representing centres of knowledge for potential commercialization:

- Division of Mathematical and Technical Sciences;
- Division of Physics and Astrophysics;
- Division of Natural Sciences;
- Division of Chemistry and Earth Sciences; and
- Division of Armenology and Social Sciences.

There are also centres of expertise in the National Academy related to the production of pharmaceutical products, e.g. the Scientific and Production Centre “Armbiotechnology”.

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<sup>137</sup> Source: Submission by Technology Transfer Association.

<sup>138</sup> Ibid.

### *Research Universities*

There is a progressive move towards greater integration between research institutions and universities, which were traditionally teaching oriented but have moved towards research activity over time. At the time of this Review, plans were underway to create a research-oriented Technological University alongside a teachnopark, on the basis of around 20 research organizations and institutes.

Another area of significant commercialization potential is the medical and healthcare sector. The Yerevan State Medical University is one of the most research-oriented and internationalized universities in Armenia. In 2013, the Government and Global Medical Solutions signed an investment agreement to build the Armenian Cancer Centre in Yerevan.<sup>139</sup> This investment project was estimated to be worth around €35 million, and constitutes a significant public-private partnership. The Center will specialize in radioisotope, radionuclide, radiology and lab diagnosis, radiotherapy, oncological and chemotherapy treatments.<sup>140</sup> There is a history of patients travelling to Yerevan from neighbouring countries for specialized medical treatment, and potential to become a regional hub for oncological treatments, with opportunities for a range of specialized SMEs. There are a range of business fairs and expositions already organized in Yerevan in the medical and healthcare sectors. The National Competitiveness Foundation plays an important role in promoting the sector.

Research-intense universities with particularly strong potential for commercialization activities with the private sector include the Yerevan State University, Yerevan State Medical University, State Engineering University of Armenia (hosting the Armenian National Engineering Laboratory in collaboration with National Instruments), National University of Architecture and Construction, American University of Armenia and the Armenian National Agrarian University.

### Armenian Development Agency<sup>141</sup>

The Armenian Development Agency is the lead implementation body for the Strategy of Export-led Industrial Policy. However, ADA also has a joint high-level mission to support foreign direct investors in Armenia by acting as a one-stop-shop on all matters related to doing business in the country, including site visits, identifying facilities and premises, business cases, company registration, follow-up support, staff recruitment and liaising with Government institutions. ADA does not charge a fee for its services.<sup>142</sup> ADA also seeks to support improvement in the business and investment climate, and has a specific mandate to support development of the Information Technology Sector.<sup>143</sup>

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<sup>139</sup> “Armenian government and Global Medical Solutions sign agreement to launch investment program to build Armenian Cancer Center”, Arka News Agency, 18 July 2013.

<sup>140</sup> “Armenian Cancer Center of Excellence to be built in Yerevan”, Arka News Agency 30 October 2012.

<sup>141</sup> See <http://www.ada.am/>.

<sup>142</sup> Interviews during ECE fact-finding mission of September 2013.

<sup>143</sup> See <http://www.ada.am/eng/about-ada/objectives/>.

ADA takes a sectoral approach to its promotion activities, reflecting the Strategy of Export-led Industrial Policy. As well as public/private co-financed promotional activities, tools at ADA's disposal include:<sup>144</sup>

- Interest rate subsidies on business loans. Commercial interest rates are typically around 12% per annum. In this case, Government financing of around 4% means that the effective interest rate faced by companies is approximately 8%; and
- Guarantees or insurance letters enabling companies to receive commercial loans.

The Industrial Development Fund disburses support, with the same criteria applied to all potential recipients.

### Ministry of Economy

The Ministry of Economy provides a range of valuable information for potential investors. The "Investment Guide: Armenia 2013"<sup>145</sup> has been produced with the support of the USAID Enterprise Development and Market Competitiveness project.

This Investment Guide provides a comprehensive overview of Armenia, covering historical, cultural, geographical and policy aspects. Detailed information is provided on the investment environment, visa requirements, procedures for starting a business in Armenia, taxation and legal issues (including dispute resolution), and the range of business support institutions. SME DNC activities also help support a range of small-scale innovative entrepreneurs, whose business ideas and activities may be of potential interest to investors.

### Industrial Council

The Industrial Council is chaired by the Prime Minister, and includes the Ministers of Economy, Finance and Agriculture, the Chief Adviser to the President, Adviser to the Prime Minister, representatives from the State Revenue Committee, National Assembly Standing Committee on Finance and Budget, National Assembly Standing Committee on Economic Affairs, Armenian Development Agency, Armenian Manufacturers and Entrepreneurs (Employers) Union and Armenian Trade and Industry Chamber, as well as international donor organizations, business unions and associations. The Council also invites five business community representatives on a rotational basis. Secretariat support is provided by the Ministry of Economy.<sup>146</sup>

The Council provides a valuable interface for policy coordination, including with the private sector. It is not a source of information for private investors per se, but a mechanism to reflect their interest in policymaking, and ensure a positive investment environment. As its role includes coordination of Armenia's industrial policy, as well as approval of the sectoral development strategies that are a key part of the Strategy of Export-led Industrial Policy, the Industrial Council's activities are of great relevance to prospective investors.

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<sup>144</sup> Interviews during ECE fact-finding mission of September 2013.

<sup>145</sup> Investment Guide: Armenia 2013, Ministry of Economy of the Republic of Armenia with support of USAID Enterprise Development and Market Competitiveness Project.

<sup>146</sup> Ibid, page 117.

### Technology Transfer Association<sup>147</sup>

The TTA has been in operation since 2001, with a membership comprising Armenian organizations that have developed advanced technologies in a range of scientific, technological and engineering disciplines. TTA aims to provide comprehensive support to all areas of the technology transfer process, from technology assessment, through identification of potential customers and technology markets assessment, to attracting investors and establishing linkages between Armenian technologies' owners and organizations looking for innovative solutions. TTA also acts as a partner of the International Science Technology Centre in making preliminary technology assessments as a basis for further commercialization, and has considerable expertise in the area of intellectual property protection, as ISTC representation for IP protection in Armenia.

TTA has also been the initiator and performer of preliminary due diligence of a number of high-tech projects later considered by the Science and Technology Council of Armenia. Members of TTA include the Institute of Molecular Biology, Scientific-Research Institute "Plastpolymer", Institute of Materials' Science, Institute of Applied Chemistry "ARIAC", Institute of Chemical Physics, Institute for Fine Organic Chemistry, Astra Crystals CJSC, Institute of Organic Chemistry, LT-Pyrkal CJSC and Yerevan Computer Research & Development Institute. Technologies assessed by TTA within the framework of collaboration with ISTC include:

- Chemical nanosensors for multi-sensor systems;
- New multi-purpose glass ceramics;
- X-ray imaging detector with high spatial resolution;
- High-performance porous convertors and detectors;
- Continuous mineral fibres for composite materials;
- Better quality perlite fillers; and
- Polymer materials for treatment of burns and radiation injuries.

TTA developed the concept of a D-STEP technopark "without walls". On the basis of this concept, the International Innovation Center in Yerevan was established in order to provide an opportunity for local and international companies to capitalize not only on the scientific-technical potential of R&D centres and specialists' groups from CIS countries and Armenia, but also on the synergy of collaborative research with colleagues from western countries. The co-founders of this Centre are the State Committee of Science of Armenia and the Armenia Development Agency.

### International Innovation Center of Armenia

The Center was founded by the Technology Transfer Association of Armenia, the State Committee of Science of Armenia and the Armenian Development Agency. It is based on the concept of a technopark "without walls", with peer-to-peer consortia and synergies from joint projects, sharing of equipment and international learning.

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<sup>147</sup> Source: Written submission by TTA.

The Center is to carry out due diligence of high-tech projects from the Center's pipeline. The intention is to form a portfolio of potential investment projects, to be submitted to members of the Financial Club of the Center, who pay a membership fee. Members of the Financial Club will then be able to select projects of potential interest, and propose the size and form of their involvement in each project's commercialization.

Due diligence will follow a five-step assessment procedure of pipeline projects. In order to improve information exchange for commercialization purposes, members of the Financial Club are able to join experts at any step of this procedure:

- Scientific value;
- Market potential;
- Practicability based on existing equipment;
- Potential profitability; and
- Team skills and capacity.

The project pipeline will originate from Armenian R&D institutes, laboratories and universities, and groups of scientists and engineers. However, joint project proposals will also be accepted from consortia of specialists' groups from CIS (Russia, Ukraine, Belarus, Kazakhstan, etc.), as well as from consortia of Armenian specialists and their partners from the EU, US, Japan, Canada, Korea and elsewhere.

The Center is to be funded from membership fees, and success fees in the case of project commercialization. When projects from the portfolio are not of interest to members from the Financial Club, these projects will be proposed to third parties for commercialization.

#### National Competitiveness Foundation of Armenia<sup>148</sup>

National Competitiveness Foundation (NCF) is a public-private entity established in 2008 through a partnership between the Government of Armenia and a group of global business leaders from the Armenian diaspora.

As at other institutions such as ADA, NCF takes a sectoral approach in its efforts to increase Armenia's international competitiveness, seeking to mobilize strategic investments and implement programmes in certain sectors, including healthcare, tourism and education. Projects are implemented in accordance with the public-private partnership principle, and so the NCF is a contact point in these particular sectors for investors looking to make investments at a nationally significant scale.

The NCF also seeks to improve Armenian competitiveness more generally, through improved access to information, particularly through investment in telecommunications infrastructure and information technologies, improved knowledge of key foreign languages, and attraction of skilled human resources to the country. As such, it also helps improve general framework conditions for innovative investment in Armenia.<sup>149</sup>

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<sup>148</sup> See [www.cf.am](http://www.cf.am) for further information.

<sup>149</sup> See <http://www.cf.am/eng/index.php?other=7> for further information.

## Technoparks

Overseen by the Ministry of Economy, and with a loan from the World Bank, the Gyumri Technopark was recently created, reflecting efforts to increase the prosperity of Gyumri, creating a technology zone with advanced IT infrastructures.<sup>150</sup> The Gyumri Information Technologies Center is also supported by the Fund for Armenian Relief, Enterprise Incubator Foundation and Shirak Technologies, and there are plans for a network of regional technoparks and business parks, intended to focus on start-ups and SMEs. The Vanadzor Technology Center has also been established by the Government on the site of the State Engineering University of Armenia. Building on the experience gained at Gyumri, the Enterprise Incubator Foundation will be responsible for operational coordination of this project, which will be based on a similar technology centre concept to Gyumri.<sup>151</sup>

Gyumri is not restricted to IT, and has a remit for broader knowledge-based development and improved competitiveness. As early as 2012, there were plans to establish a centre for jewellery, design and fashion at the Gyumri Technopark, and there are now signs of private sector activity, for example in jewellery design.<sup>152</sup> This is a general trend that can be expected in technoparks across Armenia, where activities will not be restricted to IT alone.

There are also a range of private sector initiatives, e.g. Microsoft Innovation Centre. This was originally established in an attempt to improve skills and training in the workforce, and to train and certify local companies. However, it has become one of the most successful of Microsoft's centres in Central and Eastern Europe, already with around 10 start-ups, and a high level of Armenian participation in Microsoft's Imagine Cup,<sup>153</sup> which is a student technology competition bringing together young technology specialists from around the world to generate solutions to key global challenges.

Private technoparks include Viasphere Technopark, which is a commercial technopark based in Yerevan. It has been operational since 2000, and includes several US-based subsidiaries developing information and communications technologies, while providing infrastructure for local ICT start-ups.<sup>154</sup> It provides not just physical premises, but also services from incubation through growth and management of technology companies, management and training, and international linkages. Partners include a range of incubators, venture capital and angel funds.

The "IT Park" in Yerevan currently hosts around 50 companies, and provides a full range of services – physical offices, Internet access and accounting services. "IT Park" is located on the site of two former research institutes. It is now a closed joint stock company, and run as a commercial business park, with around 700 people employed on the site. It is a good example of building on existing human capabilities in Armenia for sustainable, knowledge-based development. Around ten per cent of companies on the park were founded by former institute staff, with the significant majority resulting from foreign direct investment – mainly from the USA, but also from the Russian Federation and other countries, frequently diaspora related. A

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<sup>150</sup> Ministry of Economy.

<sup>151</sup> Enterprise Incubator Foundation to be operator of Vanadzor Technology Center, Armenpress 12 February 2014.

<sup>152</sup> "Gyumri Technopark Designs 3D Jewelry", NEWS.am 18 February 2014.

<sup>153</sup> Source: Interviews during ECE fact-finding mission to Armenia, June 2013.

<sup>154</sup> For further information, please see <http://www.viasphere.com/>.

frequently followed pattern has been to first bring orders from abroad (typically the USA), and if these are successfully fulfilled, to establish a subsidiary. Software development and applications are major areas of activity, with perhaps 70% of the work “routine”, and around 30% relating to “novel” developments. Some companies have graduated from the park, due to becoming too large or, more frequently, requiring specialized facilities such as warehousing. There is increasing interest in activities on the park from overseas venture capitalists.<sup>155</sup>

#### **4 Private investment opportunities**

##### Exhibitions and conferences

The importance of networking events cannot be underestimated as a source of information and driver of innovative development, particularly given the significance of the diaspora and FDI for Armenia. Examples include the “DigiTec” Information and Telecommunication Technologies Expo, held annually in Yerevan since 2005. There is also a regular “ArmTech” Congress high-tech industry business forum and conference, which has been held annually since 2007 in venues including San Francisco, Yerevan, San Jose and Stanford University.

While the IT and high-tech sectors have enjoyed the most intensive (international) networking activities, there are growing efforts in other sectors. For example, “Pharma Armenia 2013”, the fifth International Pharmaceutical Competitiveness Conference took place in June 2013 at the Yerevan State Medical University, organized by the Medicine Producers and Importers Union of Armenia with support of USAID EDMC programme and Industrial Development Fund of Armenia.

##### Free Economic Zones

Armenia’s first FEZ opened in August 2013, based on the site of the engineering, manufacturing and industrial complex CJSC “RAO Mars”<sup>156</sup> and the Yerevan Computer Research and Development Institute, with the operating company enjoying exemptions from import and export customs duties, value added tax and property tax, and tax on dividends.<sup>157</sup> In relation to potential investors in export-oriented manufacturing enterprises, the Industrial Development Fund of Armenia will be another potential source of support.

More recently, the Ministry of Economy and CJSC “AJA Free Economic Zone” signed an agreement regarding creation of an FEZ in Yerevan specialized in jewellery, precious stone cutting and watch making over a period of ten years.<sup>158</sup>

##### Key sectors for private investors

The IT sector is performing strongly, and has received a great deal of attention, both from policymakers and private investors. EIF, for example, provides an extensive online guide and directory of Armenian IT companies, searchable by subsector.<sup>159</sup> EIF also produces the

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<sup>155</sup> Interviews during ECE fact-finding mission to Armenia, September 2013.

<sup>156</sup> For further information, please see <http://www.raomars.com/>

<sup>157</sup> <http://www.fez.am/rus/index.php?pu=43#metka>

<sup>158</sup> Source: <http://www.mineconomy.am/eng/374/1/news.more.html>

<sup>159</sup> See <http://itguide.eif.am/?id=#top>.

annual Armenian ICT Sector State of Industry Report, with the support of the USAID EDMC. The Armenian ICT sector continues to see dynamic development, and will remain attractive to private investors.

The Armenian Development Agency is the lead implementing agency for the Strategy of Export-led Industrial Policy. Initial attention was focused on sectors of traditional strength:

- Agriculture (particularly wines and brandy making);
- Pharmaceutical sector; and
- Precision engineering.

There have already been results, in terms of strong export growth in the agricultural and pharmaceutical sectors. Precision engineering is a more general sector, and was included to reflect Armenian strengths in a range of areas, often retained from the Soviet era, and the desire to preserve and build on such capacities. It includes electronics, welding, laser technologies and optics. Two additional sectors have been added:

- Textiles and shoe making; and
- Diamond processing and jewellery.

Again, these additions partly represent historical strengths of Armenia. For example, Armenia has for a long time been a leading centre for diamond processing, and this can be used as a basis for jewellery design and other value added activities, where there are indeed now signs of investment, for example at Gyumri and in Yerevan, where an FEZ has been created.

ADA has adopted a model of equal public/private cofinancing for its activities, which helps ensure there is private sector demand for and involvement in the promotional activities taking place. This means that activities are focused on areas where there are existing or realistic prospects for Armenian comparative advantage, and where promotional activities will have an impact. This is often in areas of higher value added, where brand, reputation and quality are important factors in purchase decisions. Recent activities have included promotional activity at the Council of Europe for wines and grape products, research on emerging patterns of demand for wine in growth markets including China, and a pharmaceutical road show for investment promotion purposes.<sup>160</sup>

### *Sector strategies*

Four sector strategies have already been developed, in accordance with the Strategy of Export-led Industrial Policy developed by the Ministry of Economy, with the lead implementation agency being ADA. Four sector strategies were already developed for implementation over the period 2012-2020, and are available online.<sup>161</sup>

*Wine sector strategy:* Armenian wine production declined sharply until the mid-1990s, to reach around 5-10% of peak levels in the late 1970s and early 1980s. There has since been a

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<sup>160</sup> Interviews during UNECE fact-finding mission to Armenia, September 2013.

<sup>161</sup> Sector strategies may be downloaded at <http://www.ada.am/eng/for-exporters/export-oriented-industrial-policy/>

strong recovery in production volumes of grape and, particularly, fruit wines. Historical production volumes and potential productivity improvements indicate significant capacity for investment, possibly in conjunction with touristic activities. There is a need to upgrade skills via higher education programmes, improve legislation and meet international standards, develop supply chains and build the Armenian brand abroad. The sector strategy is supported by a Wine and Brandy Council, and has identified Russia and China as strong potential export markets, as well as the USA and France as markets with strong diaspora linkages.

*Brandy manufacturing:* A sector strategy for 2012-2020 sets strong objectives for improved quality control, as well as sales and distribution, while retaining strong market shares in Russia and CIS. New markets are being targeted in Eastern Europe and East Asia, as well as other markets with strong diaspora (e.g. USA and Germany). Brand protection, developing the supply base and human capacity are priorities until 2015, including financing, technology transfer, training, foreign expertise and specialized education.

*Pharmaceuticals and biotechnologies:* This sector enjoyed an average annual growth of 12.5% over 2003-2010, and was one of the few sectors where export growth was not interrupted by the global financial crisis. The sector is strongly export oriented, with major markets including the CIS and Middle East. The strategy over 2012-2020 is focused on achieving strong export growth, through industrial upgrading and supply chain development, improved quality certification, training, a free trade regime with Georgia and CIS countries and using diaspora connections to secure outsourcing and contract manufacturing from MNCs. In the period to 2015, the focus is on expanding sales in key existing CIS markets, entering Middle Eastern markets, while over 2015-2020 the focus will shift to market expansion in the Middle East. Likewise, initial emphasis on Armenian producer certification and outsourcing in basic areas such as packaging will after 2015 shift to production of Armenian brands of generic drugs (as opposed to pure outsourcing), continued expansion of higher value-added MNC outsourcing activities and a possible free economic zone.

*Precision engineering:* This sector is considered to include optical, electronic, mechanical and machinery production characterized by a high level of precision and/or knowledge content, and is currently oriented towards domestic and CIS markets. Certain niche markets are internationally competitive, e.g. optical and laser technologies, and crystal growing. Across all sectors, gross sales in 2010 stood at \$35 million, with exports of \$17 million and annual export growth of 10% over 2003-2008. Continued growth in engineering services is seen as a key driver of precision engineering. Goals by 2015 include attracting MNC production units and MNC R&D units collaborating with SEUA, while supporting development of a range of local companies through the supply chain. Longer term objectives, by 2020, include Armenia being an engineering R&D hub with some strong manufacturing units, internationally recognized local companies, an internationally renowned engineering research university and a move away from “brain drain” to more balanced flows of skilled personnel. Delivery strongly relies on FDI attraction. A free economic zone at “RAO Mars” industrial complex is expected to target MNC investment. The Enterprise Investment Foundation, with the support of the World Bank E-Society and Innovation for Competitiveness Project, will be providing a range of ideas grants for feasibility studies, innovation grants, venture financing and financing of investment and export, the latter with the support of PanArmenian Bank and SME Investments UCO. At SEUA, the Armenian National Engineering Laboratory has potential as a source of innovative investment projects.

# Innovation Performance Review

The Innovation Performance Review contains the findings of a participatory policy advisory service undertaken at the request of the national authorities. It considers possible policy actions aimed at stimulating innovation activity in the country, enhancing its innovation capacity and improving the efficiency of the national innovation system.

This publication is part of an ongoing series highlighting some of the results of the UNECE Subprogramme on Economic Cooperation and Integration. The objective of the Subprogramme is to promote a policy, financial and regulatory environment conducive to economic growth, knowledge-based development and higher competitiveness in the UNECE region.

Information Service  
United Nations Economic Commission for Europe

Palais des Nations  
CH - 1211 Geneva 10, Switzerland  
Telephone: +41(0)22 917 44 44  
Fax: +41(0)22 917 05 05  
E-mail: [info.ece@unece.org](mailto:info.ece@unece.org)  
Website: <http://www.unece.org>

