

Report No. 97520

Republic of Armenia

Drivers of Dynamism

June 2015



Macroeconomics and Fiscal Management
Europe and Central Asia Region



Document of the World Bank

CURRENCY EQUIVALENTS

(Exchange Rate as of June 2, 2015)

Currency Unit	Armenian Dram
US\$1.00	AMD 477.19

Weights and Measures: Metric System

ABBREVIATIONS AND ACRONYMS

ACEO	Armenian Center of Excellence in Oncology	KEI	Knowledge Economy Index
ADA	Armenian Development Agency	MENA	Middle East and North Africa
ADS	Armenia Development Strategy	MTS	Mobile TeleSystems
AMD	Armenian Dram	NAS	National Academy of Sciences
ANEL	Armenian National Engineering Lab	NCIE	National Center of Innovation and Entrepreneurship
ANQA	Armenian National Centre for Professional Education Quality Assurance Foundation	NGO	Non-governmental Organization
AUA	American University of Armenia	NIS	National Innovation System
CANDLE	Center for the Advancement of Natural Discoveries using Light Emission	OECD	Organization for Economic Co-operation and Development
CBA	Central Bank of Armenia	PPP	Purchasing Power Parity
CEM	Country Economic Memorandum	QA	Quality Assurance
CEW	Clean Energy and Water	R&D	Research and Development
CIT	Corporate Income Tax	RCA	Revealed Comparative Advantages
CNRS	French National Centre for Scientific Research	S&T	Science and Technology
DCFTA	Deep and Comprehensive Free Trade Agreement	SCPEC	State Commission for the Protection of Economic Competition
EBRD	European Bank for Reconstruction and Development	SCS	State Committee of Science
ECA	Europe and Central Asia	SDS	Strategy for the Development of Science
EDMC	Enterprise Development & Market Competitiveness	SME DNC	Small and Medium Entrepreneurship Development National Center of Armenia
EEU	Eurasian Economic Union	SME	Small and Medium Enterprise
EIF	Enterprise Incubator Foundation	SNCO	State Non-Commercial Organizations
ES	Enterprise Surveys	STI	Science, Technology And Innovation
FD	Foreign Direct Investment	STIP	Science Technology Innovation Partnership
FSU	Former Soviet Union	TFP	Total Factor Productivity
GCI	Global Competitiveness Index	UNCTAD	United Nations Conference on Trade and Development
GDP	Gross Domestic Product	UNECE	United Nations Economic Commission for Europe
GERD	Gross Expenditure on R&D	USAID	United States Agency for International Development
GII	Global Innovation Index	USD	United States Dollar
HEI	Higher Education Institutions	USSR	Union of Soviet Socialist Republics
ICT	Information And Communications Technology	VAT	Value Added Tax
IFRS	International Financial Reporting Standards	WGI	World Governance Indicators
IPR	Intellectual Property Rights	YPI	Yerevan Physics Institute
ISFIE	Initial Strategy for the Formation of the Innovation Economy		

Vice President:	Laura Tuck
Country Director:	Henry Kerali
Senior Practice Director:	Marcelo Giugale
Practice Director:	Satu Kähkönen
Practice Manager:	Miria Pigato
Task Team Leader:	Donato De Rosa

Acknowledgments

This study was prepared by a team initially led by Ulrich Bartsch and then by Donato De Rosa. Several authors contributed in various ways. Naoko Kojo, Elena Bondarenko, Ekaterina Vostroknutova, Moritz Meyer and Tigran Kostanyan contributed to Chapter 1. David Gould, Hernan Winkler, Tu Chi Nguyen, Dobrina Gogova, Georgi Lyudmilov Panterov, Moritz Meyer, Rachel Li Jiang and Artsvi Khachatryan contributed to Chapter 2. Hania Sahnoun, Pluvia Zuniga, Ekaterina Ushakova, Rachel Li Jiang and Artsvi Khachatryan contributed to Chapter 3. Pluvia Zuniga, Artsvi Khachatryan and Tigran Kostanyan contributed to Chapter 4. Jorge Pena, Hania Sahnoun, Moritz Meyer, Rachel Li Jiang, Itzhak Goldberg and Artsvi Khachatryan contributed to Chapter 5. Pluvia Zuniga and Hania Sahnoun contributed to Chapter 6. Zakia Nekaien-Nowrouz and Gayane Davtyan provided excellent support to the team.

The Bank's team benefited from the guidance of Henry Kerali (Country Director, South Caucasus), Marcelo Giugale (Senior Practice Director, MFM), Satu Kähkönen (Practice Director, MFM), Laura Bailey (Country Manager, Armenia), Miria Pigato (Practice Manager, MFM), Ivailo Izvorski (Practice Manager, MFM) and Rashmi Shankar (Program Leader, South Caucasus). Yutaka Yoshino, Mariana Iootty and Vahram Avanesyan were peer reviewers for the report.

Contents

Acknowledgments	iv
Overview	1
Introduction	1
Key Findings	2
The Way Forward: Using Public Policy to Boost Innovation	5
1. Armenia’s Growth: Past and Future	8
Slowing Growth in a Changing Economy	9
The Impact of Changing Growth Patterns on Poverty and Shared Prosperity	11
Long-Term Drivers of Growth: Domestic Policies And External Conditions	13
Conclusion: Drivers of Dynamism	15
2. Global Connectivity	17
Trade.....	18
Investment	21
Information	24
Labor Mobility	28
Leveraging Connectivity	37
3. The Knowledge Economy	39
Governance.....	40
Information and Communication Technology.....	43
Human Capital.....	45
The Creation and Use of Knowledge.....	48
Leveraging Knowledge.....	52
4. The National Innovation System	54
The Legal and Strategic Framework for Innovation	54
Institutions, Funding Mechanisms and Policies	57
Toward an Integrated Innovation System	66
5. The Policy Environment	67
Productivity	69
International Orientation.....	73
Innovation.....	74
Enterprise Performance and Policy	82
6. Innovation and Dynamism: The Way Forward.....	84
Boosting the Supply of Innovation	84
Boosting Demand for Innovation	87
Creating a More Dynamic Armenian Economy	90
Annexes	91
References	110

Figures

Figure 1.1: GDP Growth, 1990-2014	8
Figure 1.2: GNI Per Capita in Current US\$, Atlas Method, 1992-2014.....	8
Figure 1.3. Composition of Growth by Expenditure, 2001-2014	9
Figure 1.4. Composition of Growth by Production, 2001-2014	9
Figure 1.5. Moderate and Extreme Poverty Rates, 2001-2014.....	12
Figure 1.6. Percentage Growth Rate of Mean Consumption among the Bottom 40%, 2007-2013	12
Figure 1.7. Growth Composition by Factor, 1998-2012.....	13
Figure 1.8. Estimated Growth Effects Arising from Persistence in Growth Patterns, Structural Reforms, Stabilization Policies, and External Conditions.....	15
Figure 2.1. Trade-to-GDP Ratio and GDP per Capita, 2011-2013.....	18
Figure 2.2. Trade-to-GDP Ratio, Armenia and Comparators, 2003-2013.....	18
Figure 2.3. Merchandise Exports by Sector, 2011-2013	18
Figure 2.4. Export Product Concentration	20
Figure 2.5. Export Market Concentration	20
Figure 2.6. Armenian Export Destinations, 2012-2014.....	20
Figure 2.7. FDI as a Share of GDP, 2002-2012.....	21
Figure 2.8. FDI as a Share of GDP, Armenia and Compar	21
Figure 2.9. Ten Largest Sources of FDI , 2001-2012	22
Figure 2.10. Total FDI by Sector, 2003-2015.....	23
Figure 2.11. FDI by Sector, Pre- and Post-Crisis	23
Figure 2.12. FDI by Source Country and Sector	24
Figure 2.13. Internet Cost and Speed, Armenia and Comparators, 2013.....	25
Figure 2.14. Global Connectivity Based on Outgoing Communications per Capita, 2000	26
Figure 2.15. Global Connectivity Based on Outgoing Communications per Capita, 2010	27
Figure 2.16. Armenia’s Major Communications Partners by Share of Total Outgoing Communications	28
Figure 2.17. Number of Migrants as a Share of the Total Home-Country Population	29
Figure 2.18. Skilled Migrants as a Share of the Total Home-Country Population	30
Figure 2.19. Highly Educated Emigrants as a Share of the Total Highly Educated Population, 1990 and 2010.....	31
Figure 2.20. Skilled and Unskilled Armenian Migrants by Destination Country, 1990 and 2010	31
Figure 2.21. Quarterly Out-Migration, 2009-2013	32
Figure 2.22. Migrants by Destination, 2009-2013.....	32
Figure 2.23. Skill Distribution of Migrants and Non-Migrants Across Countries.....	33
Figure 2.24. Migrants by Occupation and Destination	33
Figure 2.25. Monthly Wages of Migrants and Non-Migrants	33
Figure 2.26. Remittances by Country of Origin, 2010-12, and as a Share of Armenian GDP, 1995-2013	34
Figure 2.27. Armenian Migrants in the Private Sector of European Countries	35
Figure 2.28. FDI from Major Armenian Migrant Destinations in Europe.....	35
Figure 2.29. Trade Flows, FDI and the Size of the Diaspora, 2000-2010, Conditional Correlations	36
Figure 2.30. Social and Political Values, Armenia, Russia and the US, 1990 and 2010	37
Figure 3.1. Armenia’s Performance Across the Six Dimensions of Governance	41
Figure 3.2. Armenia’s Performance in Governance and Business Regulation	41
Figure 3.3. <i>Doing Business</i> Areas in 2015	42
Figure 3.4. Firms’ Perceptions of the Governance Environment	43
Figure 3.5. Web and Email Use by Armenian Firms.....	45
Figure 3.6. Tertiary Enrollment.....	46
Figure 3.7. Tertiary Graduates in Science and Engineering	46
Figure 3.8. Researchers	46

Figure 3.9. R&D Personnel	46
Figure 3.10. Use and Retention of Talent	47
Figure 3.11. Availability of Skills in the Enterprise Sector	48
Figure 3.12. Gross Expenditures on R&D, 2011	49
Figure 3.13. Budgeted and Actual Expenditures on R&D, 2002-2013	49
Figure 3.14. Scientific Publications, 2013	50
Figure 3.15. Citable Documents 2013	50
Figure 3.16. Quality of Armenian Research: H-Index of Scientific Publications (1996-2013).....	50
Figure 3.17. Revealed Scientific Advantage –The first 15 Scientific Disciplines (1996-2013).....	50
Figure 3.18. University-Industry Collaboration	51
Figure 3.19. Patent Applications	51
Figure 3.20. Trademark Applications	51
Figure 4.1. Research Organizations.....	58
Figure 4.2. STI Budget, 2008-2013.....	61
Figure 4.3. The Evolution of the STI Budget,	61
Figure 4.4. Composition of the STI Budget by Program, 2008-2013.....	61
Figure 4.5. Execution of the STI Budget by Agency, 2008-2013	61
Figure 4.6. The STI Budget by Program, 2013	62
Figure 4.7. Public Research Spending by Discipline.....	62
Figure 5.1. Key Obstacles to Doing Business, 2009 and 2013	68
Figure 5.2. Armenia Shows a Wide Dispersion in TFP Across Firms	69
Figure 5.3. Determinants of Firm Level Productivity in Armenia.....	72
Figure 5.4. Contributions of Policy Variables to the Probability of Exporting	74
Figure 5.5. Contributions of Policy Variables to the Probability of Receiving FDI.....	74
Figure 5.6. Innovation in the Enterprise Sector	76
Figure 5.7 Average Expenditure on In-House R&D as a Percentage of Annual Turnover	76
Figure 5.8. Contributions of Policy Variables to the Probability of Investing in R&D.....	77
Figure 5.9. Percentage of Firms that Make and/or Buy Knowledge.....	78
Figure 5.10. Product Innovation at the Global Technological Frontier and the Adoption of Existing Technologies	78
Figure 5.11. Percentage of Firms Engaging in Product and Process Innovation	79
Figure 5.12. Percentage of Firms Engaging in Organizational or Marketing Innovation.....	79
Figure 5.13. Percentage of Firms Engaging in Product Innovation by Size and Age.....	79
Figure 5.14. Percentages of Foreign-Owned and Domestic Firms that Are Engaged in Innovation	80
Figure 5.15. Foreign-Owned Firms Spend More on Knowledge	80
Figure 5.16. Differences Between Innovative and Non-Innovative Firms’ Perception of the Policy Environment	80

Tables

Table 1.1. Selected Economic Indicators	11
Table 2.1. Armenia: Services Exports, 2003-2013	19
Table 2.2. Armenia’s Revealed Comparative Advantages, 2003 and 2013.....	19
Table 2.3. Export Growth Decomposition, Intensive and Extensive Margins, 2003-2013	21
Table 2.4. FDI Inflows Before and After the Crisis	22
Table 2.5. Share of FDI Inflows by Largest Contributor, 2001-2012	22
Table 2.6. Average FDI Stocks by Source Country	23
Table 2.7. Migrants and Labor Migrants by Year	31
Table 3.1. Armenia's Doing Business Performance 2014-2015	42
Table 5.1. Policy Environment and Firm-Level Variables	71

Boxes

Box 1.1. Armenia's Economic Structure before and after the Crisis	10
Box 1.2. Contributors to Growth in Post-Communist Economies.....	14
Box 2.1. Armenia's Accession to the Eurasian Economic Union	37
Box 3.1. The World Governance Indicators	40
Box 3.2. The Information and Communication Technology Sector in Armenia	44
Box 4.1. The Three Horizons of the National Innovation Strategy	55
Box 4.2. The Enterprise Incubator Foundation (EIF)	57
Box 5.1. The Enterprise Survey and BEEPS V	67
Box 5.2. Innovation in Israel	75
Box 5.3. The Views of High-Tech Entrepreneurs on the Quality of Public Governance	81
Box 5.4. The Views of High-Tech Entrepreneurs on the Relationship between Workforce Skills and Innovation.....	82
Box 6.1. Intellectual Property Rights and Innovation: Lessons from the International Experience	86

Overview

INTRODUCTION

1. Prior to the onset of the global financial crisis in 2008 Armenia experienced an unprecedented 15 years of continuous economic growth driven by major structural reforms. Between 1994 and 2008 the economy grew at an average rate of 9 percent per year, generating a tenfold increase in per capita income. Growth during this period was highly inclusive, and the poverty rate declined from 67 percent in 2001 to 26 percent in 2008.¹ Economic expansion was driven by the construction sector, and the unemployment rate dropped from 38.4 percent in 2001 to 28.7 percent in 2007.² A number of key structural reforms underpinned Armenia's transition from a centrally planned economy to a competitive market, including the elimination of price controls, the liberalization of trade and investment policies, the privatization of asset ownership, and the restructuring of state-owned industries. Despite the tumult of the early transition these reforms ultimately contributed to a dramatic and sustained increase in the productivity and efficiency of the Armenian economy.

2. Armenia was hit hard by the global financial crisis; its recovery has been moderate, and the drivers of growth have shifted. Growth slowed from nearly 14 percent in 2007 to less than 7 percent in 2008, then plunged to -14 percent in 2009. Between 2010 and 2014 the economy rebounded at an average rate of 4.2 percent a year, a modest pace compared with its pre-crisis performance. A combination of domestic consumption supported by large remittance inflows and mineral exports bolstered by high international commodity prices has fuelled post-crisis growth. The poverty rate has also risen in the wake of the crisis and is currently estimated at over 30 percent.

3. Armenia's pre-crisis growth model was predicated on an economic restructuring process which—while highly beneficial—was incomplete, and significant structural rigidities were left unaddressed. The liberalization of the 1990s facilitated an economy-wide reallocation of productive factors, greatly increasing the efficiency of both the public and private sectors. However, the crisis revealed serious unresolved weaknesses in economic governance and a lack of competition in critical industries. Returning the economy to a high-growth trajectory will require further structural reforms designed to incentivize investment, spur innovation and accelerate the growth of total factor productivity.

4. The objective of this report is to facilitate a productive policy dialogue in support of Armenia's efforts to build a more dynamic economy capable of thriving in an increasingly knowledge-driven global marketplace. The report supports the objectives of the Armenian government's national development strategy, which focuses on economic versatility and robust job creation. While Armenia faces a complex set of macroeconomic challenges, this report will concentrate on a select number of issues crucial to the creation of a more open, adaptable and resilient economy.

5. Armenia's medium-term outlook is complicated by a mix of adverse domestic and external factors, but there is reason for cautious optimism. Despite its considerable progress over the past two decades Armenia is still struggling to free itself from the vestiges of central planning. As the period of macroeconomic adjustment following the global financial crisis comes to a close the authorities are

¹ Calculated according to the international poverty line of US\$2.50 per day in purchasing-power parity terms.

² Since 2008 the indicators are not comparable with the data of previous years. The number of unemployed has been calculated by the NSS of RA since 2008 based on the ILO standard definition used by EU countries. The later partially differs from the methodology used in 2001-2007, which is based on the expanded definition of unemployment recommended by the ILO for use in transition countries.

renewing their efforts to build a sophisticated modern economy based on human-capital accumulation and technological innovation. Recognizing that Armenia is at a critical juncture in its development, this report identifies a number of reforms designed to increase competitiveness on both the supply and demand sides of the economy.

6. Several studies provide a comprehensive analysis of Armenia’s development challenges. A readers’ guide to some of the key challenges analyzed in previous work can be found in the table below. This report builds on previous work and dives into the challenges and opportunities that Armenia faces in becoming a more dynamic knowledge-based economy.

Readers’ Guide to Important Topics		
<i>If you are interested in ...</i>	<i>Covered in this Report in ...</i>	<i>You Can Find Additional Analysis Here</i>
Comprehensive “horizontal” view of constraints to Armenia’s development	Overview, Chapter One and Chapter Six	2013 CEM: Republic of Armenia: Accumulation, Competition, and Connectivity “The Caucasian Tiger” Report
Nexus between Armenia’s competitiveness and external dynamics and exchange rate shocks	Chapter One	Bi-Annual WB Armenia Economic Updates: April 2015 issue, Accelerating Reforms, Increased Uncertainty
Connections between Armenia’s options for growth and its new membership in the ECU	Chapter One and Two	2015 ECU Opportunities and Challenges Study
Global analysis of lessons learned on diaspora engagement in economy growth	Chapter Two	2013 CEM: Republic of Armenia: Accumulation, Competition, and Connectivity Migration and Development Brief 24
Links between the Knowledge Economy, Education and Skills, and Jobs	Chapter Three and Five	Armenia –Skills Toward Employment and Productivity, 2015 IT Skills Assessment in Armenia, 2014

KEY FINDINGS

Intensifying Global Connectivity through Trade, Investment, Data and Human Capital

7. **Armenia’s economic openness with the rest of the world remains limited.** Armenia has close historical ties with Russia through trade, investment, communications, and migration flows; Russia plays a major role in Armenia’s connectivity to the world, and Armenia’s accession to the Eurasian Economic Union is likely to deepen its integration with its larger neighbor. The country’s strong links to Russia still allow it to expand economic relationships with neighboring countries and with European Union member states, and this diversification will be critical in the future.

8. **Service exports, including finance, communications, construction, travel and transportation, represent less than half of total exports, but these sectors are growing rapidly.** Service exports shot from 7.4 percent of GDP and 23.6 percent of total exports in 2003 to 10.4 percent of GDP and 42.4 percent of total exports in 2013. In 2013 the country’s main service exports were travel (42 percent), construction (21 percent), transportation (15 percent), and computer and information services (7 percent).

Meanwhile, merchandise exports are heavily concentrated in mining commodities and food and beverage products, which together make up over 90 percent of merchandise exports.

9. Large foreign investment inflows have helped increase domestic competition and reorient certain sectors toward export markets. FDI in Armenia has averaged around 5 percent of GDP, the bulk of which has gone to the financial sector, telecommunications and mining. Russia is the country's largest foreign investor by far. Foreign investment in finance and telecoms has focused on domestic markets, while FDI in the mining sector has boosted exports. The information and communications technology (ICT) sector has attracted both domestic and export-oriented investment projects.

10. Exporters and foreign-owned firms tend to perform better than purely domestic firms. Exporters have greater financial resources, make more use of ICT, have better access to infrastructure, are more integrated with import markets, and are more productive overall. Foreign-owned firms and firms with substantial foreign shareholders are more productive than domestic firms and are able to attract or train more highly skilled workers. Improving the policy framework for FDI and exports would encourage the entry of additional foreign firms and accelerate productivity spillovers.

11. Armenian firms spend only 0.1 percent of their annual turnover on research and development, well below the average for regional comparators. Most innovation takes place in older and larger firms and in firms with foreign ownership. The climate for small domestic startups is generally inhospitable, especially in the manufacturing sector. Weaknesses in the policy and institutional environment, corruption and limited workforce capacity represent binding constraints on the development of innovative firms.

12. Broadband internet and mobile telecom coverage has expanded significantly since 2010. About 46 percent of Armenia's population has internet access, in line with comparable countries, and the cost of connecting is relatively low. Armenia's internet providers depend heavily on Russian infrastructure, and this connectivity facilitates the tight trade and investment links between the two countries. Expanding digital access is crucial to overcoming Armenia's geographic isolation and fostering the growth of information-driven industries.

13. Armenia's large diaspora community is increasingly important to its economic development. In recent years an estimated 600,000 Armenian emigrants have generated remittances totaling between 15 and 20 percent of GDP. Remittances are crucial to alleviating poverty, but emigration has also reduced the country's stock of human capital as emigrants tend to be relatively highly skilled. Armenia's diaspora has not leveraged its full potential as a conduit for trade and investment flows; nevertheless, many Armenian emigrants are highly successful, and there are a number of prominent examples of productive cooperation in workforce skills and business development. In addition, large private transfers from the diaspora to finance public projects and NGO activities indicate a strong degree of commitment to the country's future. Though often generating important and highly visible results at the local level, these remain isolated initiatives. Armenia has not yet capitalized on the opportunities presented by the diaspora to stimulate trade, investment and human-capital formation.

Building a Knowledge-Based Economy

14. Armenia is striving to build a knowledge-based economy. The development of sophisticated, information-driven industries requires a foundation of sound governance, modern ICT infrastructure, adequate human capital and effective protection of intellectual property. A country's policy and institutional environment shapes the incentives of knowledge creators and users, with important economy-wide spillover effects. Armenia has made substantial progress in laying the groundwork for a knowledge-based economy, particularly by improving regulatory efficiency. The country performs well on most business-climate indicators, and in recent years it has ranked among the top third of countries in

the *Doing Business* report. However, Armenia's governance environment does not match its business climate; its score on the World Governance Indicators is worse than in 60 percent of countries worldwide, and it performs especially poorly against European comparators. While the country's governance framework is generally adequate in principle, in practice its public institutions are weak and susceptible to undue influence, and official rules and regulations are poorly enforced. Efforts to improve the regulatory framework must therefore be accompanied by changes in behavioral norms in the public administration underpinned by a stronger focus on transparency and accountability.

15. ICT use remains limited. In recent years the production of ICT goods and services has begun to occupy a small but significant role in the Armenian economy. In 2014 the sector employed 11,600 people and accounted for 4.4 percent of GDP and 4.6 percent of total goods and services exports. However, the sector is largely focused on the export market, which limits its contact with public institutions, and its domestic presence is shallow. Yet the experience of more developed countries has shown that the diffusion of ICT to other sectors of the domestic economy is critical to sustaining productivity growth. In Armenia ICT remains limited to basic functions, and local internet content and e-commerce systems are underdeveloped. Consequently, ICT is having no observable spillover effect on the productivity of more traditional economic sectors.

16. The supply of workers with advanced qualifications in science and engineering is small and persistently diminished by emigration, and Armenian enterprises are generally reluctant to invest in workers' skills. Human capital was one of the country's greatest strengths during the Soviet period, but it has been severely depleted since Armenia transitioned to a market economy. Armenia lags behind its peers in educational achievement, with a tertiary enrollment rate of 46 percent in 2014, far below the OECD average of 71 percent and the Russian rate of 76 percent. Only 15.9 percent of tertiary graduates complete degrees in science or engineering, and just 16 percent of Armenian enterprises invest in workforce skills through on-the-job training.

17. Despite low rates of public and private investment the quality of Armenia's scientific output is relatively high. Research and development (R&D) intensity, defined as gross domestic expenditure on R&D as a share of GDP, decreased from 2.5 percent in 1990 to a mere 0.27 percent in 2009, and it has remained at similar levels ever since. Armenian firms tend not to collaborate with Armenian researchers due to the theoretical focus of many research projects, the low administrative capacity of academic institutions, and a lack of market incentives for firms to seek scientific and technological support. Nevertheless, Armenian researchers continue to produce world-class scientific publications.

18. Armenia is gradually developing a national innovation system. A national innovation system is the set of institutions, policies and funding arrangements that drive the creation and use of knowledge. The government has strengthened the legal and regulatory framework for science, technology and innovation (STI) and adopted a national science policy as well as ancillary policies designed to encourage innovation in the business sector. However, the government's STI agenda is still in its early stages, and at present the linkages between public polices, academic institutions and private firms continue to be undermined by regulatory gaps, administrative and scientific capacity constraints, and a lack of market demand.

19. While the authorities have formulated an appropriate strategic framework to support the development of a knowledge-based economy, implementation remains a serious challenge. Better coordination between the Ministry of Education and the Ministry of Economy could enable the government to craft industrial policies that more effectively promote innovation. Developing monitoring and evaluation frameworks that include specific quantitative targets, well-defined actions and dedicated financing mechanisms would help ensure that individual initiatives are properly aligned with the government's broader strategic objectives. Finally, the public STI budget amounts to just 1.2 percent of

total expenditures and is heavily focused on basic research. Increasing public STI funding and broadening its orientation to include market-ready technologies designed to increase economic efficiency could greatly accelerate the expansion of traditional sectors.

THE WAY FORWARD: USING PUBLIC POLICY TO BOOST INNOVATION

20. **Armenia's policy environment does not allow competitive pressures to enforce firm-level efficiency.** The result is that relatively efficient firms coexist alongside inefficient competitors without the latter being forced from the market. This heterogeneous distribution of productivity across firms is due in part to a legacy of central planning and in part to weaknesses in the current policy environment. Indeed, policy factors are estimated to account for 36 percent of the variation in firm-level productivity in Armenia, a higher share than in any comparable country. Among these, the overall quality of governance and the availability of skilled workers have the largest impact on firm-level productivity. While formal regulations are adequate, mechanisms for implementation and enforcement are lacking. The insufficient supply of highly educated workers and limited training efforts by firms themselves account for an additional 22 percent of productivity variation.

21. **Armenia has begun to elaborate a national strategic vision supporting the development of knowledge-based industries.** However, much work remains in terms of defining priorities, establishing funding arrangements, creating implementation mechanisms, and ensuring that the realities of the private sector accurately reflect the design of public policies. In this context policymakers should consider the following measures:

- **Creating a national innovation council comprising both public and private stakeholders.** Establishing a forum for dialogue on innovation would promote better alignment of public and private interests, enable the rapid incorporation of feedback into new policy initiatives, facilitate effective monitoring, evaluation and oversight of STI-related programs, and support the implementation of joint innovation and technology agendas.
- **Refocusing public R&D towards applied research.** This would help better connect public research organizations with the national economy and promote projects that generate tangible economic benefits.
- **Increasing funding for public R&D in line with the objectives of the government's national science strategy.** An increase in the public science budget should also include funding for graduate schools in science and engineering and support new master's, doctoral and post-doctoral programs.
- **Implementing monitoring and evaluation frameworks for all publicly funded science and technology programs and conducting impact evaluations for selected programs.** Impact evaluations could be quasi-experimental in cases where data were available over a sufficient timespan. Experimental approaches could also be considered for new initiatives and pilot programs. This would allow policymakers to assess the potential impact of programs and improve their design.
- **Revising the legal framework for protecting rights to intellectual property generated by publicly funded research.** Intellectual property rights should be based on international best practices, and incentives to create new forms of intellectual property should be consistent with the ways in which researchers and academic organizations are evaluated and financed.

- **Supporting the commercialization of new technologies through the creation of dedicated market platforms.** Establishing formal systems to disseminate new technologies to the private sector would help to mobilize existing knowledge and create a marketplace for innovation.
- **Strengthening incentives for scientific collaboration with the diaspora community.** The government could explore multiple avenues for accessing the skills, resources and professional networks of Armenian scientists abroad.
- **Adopting international standards for evaluating R&D and private-sector innovation.** The OECD and Eurostat Oslo Manual for Innovation and the OECD R&D Frascati Manual provide a sound methodology for assessing the development of the STI sector and situating Armenia's progress in an international context.
- **Analyzing the prospective benefits of new technologies and the feasibility of implementing them.** These analyses would identify opportunities for innovation in sectors with a high impact on economic and social development.

22. **The preceding recommendations deal with the supply of scientific research and technological innovation, but a number of key demand-side factors also inhibit the development of a knowledge-based economy.** Surveys and interviews reveal that the concentration of power among a relatively small political-economic elite is widely perceived to constrain investment and stifle innovation. There is evidence that economic power is unbalanced, that political connections allow certain firms to obtain favorable treatment, and that political ties combine with concentrated markets to suppress economic competition. This can result in higher prices, less foreign or domestic investment, lower overall growth and fewer professional opportunities for individuals and firms. To reverse these perceptions, the supply-side reforms listed above should be complemented by demand-side measures, which could include:

- **Enactment of a Tax Code.** Consolidating tax policies and tax-administration principles across government agencies would increase the transparency of the tax system and promote internal consistency. This in turn would allow for expansion of the tax base and rationalization of the tax regime. Eliminating loopholes in the tax legislation would help to ensure the equal treatment of all taxpayers.
- **Increasing firm-level disclosure requirements.** Recent reforms to Armenia's accounting rules require greater disclosure of firm-level information, paving the way for adoption of International Financial Reporting Standards (IFRS). Efforts are underway to strengthen state control of audit firms, including the establishment of a supervisory audit inspector and new rules mandating financial audits for large firms. However, auditors and regulators lack the capacity to enforce IFRS, and the financial statements of many Armenian firms do not yet meet these standards. Public access to financial statements remains limited, and those that are available are rarely presented in a user-friendly format. Increasing access to non-financial information, such as ownership structures and investor rights, would further bolster private-sector transparency.
- **Strengthening conflict-of-interest regulations.** Government officials must disclose potential conflicts of interest in order to safeguard the integrity of the public administration. Transparency requirements, institutional arrangements and enforcement mechanisms could all be strengthened by consistent implementation of the 2011 Law on Public Service, the provisions of which include online publication of conflict-of-interest declarations, which would greatly facilitate public accountability.

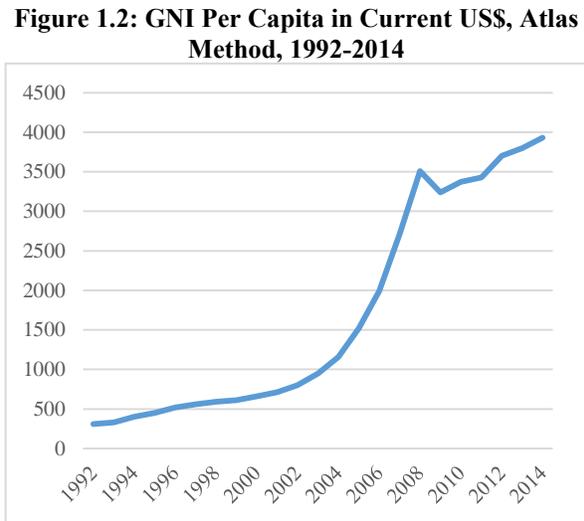
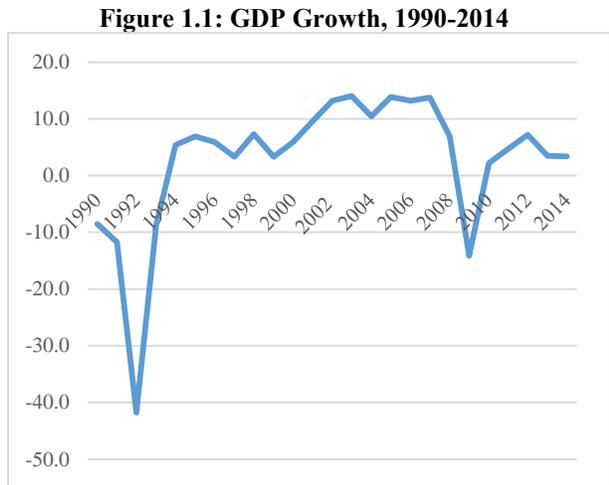
- **Enhancing the legal framework for economic competition.** The current legislation does not clearly define economic entities or establish a methodology for identifying anticompetitive agreements and market dominance. Reform measures could reaffirm the investigative powers of oversight agencies and rationalize the criteria for imposing penalties. The State Commission for the Protection of Economic Competition (SCPEC) should broaden its focus beyond price fluctuations and concentrate on eliminating actual and potential barriers to entry and competition. Greater attention to prevailing market conditions would allow the authorities to focus on sectors that are more prone to restrictive practices.
- **Reinforcing intra-governmental accountability to stop anticompetitive policy interventions.** Strengthening the SCPEC's advocacy mandate would help it to identify and eliminate distortive policies. The SCPEC could play a pivotal role in bringing potentially anticompetitive regulations to the attention of other government agencies as well as the general public.
- **Reforming the rules for providing public support to specific firms and sectors.** The introduction of a comprehensive state-aid framework would eliminate distortions, remove barriers to entry and level the playing field for Armenian firms. Stricter rules for public support would help redirect resources to economy-wide objectives and discourage anticompetitive patronage. Completing a comprehensive catalogue of all state-aid programs would represent a crucial step toward ensuring transparency and accountability in the use of public funds.

1. Armenia’s Growth: Past and Future

The Armenian economy grew rapidly from 1994 to 2008, generating a tenfold-increase in income per capita and yielding dramatic improvements in poverty indicators. However, the impact of the 2009 global financial crisis caused output to contract by more than 14 percent. Post-crisis growth has been moderate, and earlier gains in poverty reduction have been partially reversed. The composition of growth shifted in the wake of the crisis. Whereas growth had previously been driven by consumption and investment and led by the construction sector, after 2009 the construction sector shrank dramatically, and the agricultural and service sectors led the recovery. Although the pre-crisis period was marked by a positive global economic environment, increases in domestic productivity made a larger contribution to growth than external conditions. As Armenia strives to accelerate growth in the post-crisis period, a renewed focus on domestic production efficiency will both increase output and reinforce macroeconomic resilience.

1.1. Prior to the global financial crisis Armenia experienced a period of unprecedented economic growth that lasted for almost 15 years. Between 1994 and 2008 the economy continuously expanded at an average rate of 9 percent per year, and per capita income rose tenfold (see Figure 1.1 and Figure 1.2).³ Moreover, GDP growth accelerated in the run-up to the crisis, averaging over 13 percent during 2002-07.

1.2. Armenia was hit hard by the global financial crisis, and recent growth has been modest compared with the pre-crisis period. The growth rate dropped from nearly 14 percent in 2007 to less than 7 percent in 2008, and the economy contracted by 14 percent in 2009. Despite a steady recovery during 2010-12, recent growth has been subdued. Between 2010 and 2014 the economy expanded by an average rate of 4.2 percent a year, reasonably strong in global terms but far below its pre-crisis average.



Source: WDI.

1.3. Armenia may now be facing a long period of modest and uneven global economic growth, an external environment that IMF Managing Director Christine Lagarde has termed the “new mediocre.”⁴ Both global and regional growth are expected to slow over the medium term, with downward trends projected for trade volumes, capital flows and commodity prices. In order to sustain its

³ GNI per capita in current US dollars, Atlas method.

⁴ “Lift Growth Today, Tomorrow, Together” a speech by Christine Lagarde at the Atlantic Council, April 9, 2015. <https://www.imf.org/external/np/speeches/2015/040915.htm>.

recovery Armenia will have to adapt to this new international context. Meeting this challenge will require increasing domestic productivity in the absence of strong export demand while also building macroeconomic resilience against external shocks. In this difficult context Armenia’s economic dynamism—its ability to rapidly adapt to new conditions, exploit emerging opportunities, progressively diversify the drivers of growth and respond effectively to unpredictable downturns—will be central to its success.

1.4. This chapter lays the groundwork for an analysis of economic dynamism by examining Armenia’s recent economic performance, evaluating its impact on household welfare, and assessing the country’s medium-term growth prospects. Each of the next three sections addresses a key research question, while the fourth and final section summarizes the conclusions and introduces the following chapters. The three questions for this chapter are:

- How is the evolving structure of the Armenian economy affecting its growth trajectory?
- How has the country’s slowing growth rate affected poverty and shared prosperity?
- What roles have domestic and external conditions played in Armenia’s recent growth?

SLOWING GROWTH IN A CHANGING ECONOMY

1.5. As the economy accelerated in the pre-crisis period private consumption and investment became increasingly critical to growth. During 2001-08 private consumption and investment grew at annual average rates of 8.5 percent and 22.3 percent, respectively, up from 5.9 percent and 5.2 percent during 1996-2001 (Figure 1.3). The construction sector accounted for the bulk of capital formation during this period. The trade balance was deeply negative as import demand far outstripped exports.

Figure 1.3. Composition of Growth by Expenditure, 2001-2014

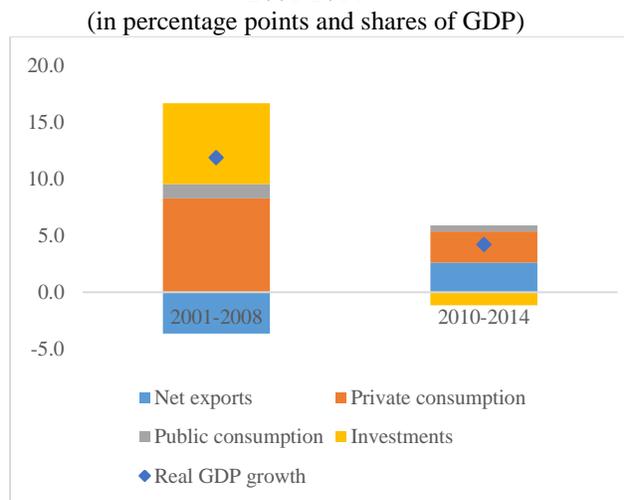
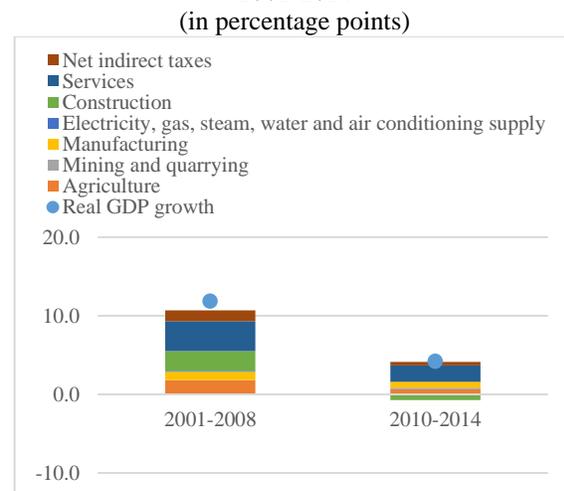


Figure 1.4. Composition of Growth by Production, 2001-2014



Source: NSS.

1.6. The composition of growth shifted dramatically in the years following the crisis. Investment contracted sharply in the post-crisis period, and although private consumption swiftly recovered, its contribution to growth has been far more modest. Indeed, consumption has diminished further since 2013 due to a decline in remittance inflows. Meanwhile, net exports have made a positive contribution to growth in the post-crisis period, as import growth has fallen and high prices for mining-sector commodities have boosted export values.

1.7. Growth slowed as the economy adjusted to the post-crisis environment. The collapse of the construction sector prompted a major supply-side shift, as construction's share in GDP growth dropped from 2.5 percent per year over 2001-2008 to -0.7 percent in 2010-2014. Growth during the post-crisis recovery was less robust, but it was driven by a more balanced combination of industry, services and agriculture. However, unpredictable commodity prices and weakening external demand among Armenia's major trading partners, Russia and the EU, caused the mining and industrial sectors to slow in 2014, though services and agriculture have continued to register modest growth (Figure 1.4).

Box 1.1. Armenia's Economic Structure before and after the Crisis

Armenia's economic liberalization in the 1990s facilitated its transition away from industry and toward services, while agriculture remained broadly stable. After 2009 the share of services in GDP continued to climb, rising from 45 percent in 2008 to 53 percent in 2014. Meanwhile, the share of agriculture rose from 16 percent to 19 percent, and the sector continued to employ close to 40 percent of the labor force. Utilities modestly increased their share of GDP, while the mining and manufacturing sectors remained broadly stable. Extractive industries and metallurgical products now constitute over two-thirds of total exports, and the diamond-processing and jewelry industries represent 2 percent of total manufacturing. Underpinning all of these trends was the dramatic decline of the construction sector, which fell from 25 percent of GDP in 2008 to just 9 percent in 2014.

Armenia's GDP Composition



Source: Armenia National Statistical Services, staff calculations.

1.8. Armenia's short- and medium-term outlook is uncertain and complicated by a worsening external environment. Global growth is projected to remain sluggish, averaging about 3.3 percent through 2017. Russia and the EU together account for half of Armenia's total exports, and weak demand by key trading partners is likely to constrain the growth of Armenian exports. Russia's economic difficulties, if they continue, could have an especially severe impact on Armenia. Russia is the destination for close to 25 percent of Armenia's exports; it is also the source of 40 percent of its foreign direct investment (FDI) and at least 70 percent of its remittance inflows. Falling global prices for base metals, which comprise half of Armenia's export basket, are further undermining the country's external position.

1.9. Armenia's capacity to counter external shocks is limited. Tighter monetary policies, a deteriorating fiscal outlook and a rising debt burden have constrained the government's ability to mount an effective policy response over the near term. The Armenian dram depreciated by 17 percent against the US dollar in 2014, following the downward trend of the Russian ruble. In an effort to slow depreciation and mitigate inflationary pressures the Central Bank of Armenia (CBA) raised the policy rate to a 13-year

high of 10.5 percent in 2015. Though largely successful in achieving its immediate objectives, this move sharply limited the government's ability to use monetary stimulus policies. A fiscal impulse launched in 2009 to counter the effects of the global financial crisis exhausted the country's fiscal buffers, and the still-diminished fiscal envelope has curbed the government's latitude for a future countercyclical response. Finally, a recent US\$500 million Eurobond issue has brought the stock debt close to its statutory ceiling of 50 percent of GDP, reducing any potential recourse to deficit spending.

Table 1.1. Selected Economic Indicators

	2009	2010	2011	2012	2013	2014	Projections		
							2015	2016	2017
Income and prices									
Real GDP (annual percentage change)	-14.1	2.2	4.7	7.2	3.5	3.4	0.8	2.7	3
GDP (current US\$, billions)	8.6	9.3	10.1	10.0	10.4	10.9	9.7	10.1	10
GNI Per Capita (US\$) Atlas	3,240	3,370	3,430	3,710	3,830	3,810	3,650	3,630	3,61
CPI (annual percentage change, end of period)	3.4	8.1	7.5	2.5	5.8	3.0	4.5	4.0	4
Investment and saving <i>(in percent of GDP, unless otherwise indicated)</i>									
Gross Investment	34.7	32.9	27.3	25.4	21.7	19.8	19.2	19.9	20
Public	7.0	5.5	4.7	3.3	3.0	3.0	2.1	2.4	2
Private	27.6	27.3	22.6	22.1	18.7	16.8	17.1	17.5	17
Private Consumption (annual percentage change)	-4.4	3.8	2.9	9.1	0.9	0.4	2.1	3.4	1
Fiscal operations <i>(in percent of GDP, unless otherwise indicated)</i>									
Revenue (incl. grants)	21.5	21.9	22.7	23.0	24.5	24.7	25.0	24.7	25
Expenditure	29.1	26.9	25.5	24.5	26.2	26.7	27.6	26.7	26
Current	22.4	21.4	20.9	21.3	23.2	23.7	25.0	24.4	24
Capital	7.0	5.5	4.7	3.3	3.0	3.0	2.5	2.4	2
Overall Fiscal Balance (incl. grants)	-7.6	-5.0	-2.8	-1.5	-1.7	-2.0	-2.6	-2.1	-1
Primary Fiscal Balance	-7.1	-4.1	-1.9	-0.5	-0.6	-0.6	-0.8	-0.5	-0
Total Public Debt	40.4	40.0	42.2	44.6	43.9	47.6	52.4	52.6	53
External Public Debt	35.7	34.7	36.4	37.7	37.0	40.1	44.2	44.4	43
Debt Service (in percent of revenue, incl. grants)	5.3	6.5	7.0	13.0	36.2	14.3	19.6	12.6	13
External sector									
Exports (annual percentage change)	-22.4	44.6	24.9	3.5	7.0	20.6	6.2	4.2	7
Imports (annual percentage change)	-23.1	13.9	8.0	2.2	2.6	10.7	0.1	3.5	4
Current Account Balance (in percent of GDP)	-18	-14	-11	-11	-8	-8	-10	-9	.
External debt (in percent of GDP)	54	61	64	67	75	63	71	69	6
Public Debt Service Ratio (in percent of exports goods and nfs)	7	7	6	12	34	10	13	9	
Nominal Exchange Rate (LCU/US\$, end of period)	378	363	386	404	406	475	499	501	50
Real Effective Exchange Rate Index (1997=100)	129	129	128	122	124	126	128	130	13

Sources: National Statistical Service of Armenia, Ministry of Finance of Armenia, Central Bank of Armenia, World Bank staff calculations.

THE IMPACT OF CHANGING GROWTH PATTERNS ON POVERTY AND SHARED PROSPERITY

1.10. Armenia's robust growth in the pre-crisis period generated major improvements in poverty indicators. The shares of the population in moderate and extreme poverty both fell sharply between the mid-1990s and late-2000s (Figure 1.5). The moderate poverty rate fell from 92 percent in 2001 to 76 percent in 2008, while the extreme poverty rate dropped from 67 percent to 26 percent over the same period.⁴ These figures are based on World Bank estimates, but national statistics present a similar picture.

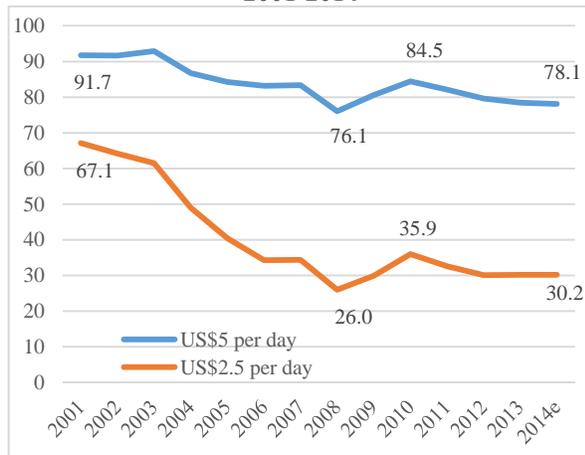
1.11. Pre-crisis growth was highly inclusive. The World Bank's key indicator of shared prosperity is the growth rate of mean consumption among the bottom 40 percent of the welfare distribution. According to this metric growth in the early 2000s economic growth substantially benefited the poor and vulnerable.

⁴ For the purposes of this analysis the moderate poverty line is defined as US\$5 per day in purchasing-power parity terms, and the extreme poverty line is set at US\$2.50 per day.

Prior to the crisis, the annual growth rate of mean consumption among the bottom 40 percent was 4.3 percent, significantly above the national average of 3.5 percent (Figure 1.6).

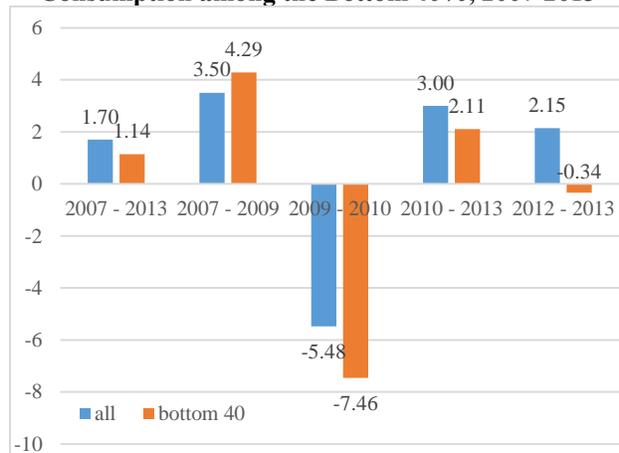
1.12. Poverty indicators deteriorated after the crisis, and despite the modest recovery poverty rates have not yet returned to their 2008 levels. Extreme poverty rose from 26 percent in 2008 to a post-crisis peak of 36 percent before stabilizing at just over 30 percent from 2012 through 2014. Rural and urban areas both experienced similar poverty trends, though poverty rates remain lowest in the capital city of Yerevan (25.6 percent) and highest in rural areas (31.1 percent). Between 2008 and 2009 poverty in Yerevan increased dramatically from 20.1 percent to 26.7 percent before declining slightly to 25.6 percent in 2013, with corresponding patterns observed in smaller cities and rural areas.

Figure 1.5. Moderate and Extreme Poverty Rates, 2001-2014



Source: World Bank.

Figure 1.6. Percentage Growth Rate of Mean Consumption among the Bottom 40%, 2007-2013



Source: World Bank Armenia Poverty Assessment 2015, based on data from the Integrated Living Conditions Survey.

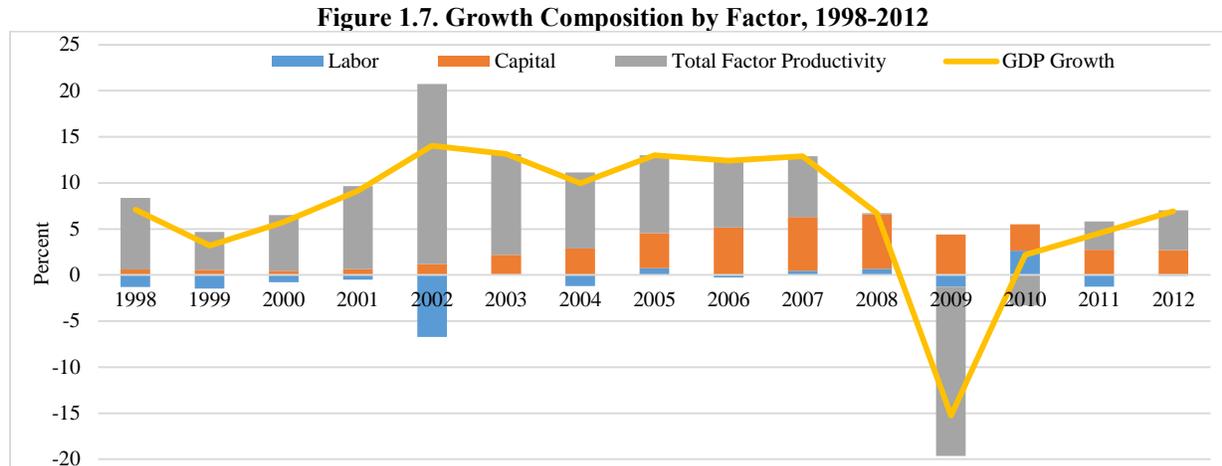
1.13. Inequality has also increased since 2008. The impact of the crisis and the sluggish recovery have undermined previous gains in shared prosperity. The economic contraction of 2009 hit the bottom 40 percent especially hard; their consumption fell by 7.5 percent in a single year, a significantly larger drop than the 5.5 percent experienced by the economy as a whole. Between 2010 and 2013 the average consumption of the bottom 40 percent grew by 2.1 percent, well below the 3 percent rate for the total population. Moreover, recent growth has been increasingly unbalanced, and between 2012 and 2013 consumption among the bottom 40 percent fell by 0.34 percent, even though the total population saw its average consumption increase by 2 percent (Figure 1.6).

1.14. The unemployment rate rose in 2014 as migrant workers returned from Russia. Both during and after the financial crisis emigration mitigated pressure on the domestic labor market, and unemployment remained more or less stable even as the economy struggled. However, the economic slowdown in Russia has prompted a large number of Armenian workers to return home, pushing the unemployment rate from 16.2 percent in 2013 to 17.6 percent in 2014.

1.15. A combination of slowing economic growth, rising unemployment and declining remittances could have a deeply negative impact on poverty. If current trends continue, income and consumption growth among the poor and vulnerable are likely to deteriorate, and the government's capacity to mitigate these effects through fiscal stabilization and antipoverty policies is limited. The replacement of unemployment benefits with active labor market policies implies that there will be no direct support to the transitory poor. Existing safety nets have relatively low coverage and will not be sufficient to compensate for projected income losses, especially if the trends described above persist through the medium term.

LONG-TERM DRIVERS OF GROWTH: DOMESTIC POLICIES AND EXTERNAL CONDITIONS

1.16. In an environment marked by slow and uneven global growth, tightening external financing constraints, falling commodity prices, and an uncertain outlook for its major trading partners, fostering more robust and inclusive growth poses a serious challenge for Armenian policymakers. The country's economic prospects are further complicated by the unpredictable effects of intensifying regional integration within the Eurasian Economic Union (EEU). In this context understanding the factors that drive Armenia's long-run growth trajectory will be vital to maintaining sound macroeconomic management and advancing the country's development objectives.



Source: Conference Board, 2014.

Note: Capital includes non-ICT assets (transport equipment, plants, machinery, other equipment, and construction, buildings and other structures).

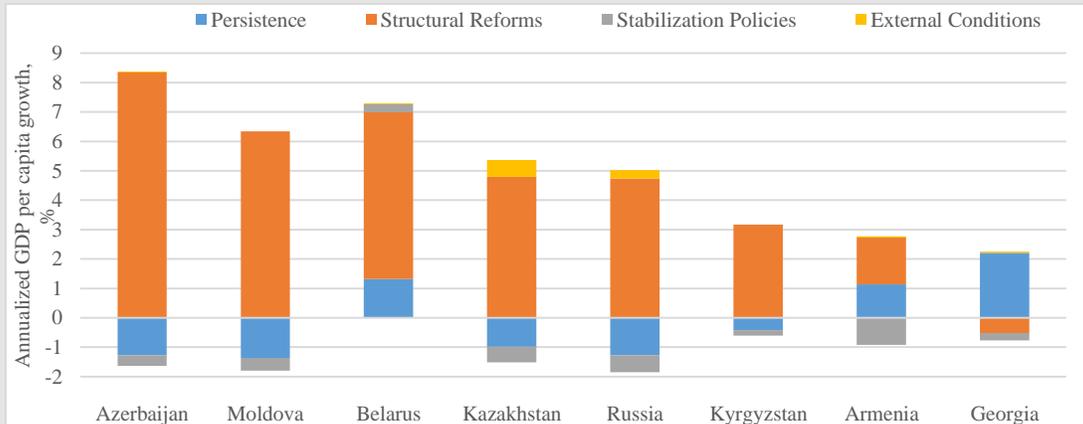
1.17. Efficiency gains were the main driver of Armenia's rapid expansion in the 1990s and early 2000s, but the potential for further efficiency improvements is now largely exhausted. At the start of its transition Armenia, like its regional neighbors, had low levels of total factor productivity (TFP) due to the inefficient allocation of resources under central planning. Following the shift to a market economy in the early 1990s TFP became the main contributor to economic growth (Figure 1.7), as labor and capital were redeployed to more productive sectors and private-sector competition increased firm-level efficiency. Over time, however, efficiency gains began to yield diminishing returns, and capital accumulation assumed a larger role in increasing productivity. Labor's contribution to growth has been almost negligible, as large numbers of Armenia workers have sought employment abroad. Labor force participation bottomed out at 59 percent in 2007-09 and has risen only modestly in the years since, reaching 63 percent in 2013.

1.18. Structural reforms have positively influenced Armenia's growth, but like improvements in TFP the impact of an enhanced policy framework has diminished over time. Regression analysis indicates that the Armenian economy has benefited from structural reforms, which yielded an important increase in domestic credit to the private sector, as well as promoting better institutional quality and facilitating infrastructure development. Structural factors contributed 1.6 percentage points to GDP growth during 2000-10 and about 1.2 percentage points during 2005-10 (Figure 1.8A). Improved stabilization policies also contributed to growth, but to a smaller extent. Persistence in growth patterns played an important role in boosting output, especially in the 2010s, while inadequate stabilization policies undermined growth. While structural factors were a major driver of Armenia's robust expansion in the 2000s, by the 2010s their contribution to annual GDP growth had fallen to an average of just 0.4 percentage points.

Box 1.2. Contributors to Growth in Post-Communist Economies

In most former Soviet republics structural policies played a major role in economic growth during the late 1990s and 2000s, reflecting the radical institutional transformation that followed the collapse of central planning. Structural reforms contributed an average of about 70 percent to per capita GDP growth over the period. In some countries growth was led by an increase in domestic credit to the private sector (Armenia, Azerbaijan, Georgia, Kazakhstan and Russia), while rising government consumption was the driving force in others (Belarus, Kyrgyzstan and Moldova). Resource-rich countries such as Kazakhstan and Russia also benefited from favorable external conditions, especially high oil, gas and mineral prices.

The Estimated Growth Contributions of Persistence in Growth Patterns, Structural Reforms, Stabilization Policies and External Conditions in Former Soviet Republics, 2000-10



Source: World Bank staff calculations based on Araujo et al., 2014.

Note: "The 2000s": Avg. [2006-2010] – Avg. [1996-2000] = 2010-2000. See Annex 1.

1.19. Reform momentum has slowed since the 2000s, and the authorities have made limited progress in addressing a number of key structural obstacles. Since the launch of the structural reform agenda in the mid-1990s the role of private markets has rapidly expanded, while the public sector's growth has been contained. Market-liberalization policies have been adopted to ensure free price formation, promote trade and investment openness, protect and adjudicate private property rights, and restructure the industrial sector. However, reform progress slowed in the 2000s, leaving the country with unresolved weaknesses in its competitive framework, integration into international trade and capital markets, corporate governance policies, property rights enforcement mechanisms, tax and customs administrations, anticorruption legislation and public oversight institutions.⁶

1.20. External conditions have played a relatively modest role in Armenia's growth. Despite the large share of commodities in Armenia's total merchandise exports, external conditions⁵ have had only a marginal economic impact since the transition, though a recent decline in base-metal prices cut GDP growth by 0.3 percentage points between 2010 and 2013.⁶ Nevertheless, compared to other commodity exporters such as Peru, a fellow metals exporter, Armenia's growth has been highly resilient to external conditions (Figure 1.8B).

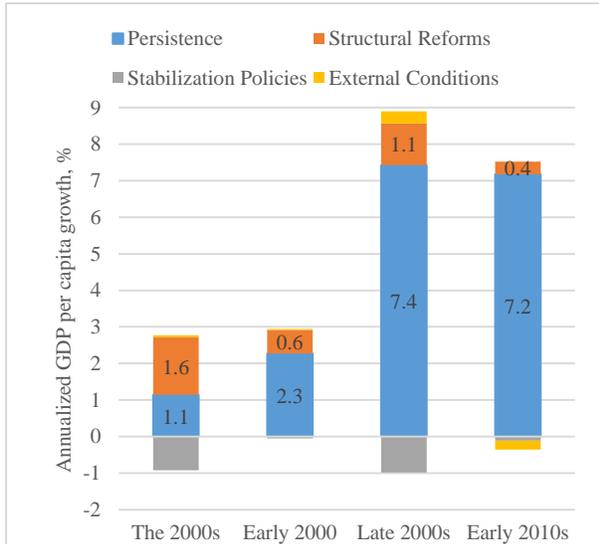
⁶ Mitra et al. (2007).

⁵ External conditions in the model refer to commodity prices and terms of trade growth. They do not include remittances, which would be relevant in the Armenian context.

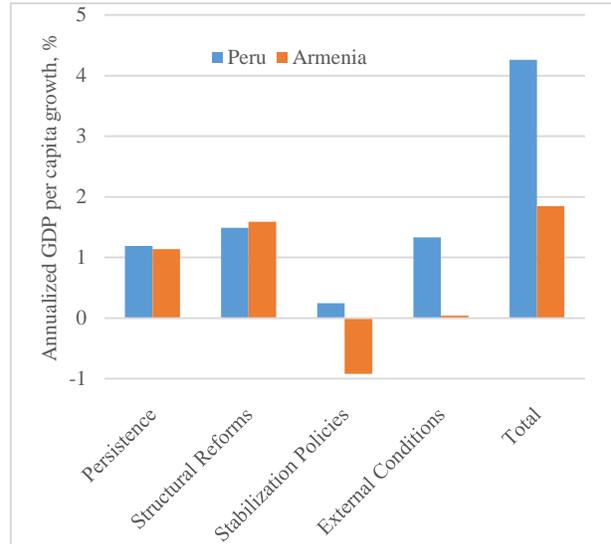
⁶ Data for the net barter terms-of-trade index, which is a proxy for terms-of-trade variables, are only available after 2000, limiting the timeframe for which the impact of term-of-trade changes on growth can be estimated. Prior to the 2000s the contribution of external conditions to growth is estimated based on the international commodity export price index.

Figure 1.8. Estimated Growth Effects Arising from Persistence in Growth Patterns, Structural Reforms, Stabilization Policies, and External Conditions

A. 1996-2013



B. Armenia and Peru: The 2000s



Source: World Bank staff calculations based on Araujo et al., 2014.

Note: The period 1996-2013, consists of 4 data points (2000, 2005, 2010, 2013) and captures the average values of the following time periods: “The 2000s”: Avg. [2006-2010] – Avg. [1996-2000] = 2010-2000; “Early 2000s”: Avg. [2001-2005] – Avg. [1996-2000] = 2005-2000; “Late 2000s”: Avg. [2006-2010] – Avg. [2001-2005] = 2010-2005; “Early 2010s”: Avg. [2011-2013] – Avg. [2006-2010] = 2013-2010. See Annex 1.

CONCLUSION: DRIVERS OF DYNAMISM

1.21. The global financial crisis substantially altered Armenia’s macroeconomic position; while consumption proved relatively resilient, net exports turned positive, and investment collapsed. In the pre-crisis period private investment, focused on the construction sector, was the major contributor to growth, supported by robust consumption. However, the post-crisis recovery was led by the growth of net exports, while large remittance inflows bolstered consumption. On the supply side the construction sector’s precipitous decline has increased the prominence of services. Together, services, agriculture, mining and industry have become the drivers of a slower but more evenly balanced growth pattern.

1.22. No single sector is likely to replace construction as a dominant economic force in the post-crisis period. Mining and mineral exports have the greatest potential for rapid growth, but as discussed in Chapter 2 Armenia’s limited trade openness and the inherent volatility of international commodity prices temper the mining sector’s growth prospects. Increased public investment could offset the diminished role of the construction sector in gross capital formation, which has been negative since 2010. However, the government’s limited resource envelope and the priority of rebuilding fiscal buffers makes such an expansion unlikely.

1.23. The pre-crisis expansion was highly inclusive, but important gains in poverty reduction and shared prosperity could be lost if growth remains weak over the medium term. The incidence of extreme poverty declined sharply from 67 percent in 2001 to 26 percent in 2008. However, the impact of the crisis halted and then partially reversed these gains, and the extreme poverty rate has again risen above 30 percent. A similar pattern was observed in shared prosperity. The average consumption of the bottom 40 percent grew faster than the national average until 2009, but it fell further during the crisis and has recovered more slowly. If current growth patterns continue over the medium term, the achievements of the pre-crisis period may be largely erased.

1.24. Since Armenia's transition to a market economy domestic factors have influenced growth to a much greater extent than external conditions. Unlike other commodity exporters, domestic developments have been much more important to Armenia's growth than export prices. First-generation structural reforms and economic liberalization measures spurred an increase in TFP that far outweighed the impact of changes in the external environment.

1.25. Armenia will need a new growth model in order to achieve its development objectives and resume a convergence trajectory. Armenia's per capita income is still less than a tenth of the OECD average. Accelerating income growth to a rate consistent with economic convergence will not be possible under either Armenia's current or historic growth models. The reallocation of productive factors is now largely complete, and the returns to gross fixed capital formation are diminishing. In this context a comprehensive shift toward a more flexible, innovative economy will be vital to sustain further increases in productivity growth. Going forward, a renewed focus on structural reforms will help alleviate remaining constraints on economic efficiency, facilitate the growth of sophisticated, knowledge-based sectors, and promote the development of a more adaptable and dynamic growth model.

1.26. The following chapters will examine the drivers of dynamism in the Armenian economy. Chapters 2-5 present an empirical analysis of various aspects of Armenia's economic model, and the sixth chapter offers policy options for accelerating inclusive growth. Chapter 2 examines Armenia's international connectivity and finds that in addition to trade and investment openness, the free flow of data and human capital is critical to expanding opportunities for Armenian firms. Chapter 3 benchmarks Armenia's progress against four critical elements of a knowledge-based economy: governance, information and communications technology (ICT), workforce skills and the overall economic capacity to create and use knowledge. Chapter 4 explores Armenia's national innovation system, the web of public- and private-sector actors and policies that constitutes the institutional foundation for economic innovation. Chapter 5 evaluates the role of government policy in building a more dynamic economy by estimating its impact on the productivity, international integration and innovative capacity of Armenian firms. Chapter 6 concludes the report and presets policy options for promoting sustainable, broad-based growth through economic dynamism.

2. Global Connectivity

In an increasingly interconnected global economy a country's access to international markets via trade, investment, technology and labor mobility are vital to its growth and development. Armenia's global connectivity, however, is limited across all of these dimensions. The country has active trade embargoes with two of its four neighbors, and Russia continues to play a dominant role in its economy, a role that may become even more important following Armenia's accession to the EEU. Armenia's merchandise trade equals less than 80 percent of GDP, well below the share of comparable countries, especially in Europe. Trade is relatively diversified in terms of export destinations, yet concentrated in terms of products, a reflection of Armenia's geography and resource endowments. Foreign investors have pursued emerging opportunities in the financial services, communications and mining sectors, but investment in information and communications technology (ICT) has been low and inconsistent. Expanded internet services could substantially boost trade and investment, but despite improvements since 2010 Armenia's internet coverage and speed remain limited. Among Armenia's greatest assets is its large diaspora community, and remittances have substantially increased household welfare, mitigated unemployment pressures, and strengthened the resilience of private consumption. However, the migration of Armenian workers to foreign labor markets has also significantly reduced the country's aggregate human capital. Going forward, Armenia could do much more to leverage the potential of its diaspora to increase international trade and investment flows and to shape the evolution of its domestic institutions.

2.1. A growing body of research has found that a country's connectivity to external markets is a major determinant of its economic growth trajectory and the quality of its development.⁷

Connectivity comprises four basic dimensions—trade, investment, technology and labor mobility—and depends not only on physical links such as roads, ports, and fiber-optic cables, but also intangible connections such as diplomatic ties, trade and immigration policies, customs protocols and the removal of informal economic barriers. Connectivity can directly impact output by maximizing gains from specialization and trade, harnessing the potential of existing absolute and comparative advantages, and it can indirectly accelerate long-term growth through technology transfer and the cultivation of dynamic comparative advantage. The importance of technology transfer is further underscored by evidence of increasing returns to technological accumulation, as the acquisition of new technologies builds an economy's capacity to exploit future innovations.

2.2. This chapter will examine Armenia's global connectivity along each of the four dimensions described above and describe how these links are shaping its economy.

Trade, investment, technology and labor mobility are related phenomena with overlapping effects, and in Armenia labor mobility has especially pivotal implications for the other dimensions of connectivity due to the country's large diaspora community. The diaspora facilitates the formation of transnational social networks, increasing Armenians' exposure to new technologies, access to diverse educational institutions, experience with different public administrative systems and capacity to identify and exploit global economic opportunities. In a densely interconnected global economy the potential of labor mobility to shape national economic growth extends far beyond its immediate impacts on employment, remittances and relative factor intensity. An actively engaged diaspora can speed productivity growth, strengthen investment inflows, augment social spending and influence the course of public sector reform. In light of the enormous potential of global connectivity, this chapter addresses the following research questions:

- To what extent is Armenia leveraging its global trade ties?
- Is foreign investment increasing the efficiency and openness of the Armenian economy?

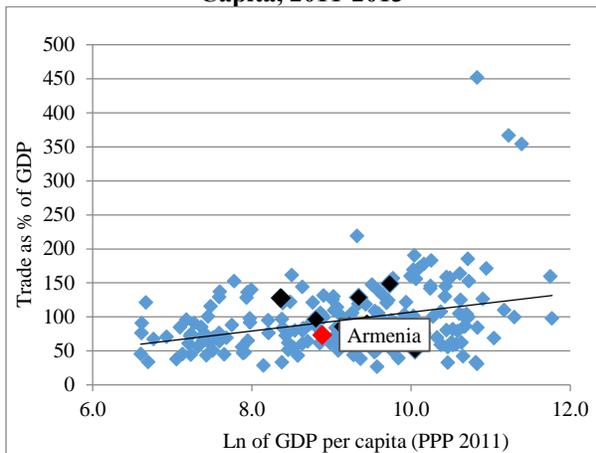
⁷ See, for example, Frankel and Romer (1999), Duernecker et al. (2014), Kali et al. (2007), Kali and Reyes (2007).

- Is Armenia exploiting the full potential of digital connectivity to overcome its geographic isolation?
- How is the Armenian diaspora contributing to economic development at home?

TRADE

2.3. Armenia is less open to trade than many comparable countries. Trade openness, defined as total imports and exports as a share of GDP, has declined over the past decade from a peak of 82 percent in 2003 to 75 percent in 2013. Armenia is not only less open to trade than would be predicted by its income level (Figure 2.1), it is also significantly less open than other post-Soviet states (Figure 2.2).

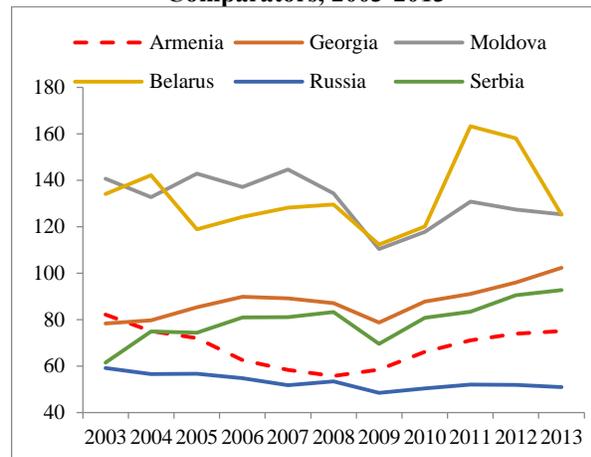
Figure 2.1. Trade-to-GDP Ratio and GDP per Capita, 2011-2013



Source: World Bank staff calculations based on WDI data.

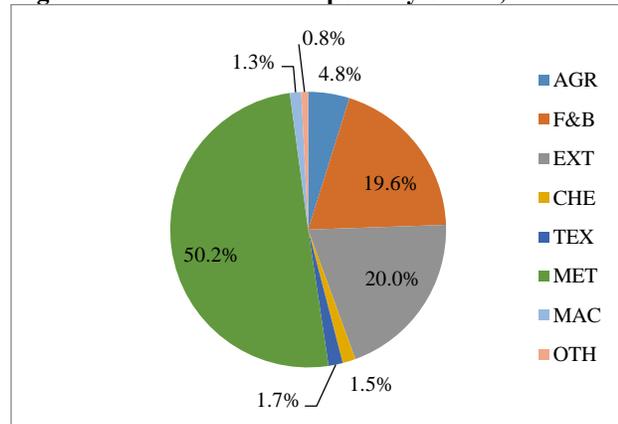
Note: In order to account for cyclical fluctuations, trade and GDP in the left panel are averages for 2011-2013.

Figure 2.2. Trade-to-GDP Ratio, Armenia and Comparators, 2003-2013



2.4. Industrial commodities dominate Armenia's merchandise exports, while travel, construction and transportation lead a rapidly growing service export sector. The composition of exports has changed significantly over the last decade. The share of non-metal extractive industries in total exports declined from 53 percent in 2001-03 to 20 percent in 2011-13, while the share of metals increased from 22 to 50 percent over the same period (Figure 2.3). Service exports grew at an average annual rate of 18 percent from 2003 to 2013. In 2003 service exports equaled 31 percent of the value of merchandise exports and comprised 7.4 percent of GDP. By 2013 they had grown to 74 percent of merchandise exports and 10.4 percent of GDP. In 2013 the sectors which accounted for the largest share of services exports were travel (42 percent), construction (21 percent), transportation (15

Figure 2.3. Merchandise Exports by Sector, 2011-2013



Source: World Bank staff calculations based on WITS data.

Note: AGR = Agriculture, meat and dairy, seafood (HS 1-10, 12-14); F&B = Food, beverages, tobacco, wood, paper (HS 11, 15-24, 44-48); EXT= Extractive industries (HS 25-27, 68-71); CHE = Chemicals, plastics, rubber (HS 28-36, 38-40); TEX = Textiles, apparel, leather, footwear (HS 41-42, 50-65); MET = Iron, steel, and other metals (HS 26, 72-83); MAC = Machinery, electronics, transportation equip. (HS 84-89); OTH = Other industries (HS 37, 43, 49, 66-67, 90-97).

percent), and computer and information services (7 percent).

Table 2.1. Armenia: Services Exports, 2003-2013

CATEGORY	2003				2013				CAGR 03-13
	US\$ mill	% of total	% of merch. export	% of GDP	US\$ mill	% of total	% of merch. export	% of GDP	
Total services	207.4	100.0	30.9	7.4	1082.4	100.0	73.7	10.4	0.18
Transport	73.0	35.2	10.9	2.6	164.2	15.2	11.2	1.6	0.08
Travel	72.7	35.1	10.8	2.6	458.1	42.3	31.2	4.4	0.20
Communications	16.7	8.1	2.5	0.6	36.2	3.3	2.5	0.3	0.08
Construction	7.9	3.8	1.2	0.3	222.3	20.5	15.1	2.1	0.40
Insurance	7.4	3.6	1.1	0.3	19.5	1.8	1.3	0.2	0.10
Financial services	1.6	0.8	0.2	0.1	9.0	0.8	0.6	0.1	0.19
Computer and information	11.0	5.3	1.6	0.4	74.6	6.9	5.1	0.7	0.21
Royalties and license fees	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Other business services	6.7	3.2	1.0	0.2	52.6	4.9	3.6	0.5	0.23
Personal, cultural and recreational services	2.3	1.1	0.3	0.1	19.0	1.8	1.3	0.2	0.24
Government services n.i.e.	8.0	3.9	1.2	0.3	26.9	2.5	1.8	0.3	0.13

Source: World Bank staff calculations based on UNCTAD data.

Note: CAGR is the compound annual growth rate.

2.5. Armenia has a revealed comparative advantage (RCA) in resource- and labor-intensive industries. Over the 2003-13 period Armenia's RCAs were focused on a mix of primary and refined commodities in the agricultural and resource sectors and a narrow range of finished goods produced from those commodities. The major change in RCA over the period reflected Armenia's decreased competitiveness in non-metal extractive industries.

Table 2.2. Armenia's Revealed Comparative Advantages, 2003 and 2013

Sector	2003	2013
Agriculture, meat and dairy, seafood	0.270	1.435
Foods, beverages, tobacco, wood, paper	1.880	3.712
Extractive industries	4.797	0.980
Chemicals, plastics, rubber	0.086	0.132
Textiles, apparel, leather, footwear	0.095	0.546
Iron, steel and other metals	3.158	4.898
Machinery, electronics, transportation eq.	0.053	0.030
Other industries	0.129	0.142

Source: World Bank staff calculation based on UNCTAD data.

Note: The RCA index is defined as the ratio of two shares. The numerator is the share of each export in the country's total exports. The denominator is the global share of each export in total world exports. The index assigns a value of between 0 and $+\infty$ to each export, and a country is determined to have a revealed comparative advantage if the value exceeds 1.

2.6. Armenia appears to be diversifying its exports in terms of both products and markets. Between 2003 and 2013 Armenia's mix of export products diversified more rapidly than its range of export

destinations. Export product concentration⁸ has fallen by 57 percent since 2003, the largest decrease among comparable countries (Figure 2.4). Meanwhile, market concentration has dropped by 35 percent and is now lower than Russia and Belarus, higher than Moldova, Macedonia, Albania and Azerbaijan, and on par with Bosnia and Georgia (Figure 2.5).

Figure 2.4. Export Product Concentration

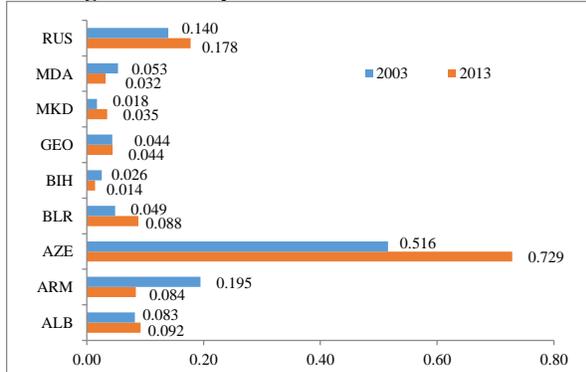
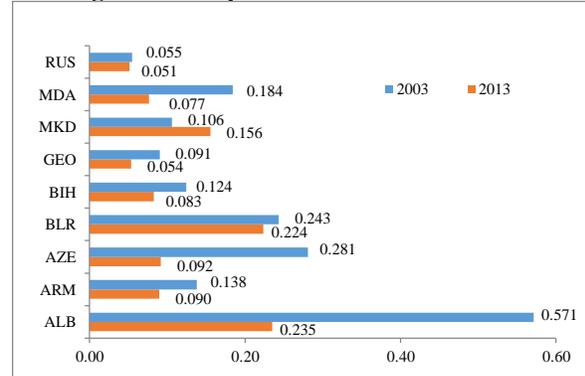


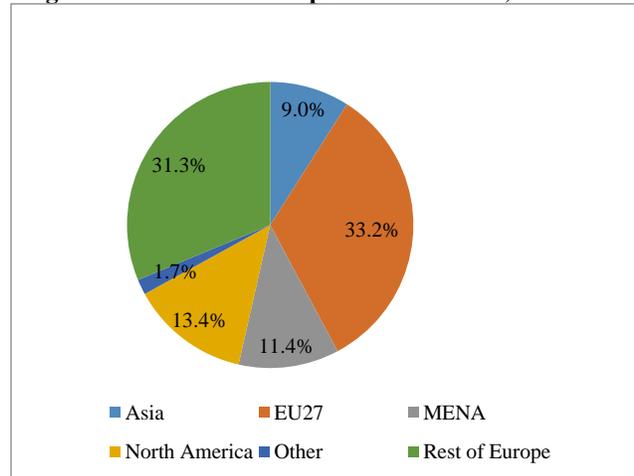
Figure 2.5. Export Market Concentration



Source: World Bank staff calculation based on WITS data.

2.7. Two-thirds of Armenian exports are bound for Europe and Russia. Over 2012-14 Armenia’s largest export markets were the EU-27 with 33 percent of total exports and non-EU Europe and Russia with 31 percent, followed by North America with 13 percent, and the Middle East and North Africa (MENA) with 11 percent (**Error! Reference source not found.**). The share of MENA exports fell from 28 to 11 percent between 2002-04 and 2012-14 due in large part to a decline in shipments to Israel. In 2002-04 Israel received the largest share of Armenian exports of any single country (21 percent), followed by Belgium (19 percent). By 2012-14 Russia had become Armenia’s largest export partner (22.4 percent) followed by Bulgaria (9.2 percent). The export shares of Canada and China experienced the strongest growth over the period.

Figure 2.6. Armenian Export Destinations, 2012-2014



Source: World Bank staff calculation based on WITS data.

2.8. Export growth has been driven by increases in existing products in established markets. An analysis of export growth over the last decade reveals that 69 percent of the increase in exports was driven by changes on the extensive margin, led by export diversification in established markets (46 percent). While the largest single expansion occurred on the intensive margin, with a dramatic rise in exports of existing products to established markets (96 percent), this was offset by the decline or termination of other existing exports to established markets, which cut growth on the intensive margin by 37 and 28 percent, respectively.

⁸ Export concentration is measured by a variation on the Herfindahl-Hirshman index, which sums the squares of market shares for major export products and major export markets.

Table 2.3. Export Growth Decomposition, Intensive and Extensive Margins, 2003-2013

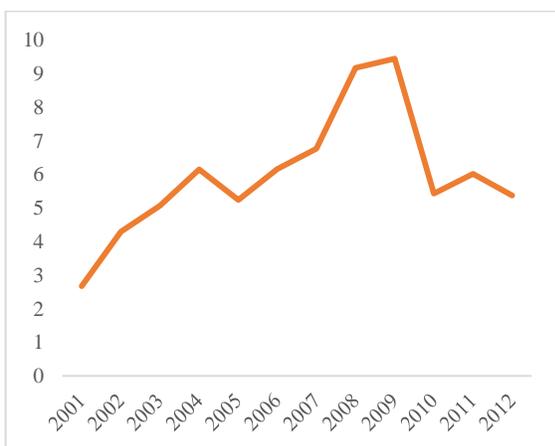
	Armenia	Albania	Belarus	Bosnia and Herzegovina	Macedonia	Moldova
Increase in exports of existing products to established markets	96	41	96	60	55	54
Decrease in exports of existing products to established markets	-37	-3	-7	-6	-12	-17
Termination of exports of existing products to established markets	-28	-4	-3	-8	-10	-13
Intensive margin (net)	31	34	86	46	33	24
Introduction of new exports to new markets	0	1	0	0	0	1
Increase in new products to established markets	17	48	1	7	23	12
Introduction of existing exports to new markets	6	2	0	6	2	6
Diversification of exports to established markets	46	14	13	40	43	57
Extensive margin (net)	69	66	14	54	67	76
Total	100	100	100	100	100	100

Source: World Bank staff calculation based on WITS data.

INVESTMENT

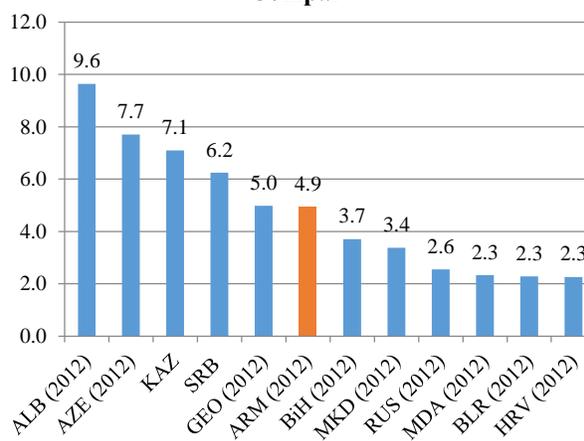
2.9. While Armenia’s trade performance has been mixed, foreign direct investment (FDI) inflows have remained relatively strong over time. FDI represented 5 percent of GDP in 2012, down from a peak of 9 percent in 2009 but close to its decade average (Figure 2.7). Armenia’s FDI levels are similar to those of Georgia and Bosnia and Herzegovina and near the middle of the range for comparable countries (Figure 2.8).

Figure 2.7. FDI as a Share of GDP, 2002-2012



Source: UNCTAD.

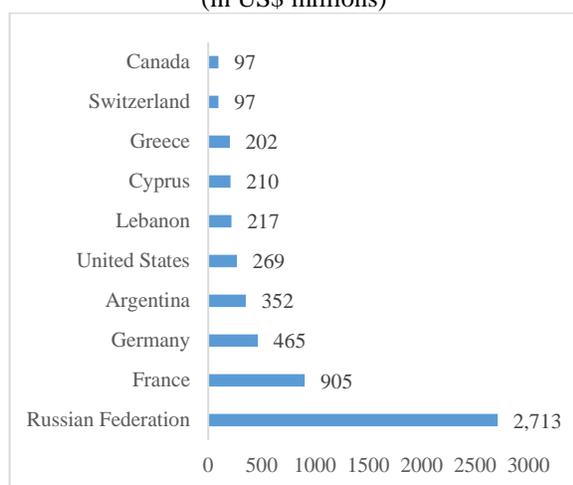
Figure 2.8. FDI as a Share of GDP, Armenia and Compar



Source: World Development Indicators.

2.10. Russia is the largest source of Armenian FDI. From 2001-2012 Russia accounted for 40 percent of FDI, and it remained Armenia’s largest single investor both before and after the financial crisis. France has increased its investment in Armenia since 2008. It now represents the second-largest share of FDI, accounting for about a third of total inflows in the post-crisis period. Canada, the United States and Greece all significantly decreased their investment in Armenia in the wake of the crisis (Figure 2.9 and Table 2.4).

Figure 2.9. Ten Largest Sources of FDI , 2001-2012
(in US\$ millions)



Source: UNCTAD.

Table 2.4. FDI Inflows Before and After the Crisis

	2001-2012	Pre-crisis (2001- 2008)	Post crisis 2009-2012
Russian Federation	38.23	36.77	41.14
France	13.91	6.45	28.83
Germany	8.55	10.25	5.13
United States	6.82	8.87	2.72
Greece	6.23	9.35	0.00
Argentina	5.04	4.71	5.71
Canada	4.12	6.18	0.00
Cyprus	3.18	3.26	3.01
Lebanon	2.82	2.81	2.83
United Kingdom	2.54	3.15	1.32

Source: UNCTAD.

2.11. Armenia's dependence on Russia as its primary source of FDI is not extreme by international standards. Although Russia has consistently accounted for the bulk of FDI inflows, at just under 40 percent Russia's share of FDI is not overwhelming. Armenia ranks 111th in the world in terms of the share of its largest FDI contributor, and among comparable countries its FDI is less dominated by a single source than that of Belarus, Tajikistan and Moldova (Table 2.5).

Table 2.5. Share of FDI Inflows by Largest Contributor, 2001-2012

Country	Largest FDI flow contributor	Average Annual Share of FDI Inflows as a percentage of Total Inflows	World Rank
Belarus	Russian Federation	99.4	31
Tajikistan	China	77.0	44
Moldova	Romania	42.5	99
Armenia	Russian Federation	38.2	111
Ukraine	Cyprus	34.7	124
Azerbaijan	Turkey	33.0	128
Kyrgyz Republic	Russian Federation	31.1	132
Kazakhstan	Netherlands	26.1	144
Georgia	United States	14.2	166

Source: UNCTAD.

2.12. Armenia's FDI stock presents a similar picture, with Russia assuming a dominant but not overwhelming position. Other countries with sizeable FDI stocks in Armenia include France, the US and Germany. While France's FDI inflows increased dramatically after 2009, its share of the total FDI stock rose by only 3 percent due to its relatively low initial base (Table 2.6).

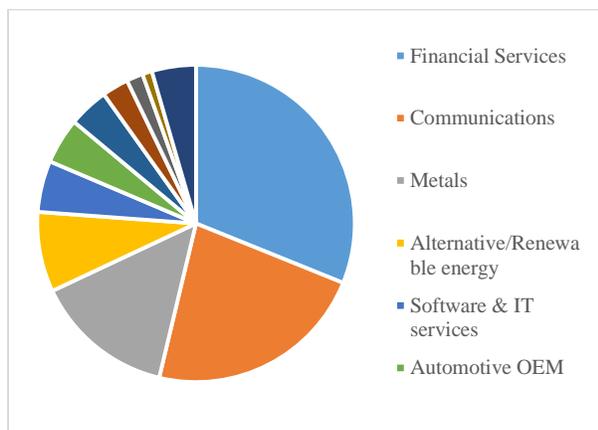
Table 2.6. Average FDI Stocks by Source Country
(in % of total FDI stock)

Country of Origin	2001-2012	2001-2008	2009-2012
Russian Federation	42.7	35.3	57.6
France	8.6	7.7	10.2
United States	8.6	10.4	5.0
Greece	9.7	14.6	0.0
Germany	4.3	4.8	3.3
Canada	5.7	7.3	2.5
Argentina	3.3	2.4	5.0
Cyprus	3.6	3.2	4.3
Switzerland	2.5	2.4	2.8
United Kingdom	3.4	4.5	1.0

Source: UNCTAD.

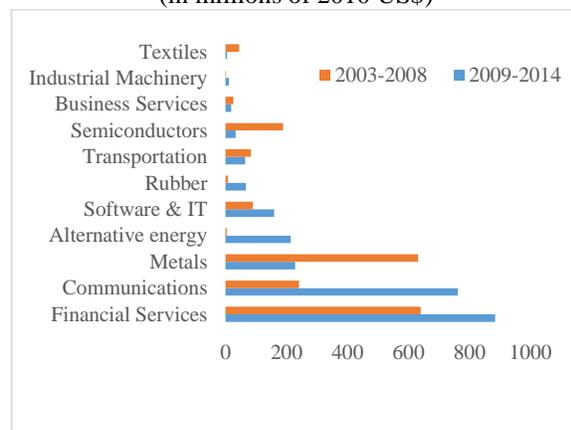
2.13. Financial services, communications and metals are the top three targets of FDI. The largest investments by individual companies are by the German firm ProCredit Holding (US\$487 million), followed by Orange/France Telecom (US\$402 million) and the Russian firm Mobile TeleSystems (US\$319 million). Other notable source of FDI include Russian energy company Gazprom (US\$270 million), which is investing in renewable energy, and the Indian firm Mahindra Group (US\$227 million), which is investing in the automotive industry. Investments in financial services represent the largest share of FDI over the period (Figure 2.10 and Figure 2.11). The sources of FDI in the financial services sector are very diverse, encompassing 20 companies from 9 different countries. By comparison, investment in communications, the second largest sector for FDI, includes 8 companies based in 6 countries. Foreign investment in financial services and communications has increased significantly in recent years, while investment in metals and textiles has declined.⁹

Figure 2.10. Total FDI by Sector, 2003-2015



Source: FDI Markets.

Figure 2.11. FDI by Sector, Pre- and Post-Crisis
(in millions of 2010 US\$)

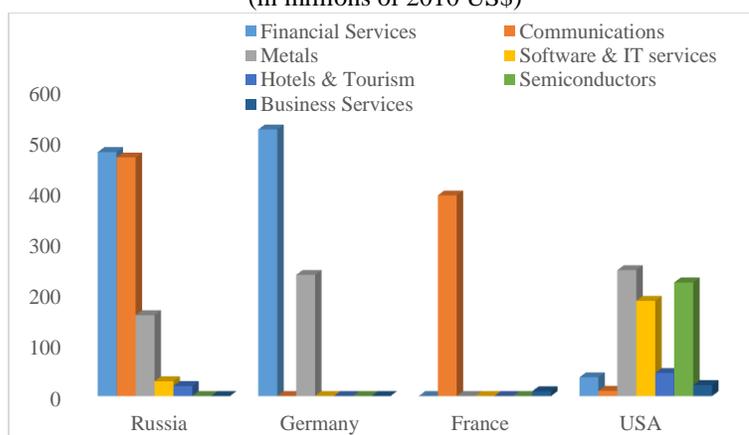


⁹ These sectoral FDI data are estimates of capital investment for the period 2003-2014. Unlike the country-level data, these figures are taken from corporate announcements about planned investments and may over- or under-estimate actual FDI flows. They may also be distorted by the timing of investment flows, as planned investments may be implemented over a period of years. The data presented here are published by FDI Markets.

2.14. **FDI in the financial services sector originates primarily from Germany and Russia; in communications from Russia and France; in metals from the US, Germany and Russia; and in ICT and semiconductors from the US.**

Gazprom launched the largest single FDI project by a Russian company (US\$200 million) in 2009. Mobile TeleSystems accounted for the largest Russian investment in the communications sector, with 5 different projects totaling US\$319 million. Germany and France were second and third in terms of overall FDI flows after Russia. However, their combined investment portfolio is less diversified than that of Russia or the US. German FDI in particular tends to be concentrated in financial services and metals. The largest single investment in financial services was undertaken by ProCredit Holding (US\$487million), while the German firm Cronimet Ferrolegerungen Handelsges launched a large project in the metals sector (US\$221 million). French FDI focused almost entirely on the communications sector, where Orange invested US\$402 million between 2008 and 2013. Investments by US firms were largely devoted to ICT and semiconductors, but also included a large 2005 investment in metals by the US firm Global Gold (US\$220.8 million). High-tech sectors attracted investments from Intel (US\$35 million), Microsoft (US\$26 million) and Oracle (US\$22 million).

Figure 2.12. FDI by Source Country and Sector
(in millions of 2010 US\$)



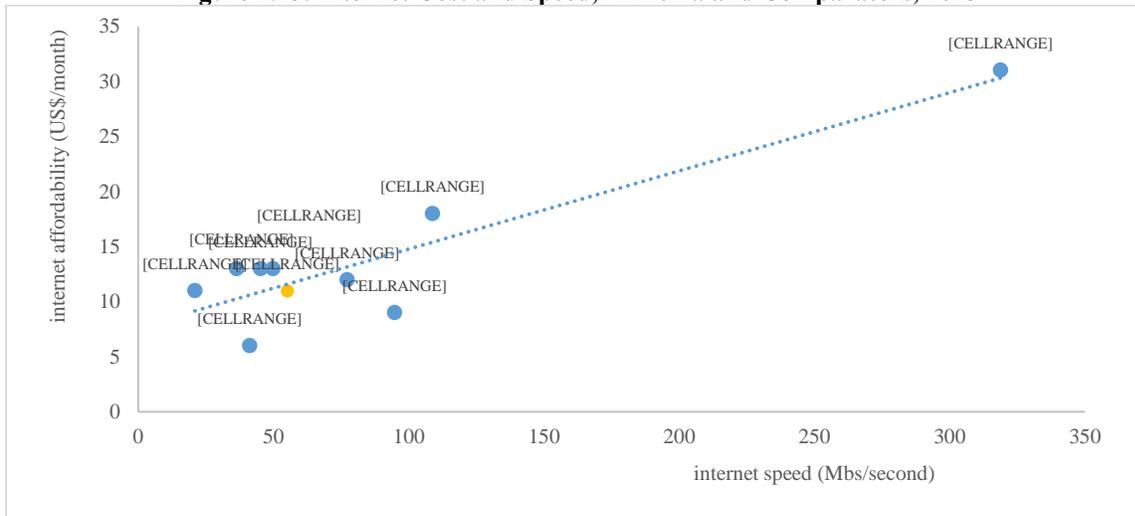
Source: FDI Markets.

INFORMATION

2.15. **Internet access in Armenia is low by OECD standards, but roughly in line with comparable countries.** In 2013 46.3 percent of Armenia's population had access to internet, slightly higher than the rate in Georgia (43.1 percent), but lower than that of Azerbaijan (58.7 percent), as well as Russia, the EU and the OECD average (78 percent). Armenia has an average of 7.88 broadband internet subscribers per 100 people, far below the OECD average (27.8) and the rate of the leading comparator country, Belarus (29.8). The proportion of broadband internet subscriptions in Armenia has increased since 2010, and the gap with the OECD is gradually narrowing.

2.16. **Internet affordability and speed are also similar to comparable countries, but far behind the OECD average.** Armenia's bandwidth was 55,146 kilobytes per second per user in 2013, with an average monthly cost of US\$11. Serbia, which had the fastest internet connection among comparable countries (108,874 kb/s per user) also had the highest cost (US\$18 per month). All Balkan countries had higher costs relative to their speeds, while costs were lower in Russia and Belarus. The average OECD speed was 318,845 kb/s per user, triple the speed of Serbia and more than 5 times that of Armenia. However, the average monthly cost for OECD countries was also much higher (US\$31). Armenia's internet bandwidth has increased dramatically since 2012, but the pace of growth has been even faster in the OECD, widening the speed gap over time.

Figure 2.13. Internet Cost and Speed, Armenia and Comparators, 2013

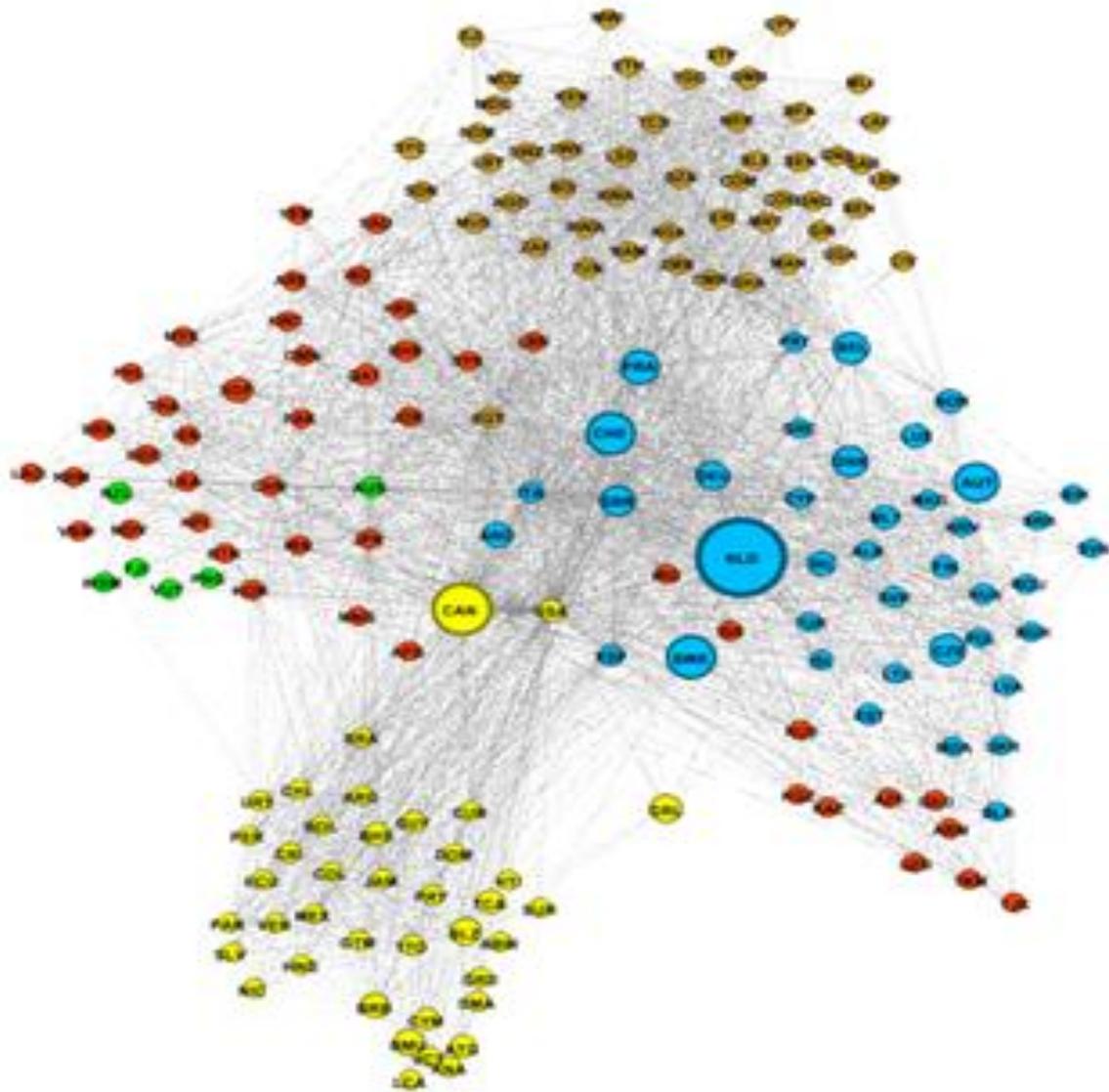


Source: World Development Indicators.

2.17. International telephone calls can be used as a proxy for ICT connectivity between countries. Bilateral data flows would provide a more precise metric of connectivity, but information on data flows is inadequate to allow for meaningful analysis. Consequently, the number of international telephone calls is the best measure currently available. Figure 2.14 and Figure 2.15 diagram international communication networks based on the number of phone calls between countries. The position and size of each country reflects the extent of its connections with other countries in the network. Countries with higher degrees of connectivity (more connections) will be located in the center of the network, while countries with fewer connections will be in the periphery.

2.18. Armenia has low overall connectivity, but is closely linked with Russia. Nevertheless, Armenia is better integrated in the global network than many countries in Latin America, which were among the least integrated both in 2000 and 2010. Between 2000 and 2010 Armenia’s connectivity became more closely aligned with that of comparable countries, and its connections to Europe markedly increased.

Figure 2.14. Global Connectivity Based on Outgoing Communications per Capita, 2000



Source: World Bank staff calculations.

Note: The size of the country (node) represents the total outgoing communications from that country relative to the rest of the world as a share of the population of the sending country, while the width of the arrows between countries represent the bilateral flow of communications between two countries in a given year.

Figure 2.15. Global Connectivity Based on Outgoing Communications per Capita, 2010



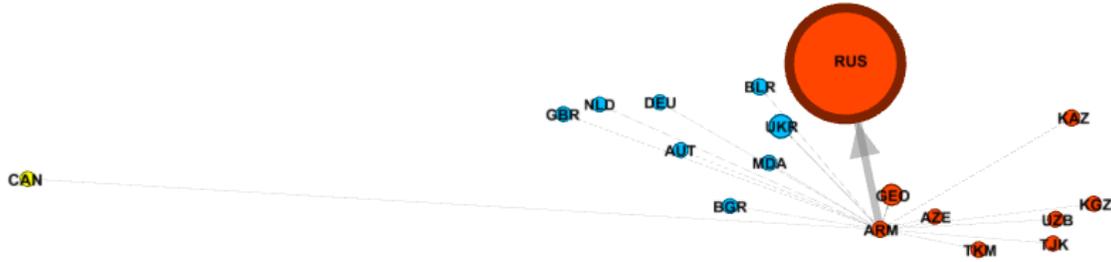
Source: World Bank staff calculations.

Note: The size of the country (node) represents the total outgoing communications from that country relative to the rest of the world as a share of the population of the sending country, while the width of the arrows between countries represent the bilateral flow of communications between two countries in a given year.

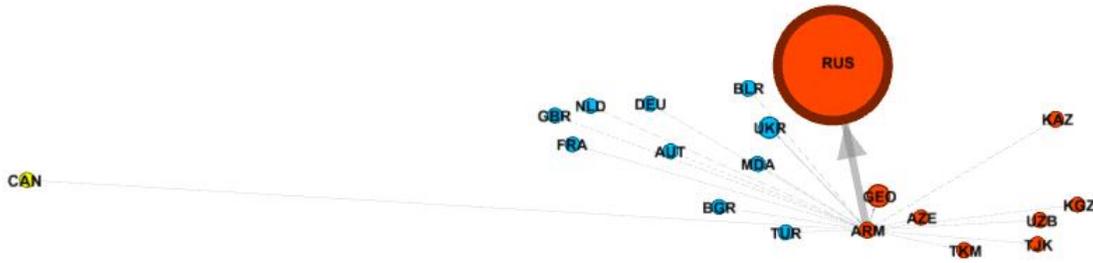
2.19. **Armenia has diversified its connections in recent years but it remains heavily focused on Russia.** Russia accounts for the bulk of Armenia's outgoing communications, a pattern which changed little between 2000 and 2010. However, Armenia added France and Turkey to its list of top communications partners. This corresponds with changes in its trade, investment, and labor migration profile. While Armenia remains closely connected to Russia, it is gradually expanding its links to the wider world.

Figure 2.16. Armenia’s Major Communications Partners by Share of Total Outgoing Communications

A. 2000



B. 2010



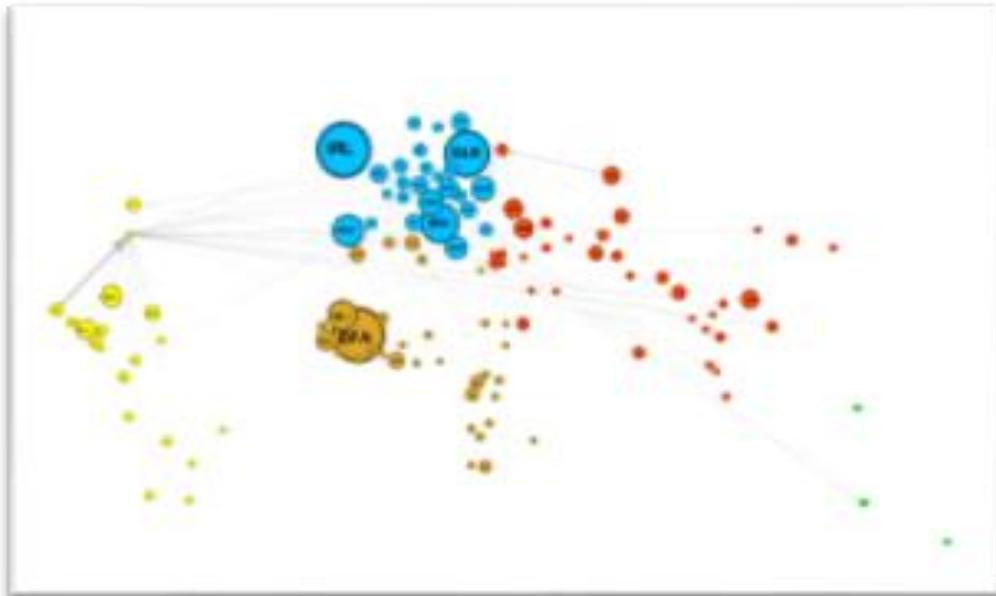
Source: World Bank staff calculations.

Note: The size of the country (node) represents the total outgoing communications from that country relative to the rest of the world as a share of the population of the sending country, while the width of the arrows between countries represent the bilateral flow of communications between two countries in a given year.

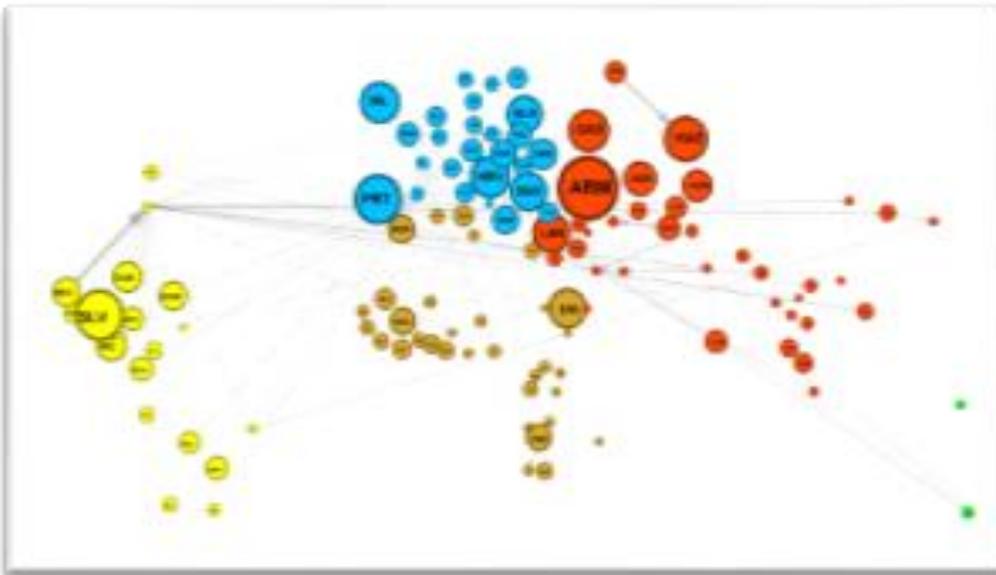
LABOR MOBILITY

2.20. **Armenia has a large diaspora community with roots stretching back over centuries.** The most recent wave of emigration began in the early 1990s following the breakup of the former Soviet Union. Although the total number of Armenian migrants is small in absolute terms, relative to the domestic population Armenia’s diaspora is one of the largest in the world (Figure 2.17). While other former communist countries experienced similar levels of emigration after the fall of the Soviet Union, Armenia’s was among the largest in per-capita terms.

Figure 2.17. Number of Migrants as a Share of the Total Home-Country Population
A. 1990



B. 2010

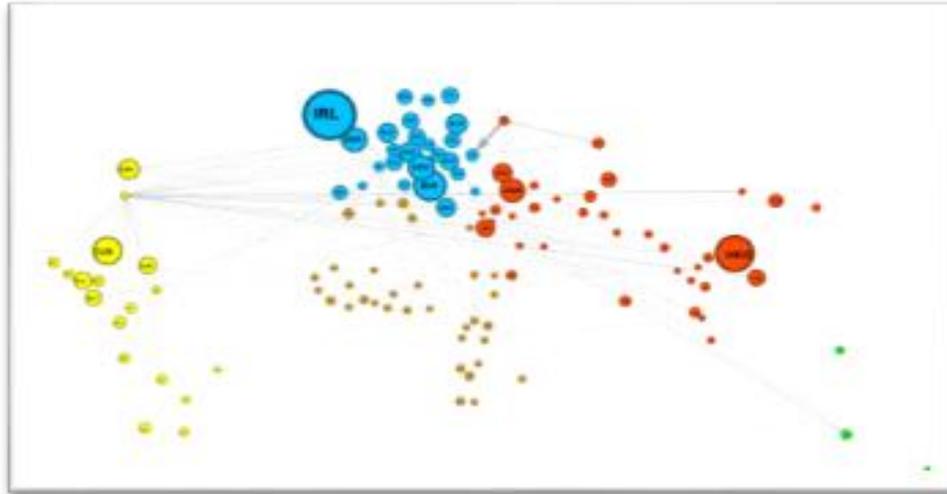


Source: World Bank staff calculations.

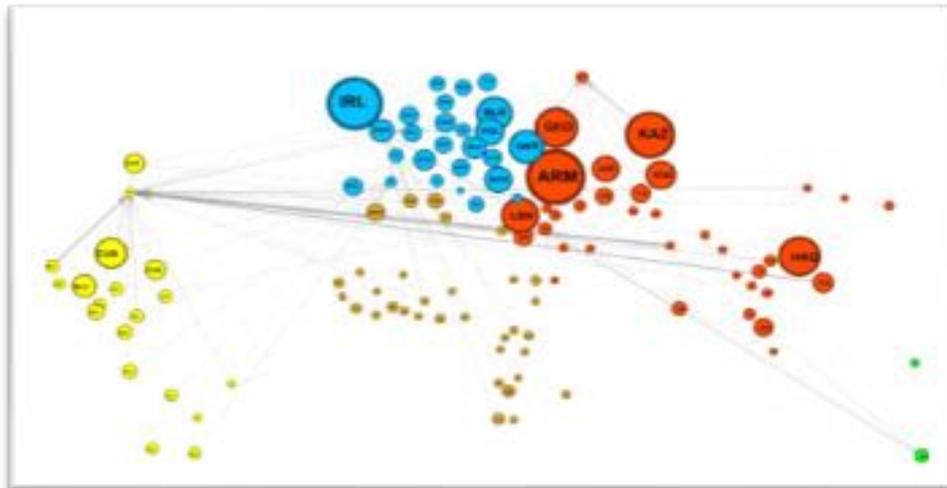
Note: The size of the node represents the number of migrants as a share of the home-country population. Arrows indicate the size and direction of the flow of migrants.

2.21. Large-scale emigration has substantially reduced Armenia’s human capital stock. Over the past 25 years Armenia has experienced a substantial and accelerating “brain drain” effect, as skilled professionals have left to pursue opportunities abroad. Even before 1990 Armenia already had the largest number of high-skilled emigrants, in per capita terms, in the former Soviet Union. From 1990 to 2000 that share grew rapidly across the board, but the emigration of skilled professionals was especially rapid in Armenia, ranking it among the countries with the highest human capital exports in the world.

Figure 2.18. Skilled Migrants as a Share of the Total Home-Country Population
A. 1990



B. 2010



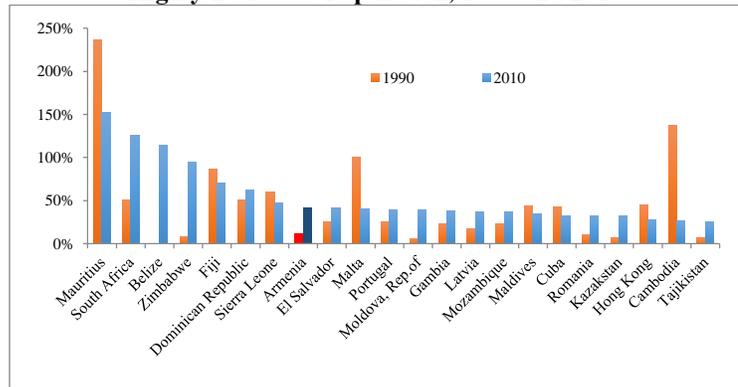
Source: World Bank staff calculations.

Note: The size of the node represents the stock of migrants with completed tertiary education as a share of the total home-country population. Arrows indicate the size and direction of the flow of educated migrants.

2.22. The importance of emigration is underscored by Armenia's relative scarcity of highly educated workers.

In 2010 just 14.4 percent of Armenians had completed tertiary education, compared to an OECD average of 25 percent. Educated emigrants represented a remarkable 43 percent of Armenia's total educated population in 2010, compared to just 12 percent in 1990. While Armenia's proportion of highly skilled emigrants is not the highest in the world, emigration by skilled workers has increased dramatically over the period.

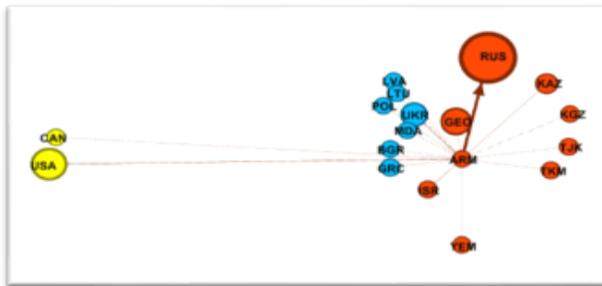
Figure 2.19. Highly Educated Emigrants as a Share of the Total Highly Educated Population, 1990 and 2010



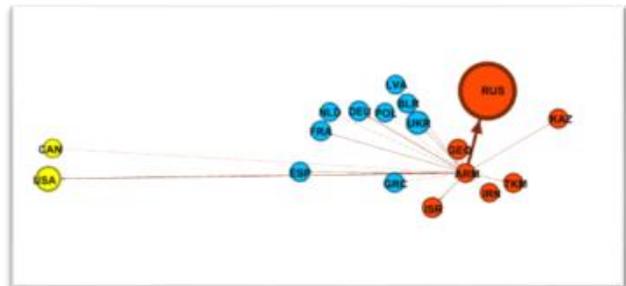
Source: Barro and Lee.
 Note: Share of emigrants with completed tertiary education as a percentage of total population 25 and older with completed tertiary education.

Figure 2.20. Skilled and Unskilled Armenian Migrants by Destination Country, 1990 and 2010

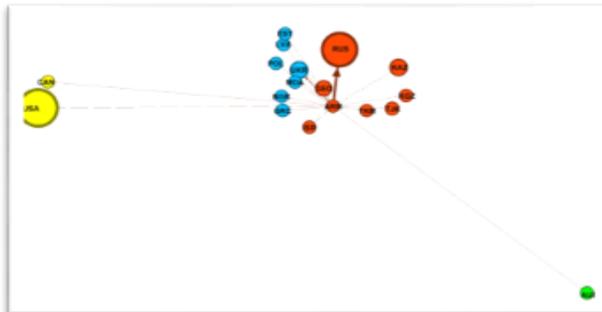
A. Share of total Armenian migrants by destination country, 1990



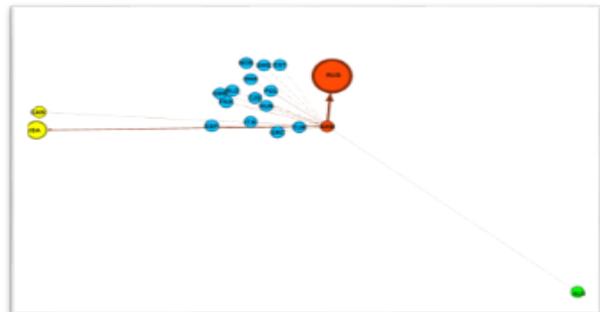
B. Share of total Armenian migrants by destination country, 2010



C. Skilled Armenian migrants as a share of total Armenian migrants by destination country, 1990



D. Skilled Armenian migrants as a share of total Armenian migrants by destination country, 2010



Source: World Bank staff calculations.
 Note: Arrows indicate the size of the flow of Armenian migrants to each destination country.

2.23. Russia is the most common destination for both skilled and unskilled Armenian migrants. Russia accounts for 80 percent of all Armenian migrants, and its share of the skilled emigrant workforce increased to 68 percent in 2010. Meanwhile, Western countries have surpassed the former Soviet states to become the second-largest destination for skilled migrants. In 2010 the US was home to 38 percent of Armenia's skilled migrant workforce.

Table 2.7. Migrants and Labor Migrants by Year

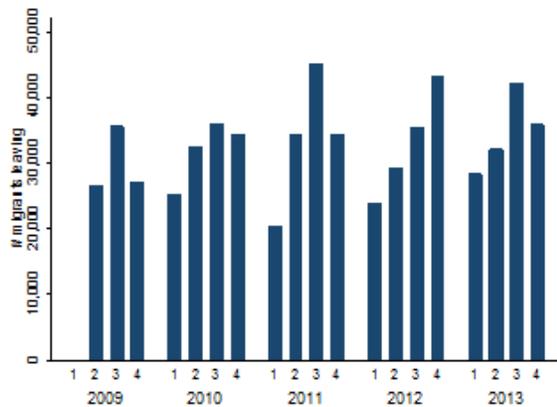
2.24. **The pace of out-migration has remained relatively stable over time, with regular seasonal peaks and a temporary surge in migration to Russia in 2010.** Household surveys do not account for migrants whose entire family has moved abroad, and thus captures only about a third of the stock of Armenians abroad (Table 2.7). People are recorded as migrants if their remaining household members report them as having left in the previous 4 years.

Migration peaks during the third quarter of the year, highlighting its partial seasonality (Figure 2.21). Many are labor migrants (around 60 percent). The number of migrants to Russia is increasing over time, while the number bound for other countries in the former Soviet Union is declining (Figure 2.22).

Year	Migrants	% labor migrants
2009	165,005	57.88
2010	200,754	53.10
2011	204,660	54.48
2012	199,050	64.50
2013	201,582	63.74

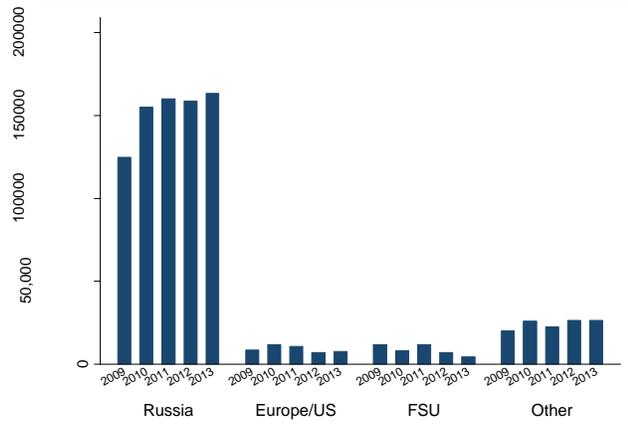
Source: Integrated Living Conditions Survey (ILCS).

Figure 2.21. Quarterly Out-Migration, 2009-2013



Source: ILCS.

Figure 2.22. Migrants by Destination, 2009-2013

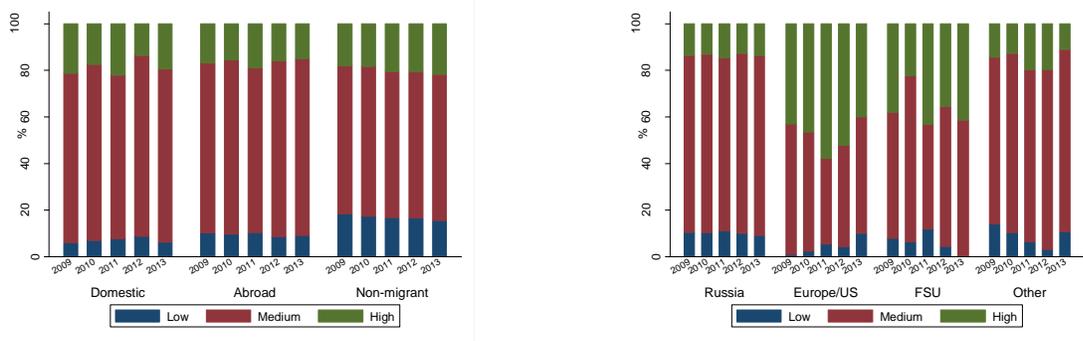


Source: ILCS.

Note: The former Soviet Union (FSU) includes Ukraine, Belarus, Moldova, Armenia, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Georgia, and Azerbaijan.

2.25. **The skill profile of migrants has remained stable over time, with the most highly skilled workers moving primarily to the US and Europe to seek employment in the service sector.** The share of migrants with tertiary education is similar to the share of the population as a whole. However, the share of migrants with upper secondary or vocational education is higher than the share of the total population. Migrants abroad seem to be less skilled than domestic migrants, but this difference is not significant. Migrants to Europe and the US, although small in number, are much more skilled than those bound for other countries, and the share of skilled migrants to the US and Europe has increased in recent years. Migrants to other former Soviet countries also tend to have higher skill levels, whereas most migrants to Russia and other destinations worldwide are largely medium-skilled (Figure 2.23). Migrants to Russia and other former Soviet countries primarily work in construction, whereas migrants to Europe and the US tend to work in services. A significant share of migrants bound for minor destinations have moved from construction to manufacturing in recent years (Figure 2.24). The average wages of migrants are higher than the wages of non-migrants, which suggests a high return to migration (Figure 2.25).

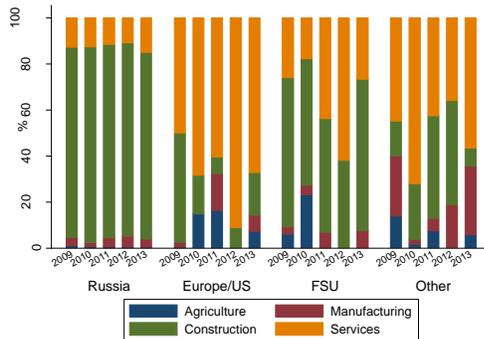
Figure 2.23. Skill Distribution of Migrants and Non-Migrants Across Countries



Source: ILCS.

Note: FSU includes Ukraine, Belarus, Moldova, Armenia, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Georgia, and Azerbaijan. Low=from no education to lower secondary; Medium=upper secondary and vocational; High: tertiary and post graduate.

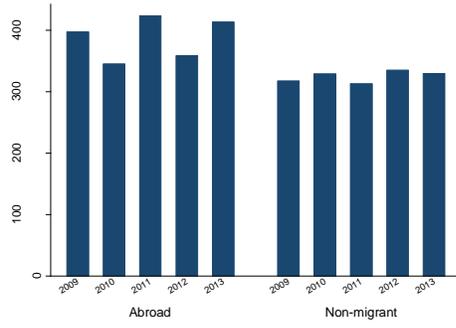
Figure 2.24. Migrants by Occupation and Destination



Source: ILCS.

Note: FSU includes Ukraine, Belarus, Moldova, Armenia, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Georgia, and Azerbaijan.

Figure 2.25. Monthly Wages of Migrants and Non-Migrants



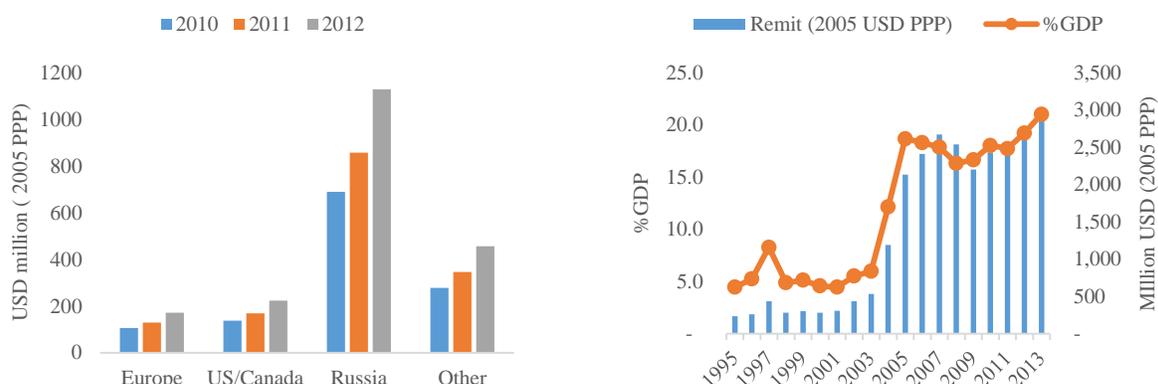
2.26. Migrants tend to be younger than non-migrants, predominantly male, and equally likely to come from rural and urban areas. Migrants to Russia are younger than those going to Europe and the US, likely due to the larger share of semiskilled construction workers bound for Russia. Migrants are evenly divided between urban and rural areas, but the share of migrants from rural areas has increased in recent years, possibly reflecting expanded access to information and opportunities. More than 80 percent of migrants are male, and this gender imbalance has increased even further in recent years. Around 50 percent of migrants are children of the head-of-household, while a third are household heads themselves.

2.27. Armenian migrants to Russia are more likely to come from a household in the bottom 40 percent of the income distribution. In 2009 most migrants came from the bottom deciles, but in 2013 the share from the middle deciles increased. This was probably driven by a rise in the number of migrants going to Europe and the US, which are relatively skill-intensive destinations. Conversely, migrants to Russia are the most likely to come from a household in the bottom 40 percent. Migrants to other destinations tend to be more evenly distributed across income levels.

2.28. Remittances from Russia account for the largest share of total remittances. Remittances have become increasingly important as a share of GDP, reaching 20 percent in 2013 (Figure 2.26). Not all households with migrant members receive remittances, while some households receive remittances from

non-members or from members who have left the household permanently. In 2013 63.6 percent of Armenian households neither sent migrants abroad nor received remittances; 13.4 percent of households received remittances despite having no migrant members; 6.1 percent had migrant members but received no remittances; and 16.8 percent of households had migrant members and received remittances. At least 45 percent of remittance households receive remittances from Russia, whereas 25-30 percent receive remittances from Europe, the US or Canada. The average income of remittance-receiving households is close to the national average, but remittances make up around 60 percent of that income, and recent increases in household income have been largely driven by remittances.

Figure 2.26. Remittances by Country of Origin, 2010-12, and as a Share of Armenian GDP, 1995-2013



Source: National Accounts.

The Diaspora and the Armenian Private Sector

2.29. The international movement of labor has implications that extend far beyond employment and remittances. Labor migration not only creates new income opportunities for migrants, it also exposes them to new industries and new productive technologies. And while migrants directly contribute to domestic consumption through remittances, a well-established diaspora community with close ties to its home country can accelerate growth through investment and trade. This section explores the extent to which the Armenian diaspora in Europe plays a role in the development of Armenia’s private sector.¹⁰

2.30. Armenians make up a very small share of all European migrants, especially when compared to migrants from more developed economies. Armenia’s migrant community is dwarfed by migrants from the OECD and middle-income countries such as Romania and Bulgaria, among others (Figure 2.27). The comparison is even starker when focusing on the fraction of foreign-born shareholders and managers of European firms. However, Armenian migrants are more likely to be shareholders in European firms than migrants born in Georgia and Azerbaijan.

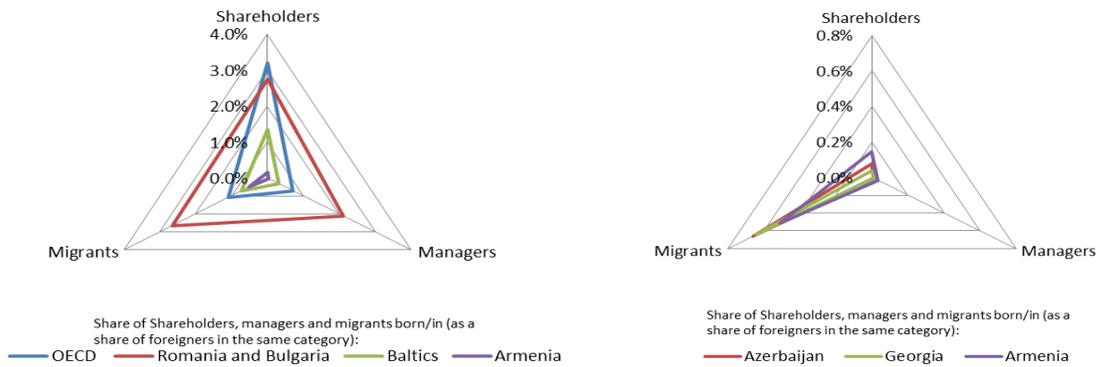
2.31. Armenia attracts little FDI from the European countries where its diaspora resides. There is a limited correlation between migrant destinations, FDI, and the presence of foreign subsidiaries in Armenia. Large diaspora communities have the potential to facilitate cross-border information flows and spur increased investment in their country of origin.¹¹ Conversely, expanding business ties and investment

¹⁰ The firm-level data used in this section is taken from Amadeus and includes registered firms with more than 5 employees. The final sample includes 724,529 firms in 2011, the most recent year for which data on managers and shareholders are available. European economies included in this sample include Austria, Belgium, Bulgaria, Bosnia-Herzegovina, Czech Republic, Germany, Spain, Estonia, Finland, France, UK, Greece, Croatia, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Sweden and Ukraine.

¹¹ See, e.g., Gould (1994) and Ghatak et al. (2009).

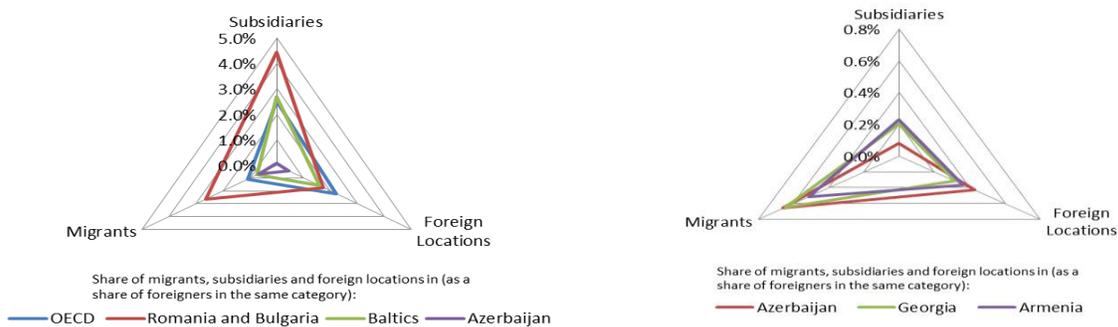
flows can promote increased migration. While Armenia accounts for a somewhat smaller share of European migrants than the Baltic States, the latter have been much more successful in attracting subsidiaries of European firms. Armenia’s relatively poor performance in attracting European FDI is explained by a number of factors, including EU membership, geography, the investment climate, and the overall quality of governance. When compared to its most closely comparable neighbors, Azerbaijan and Georgia, Armenia attracts roughly the same share of European subsidiaries.

Figure 2.27. Armenian Migrants in the Private Sector of European Countries



Source: World Bank staff calculations based on Amadeus.

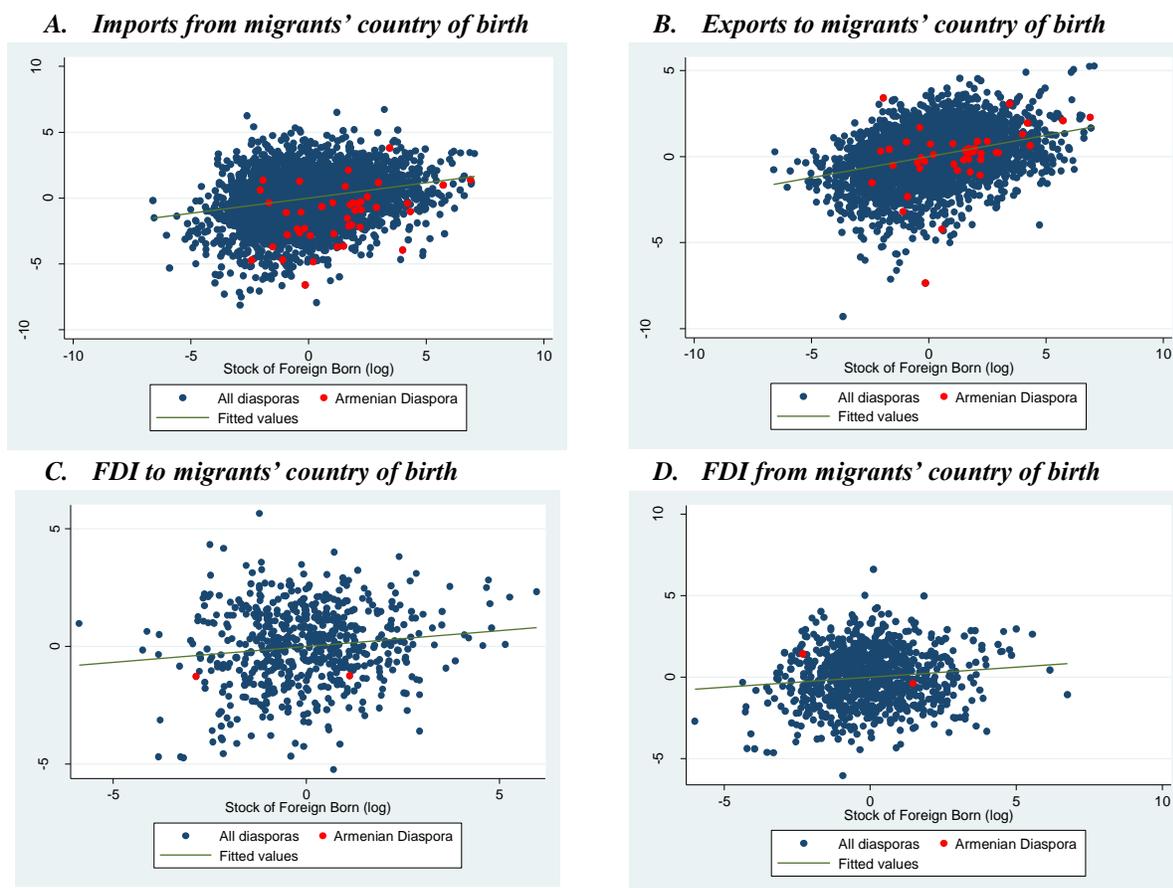
Figure 2.28. FDI from Major Armenian Migrant Destinations in Europe



Source: World Bank staff calculations based on Amadeus.

2.32. The Armenian diaspora has untapped potential to support increased international trade and investment flows. Globally, the size of a country’s diaspora is correlated with both trade and investment. Holding the GDP per capita and population size of the sending and receiving countries constant, as well as the distance between them, and using a dummy variable for common language, there is a significant positive association between the size of the diaspora and international trade and investment. Armenian migrant destinations receive fewer imports from their home country compared to other migrant groups, but in terms of exports from their destination country to their country of origin, Armenian migrants are similar to other groups.

Figure 2.29. Trade Flows, FDI and the Size of the Diaspora, 2000-2010, Conditional Correlations



Source: World Bank staff calculations.

Note: Each variable is separately regressed on a group of explanatory variables (GDP and population of sending and receiving economies, common language indicator and distance). Graphs show plots of the residuals of each regression.

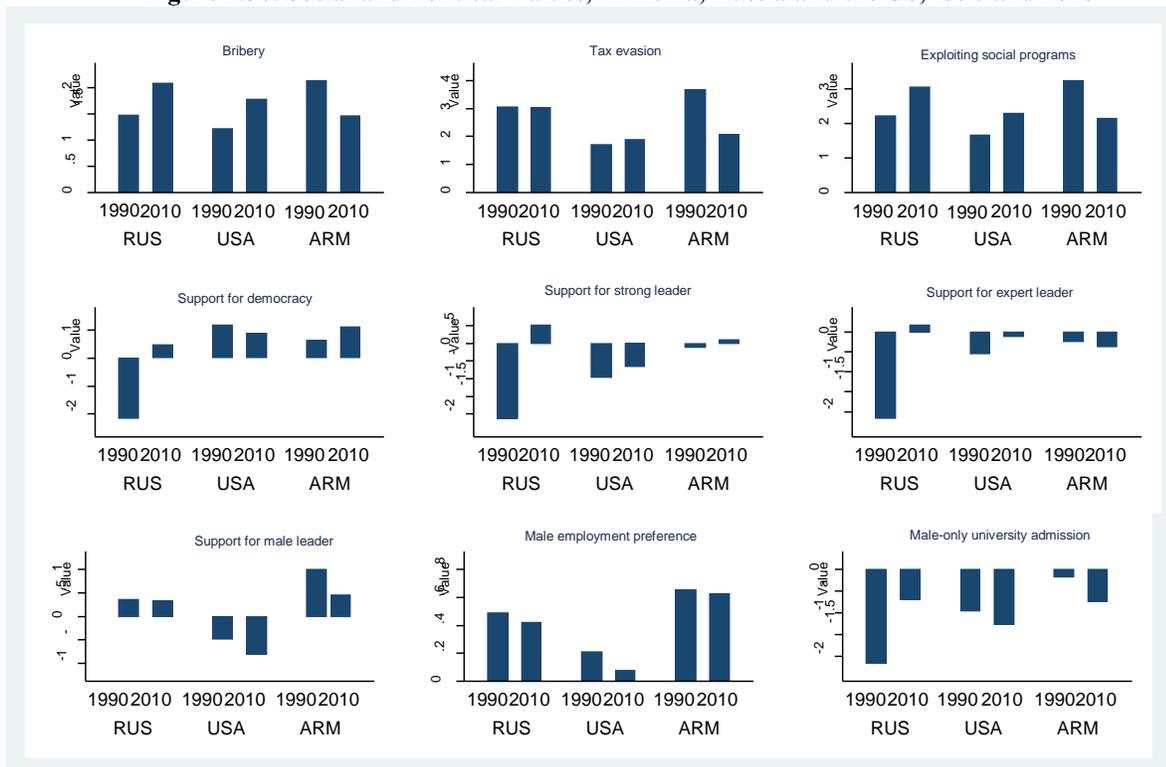
The Diaspora and the Armenian Public Sector

2.33. Migration can positively or negatively affect a country's domestic governance institutions. On one hand, the emigration of skilled professionals can erode the quality of a country's public administration, while the emigration of dissidents may reduce pressures for reform. On the other hand, migration can strengthen the public sector by expanding access to international education opportunities and increasing exposure to the political systems and social norms of countries with highly effective governments. Li et al. (2013) show that skilled migrants have positive effects on home country's political institutions according to metrics of voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. Docquier et al. (2010) find that migration improves home-country institutions according to metrics of political rights, civil liberties, and the openness of political institutions. These analyses, however, assume that migrants are attracted only to countries with markedly higher institutional quality. In cases where the countries of origin and destination have similar governance indicators, the impact of migration is far less clear.

2.34. There is evidence that over the past 20 years Armenia's large migrant population may have influenced domestic social and political values. Political preferences may shift as the home country's population is exposed to the international experience of the diaspora. In the last 20 years Armenians have become measurably less tolerant of bribery, tax evasion and the exploitation of social benefits, while

attitudes toward democracy have become more favorable. However, Armenians now prefer a strong leader more intensely and are less inclined to be led by a technocratic expert. Armenians have adopted more progressive attitudes toward gender equality and are less likely to believe that leaders must be men or that universities should admit male student only. Nevertheless, Armenians still tend to believe that men should have preferential access to employment when jobs are scarce (Figure 2.30).

Figure 2.30. Social and Political Values, Armenia, Russia and the US, 1990 and 2010



Source: World Values Survey.

LEVERAGING CONNECTIVITY

2.35. There is a high degree of overlap between different dimensions of connectivity. This section summarizes the answers to the research questions posed at the beginning of the chapter. Trade, investment, information flows and labor mobility are highly correlated with one another. Russia plays a dominant role in Armenia’s connectivity to the world, and its ties to Russia may deepen following Armenia’s accession to the Eurasian Economic Union (Box 2.1). However, Armenia’s close links with Russia have not prevented it from expanding its connectivity, both with neighboring countries and with Western Europe. Successfully leveraging international connectivity to accelerate growth and development will require a high degree of policy openness coupled with strong domestic and transnational institutions.

Box 2.1. Armenia’s Accession to the Eurasian Economic Union

In September 2013 Armenia announced its intention to seek membership in the Eurasian Economic Union (EEU). The announcement triggered a series of reforms designed to harmonize Armenia’s tax and customs regime with other EEU member states. This process was completed in January 2015, and Armenia formally joined the EEU, acquiring customs-free access to a common market of 170 million consumers.

It is unclear to what extent EEU accession will promote—or inhibit—further structural reforms. Prior to 2013 the Armenian government’s development strategy was guided by a planned Association Agreement with the EU

including a Deep and Comprehensive Free Trade Agreement. The prospect of closer ties with the EU anchored a far-reaching institutional and regulatory reform program. It is uncertain whether the EEU will provide similar support for structural reforms, or to what extent the Armenian government will be able to pursue its stated intention to further strengthen its ties with European partners.

Armenia tends to import technologically advanced goods from the EU and a mix of energy and basic goods from Russia. While Armenian exports to the EU consist mostly of metals and minerals, exports to Russia include higher-value-added goods such as processed food and manufactures. Consequently, the trade-diversion effects of EEU accession could inhibit Armenia's ability to develop more sophisticated industries and shift into higher-value sectors. However, Armenia could attract more market-seeking FDI if its policy environment were more supportive than those of other EEU members and if investors came to regard Armenia as a base for expanding into the wider EEU market. If increased foreign investment brought new technologies to Armenia, positive productivity spillovers could compensate for the disadvantages of trade diversion.

2.36. Armenia is not taking full advantage of current opportunities to expand international trade, but export diversification should not be regarded as a priority objective. Armenia's total trade value amounts to less than 80 percent of GDP, far lower than in many countries with similar income levels, especially small European economies that are either in the EU or on the path to EU accession. Two-thirds of Armenian exports are bound for either Russia or the EU, and the export mix is focused on metals, minerals, and food and beverages, with the budding ICT sector contributing less than 2 percent. However, this export profile is fully consistent with the country's factor endowments and should not be treated as a cause for policy action, as Armenian policymakers lack the tools necessary to influence trade outcomes.¹³

2.37. Sizeable foreign investment inflows have helped increase domestic competition and export orientation. Armenia's inbound FDI is comparable to countries of a similar size and income level. The financial sector, telecoms and mining have been the primary beneficiaries of foreign investment. Foreign investors have spurred the development of the domestic finance and telecom markets, while investment in the mining sector has boosted Armenia's export capacity. The technology sector has attracted a number of substantial investment projects, which are primarily export-oriented.

2.38. Armenia is not efficiently exploiting the potential of digital connectivity, which is crucial to overcome its geographic isolation. Internet service and broadband coverage have expanded rapidly since 2010, but Armenia still lags behind more developed economies. The cost of connecting is relatively modest, which facilitates access, but average speeds are slow, which limits business applications. Armenia's dense information connectivity with Russia mirrors the close trade, investment and migration links between the two countries. As the global digital economy continues to expand, improving internet access, speed and service quality will become increasingly crucial to stimulating trade and investment flows.

2.39. Armenia's large diaspora community has had a limited impact on its economic development. Remittances are a key element of household consumption and vital to poverty alleviation, but emigration has also significantly reduced the domestic stock of skilled labor. An estimated 600,000 Armenians are currently living abroad, but they do not appear to be having a significant impact on trade and investment flows between their home and destination countries. Nevertheless, many individual members of the diaspora are highly successful, and there have been a number of important philanthropic initiatives targeting workforce skills and business development in Armenia. Though many of these efforts have had a highly visible impact at the local level, these remain isolated initiatives. Overall, Armenia is still far from fully leveraging its greatest asset and transforming the diaspora into an organized force for economy-wide growth and development.

¹³ Gill et al. (2014)

3. The Knowledge Economy

A knowledge economy is built on sound governance institutions, modern ICT infrastructure, adequate human capital and the ability to create and use knowledge. Armenia faces challenges in all of these areas. Its governance environment reflects the dominance of powerful elites, and while significant progress has been made in formal business regulation, weak institutions often prevent their effective implementation. Human-capital constraints are preventing Armenia from fully exploiting its scientific and technological potential. Although the country was once a major regional technology center, a decline in educational achievement and a dearth of scientists and engineers is jeopardizing what remains of Armenia's scientific base. Private firms rarely invest in the skills of their employees, and low levels of investment in science and technology by both the public and private sectors limits Armenia's ability to create and use knowledge.

3.1. A knowledge economy leverages intellectual capabilities rather than physical inputs in production. According to one of many definitions, a knowledge economy is one in which the production of economic output is based on knowledge-intensive activities that accelerate the pace of technical and scientific progress. Its distinguishing characteristic is dependence on knowledge, information, and high skill levels—or intellectual capabilities—rather than on physical inputs and resources.¹² Since the late 20th century global economic development has been shaped by the gradual transition away from a physical economy and towards a knowledge-based economy. This has influenced technological advancement in more developed countries and the convergence of less developed economies.

3.2. Governance, information flows, human capital, and knowledge generation are the pillars of a knowledge economy. According to the World Bank's Knowledge Economy Index¹³ four pillars are critical to the establishment of a knowledge economy. First is the governance environment, the prevailing formal and informal rules that shape incentives to invest and innovate. Second is use of information and communication technology to facilitate the effective creation, dissemination, and processing of information. Third is the availability of adequate human capital, as influenced by education and training, particularly at the tertiary level and in the science and technology fields. Fourth is the ability of the economy to create and use knowledge by investing in research and development, encouraging internationally recognized knowledge outputs (e.g. patents and publications), facilitating knowledge use by enterprises, and fostering collaboration between science and industry.

3.3. This chapter assesses whether Armenia is adequately equipped to move towards a knowledge economy by examining Armenia's comparative standing across these four dimensions. Armenia's progress is assessed against that of its neighbors in the Caucasus (Georgia and Azerbaijan), its EEU partners (Belarus, Kazakhstan and Russia), comparable small economies in Southeast Europe (Albania, FYR Macedonia, and Serbia), and new EU member states.¹⁴ Depending on data availability comparisons are made to the OECD average, which proxies for the developed world standard. This chapter addresses the following research questions:

- Are the formal rules and informal norms that constitute the governance environment consistent with a level playing field?
- Is the production and use of ICT contributing to a more efficient economy?

¹² Powell and Snellman (2004). Also, see OECD (2005).

¹³ See <http://data.worldbank.org/data-catalog/KEI>. The KEI was last estimated in 2012. The present analysis does not estimate a summary KEI indicator for Armenia. It is based on a modified version of the KEI pillars with the aim of broadening their scope by using both country- and firm-level data.

¹⁴ Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia.

- Do Armenia’s research and enterprise sectors have adequate human capital?
- Are Armenia’s public and private sectors investing in knowledge creation and use?

GOVERNANCE

3.4. Armenia’s governance and regulatory environment is more developed than in its EEU partners, but far less developed than in new EU member states and OECD countries. The World Governance Indicators (WGI) summarize six dimension of governance (see Box 3.1) that capture the extent to which a country’s formal rules and informal norms are conducive to economic development. According to this measure Armenia’s governance environment is far inferior to that of new EU member states and advanced OECD economies. The gap is widest with respect to voice and accountability, control of corruption and rule of law. This is less a reflection of state efficiency or sophistication as it is indicative of a political system where decision making is dominated by a powerful elite. Armenia’s governance environment is however better developed than in Belarus, Kazakhstan or Russia. This suggests that Armenia could benefit from improvements to its investment climate that attract greater foreign direct investment aimed at serving the wider EEU market.

Box 3.1. The World Governance Indicators

The WGI compile and summarize information from 32 existing data sources that report the views and experiences of citizens, entrepreneurs, and experts from around the world on the quality of various aspects of governance in the public, private and NGO sectors. Six broad dimensions of governance are measured:

Voice and Accountability – captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and a free media.

Political Stability and Absence of Violence/Terrorism – captures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.

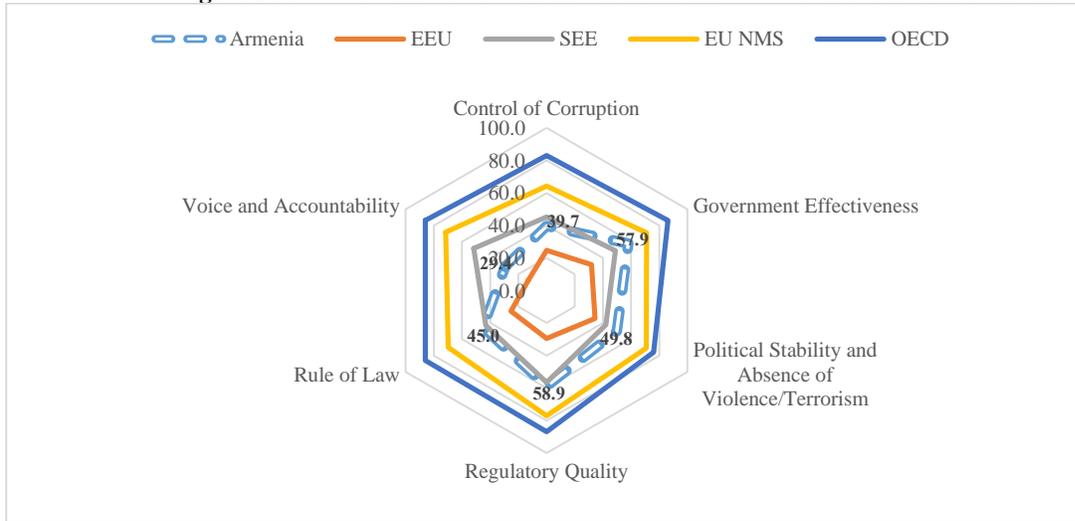
Government Effectiveness – captures perceptions of the quality of public services, the quality of the civil service and the public administration’s relative independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

Regulatory Quality – captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Rule of Law – captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

Control of Corruption – captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as for "capture" of the state by elites and private interests.

Figure 3.1. Armenia’s Performance Across the Six Dimensions of Governance

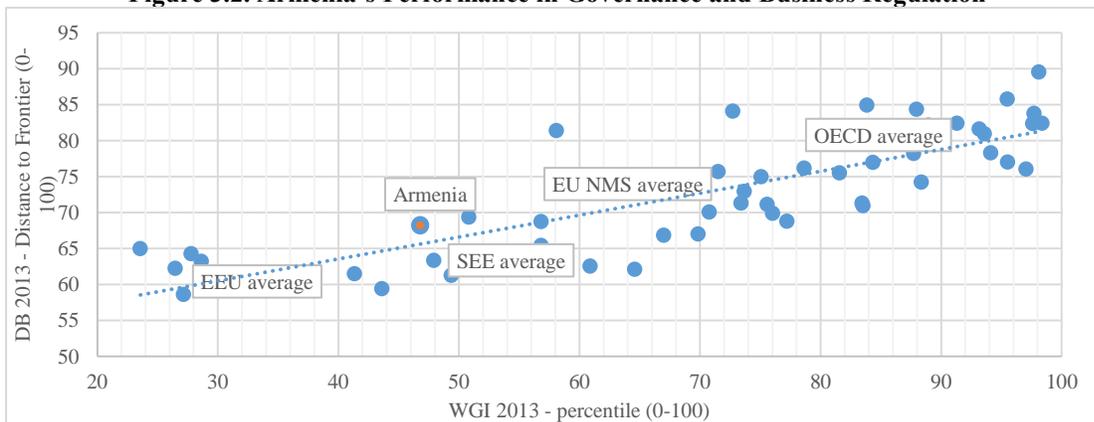


Source: World Governance Indicators 2013, percentile rank (0-100). See Box.

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

3.5. Armenia’s regulatory framework is relatively well-designed by international standards, but the actual enforcement of business regulations is inconsistent and vulnerable to undue influence. Figure 3.2 plots Armenia’s overall performance on the 2013 WGI against its “distance to frontier” performance in the *Doing Business* report. The former captures the overall governance environment, providing a summary of the country’s formal and informal institutions, while the latter reflects the quality of official regulations in a number of areas relevant for doing business. Armenia’s overall WGI score is below the global median. Its relative ranking with OECD countries and new EU members is particularly low, but still far better than that of other EEU member states. In terms of official regulations, however, Armenia is in the top third of countries worldwide and relatively close to the EU and OECD averages. This strongly implies that the letter of the law differs significantly from the reality of its implementation.

Figure 3.2. Armenia’s Performance in Governance and Business Regulation



Source: World Governance Indicators 2013, percentile rank (0-100) and *Doing Business* 2013, distance to frontier (0-100).

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

3.6. **Armenia has made substantial progress in improving regulatory efficiency.** In 2015 *Doing Business* ranked Armenia 45th globally, up four positions from 2014. This places Armenia among the top third of countries included in the report (Table 3.1). Armenia performs particularly well in the areas of (i) starting a business, where it nears best practice, (ii) registering property, (iii) getting credit, and (iv) paying taxes. The biggest improvement has been in the area of paying taxes; yet, businesses continue to cite tax administration as a major impediment to their operations (Figure 3.3). This may be another indication of the gap between the law as it is written and as it is actually enforced. Armenia continues to perform poorly in the areas of getting electricity, enforcing contracts and trading across borders.

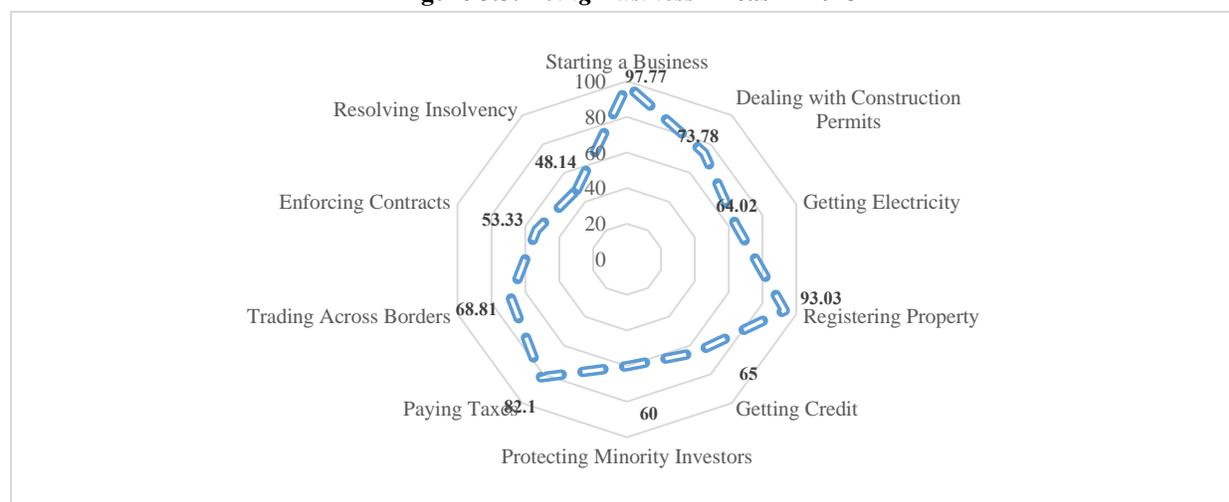
Table 3.1. Armenia's *Doing Business* Performance 2014-2015

	Rank			Distance to frontier (%)		
	DB 2015	DB 2014	Change	DB 2015	DB 2014	Change
<i>Doing Business</i> - Overall	45	49	4	70.6	69.31	1.29
Starting a Business	4	5	1	97.77	97.51	0.26
Dealing with Construction Permits	81	82	1	73.78	73.64	0.14
Getting Electricity	131	132	1	64.02	63.99	0.03
Registering Property	7	7	No change	93.03	93	0.03
Getting Credit	36	30	-6	65	65	No change
Protecting Minority Investors	49	48	-1	60	60	No change
Paying Taxes	41	73	32	82.1	74.46	7.64
Trading Across Borders	110	124	14	68.81	64.46	4.35
Enforcing Contracts	119	119	No change	53.33	53.33	No change
Resolving Insolvency	69	67	-2	48.14	47.74	0.4

Source: *Doing Business*.

Note: The distance to frontier score measures how far an economy is on average at a point in time from the best performance achieved by any economy on each *Doing Business* indicator since 2005, or the third year in which data for the indicator were collected. The measure is normalized to range between 0 and 100, with 100 representing the frontier.

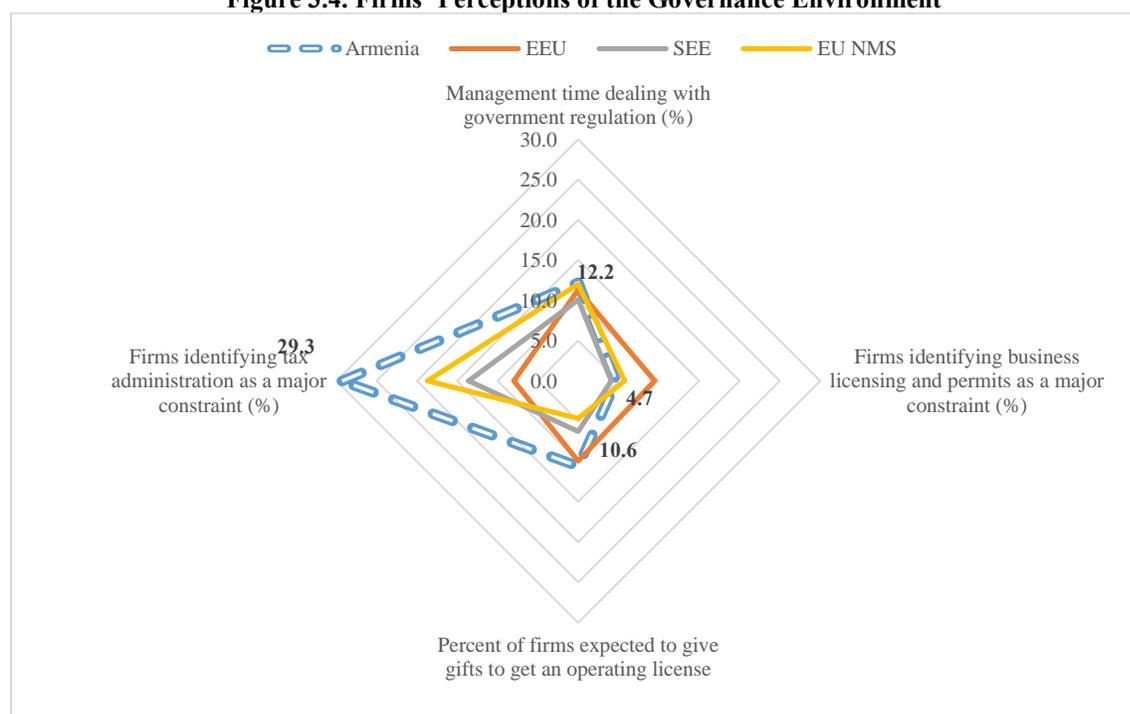
Figure 3.3. *Doing Business* Areas in 2015



Source: *Doing Business* 2015.

3.7. Based on Armenian firms' perceptions, corruption is worse than in European comparators and tax administration stands out as an especially serious issue. The World Bank's 2013 Enterprise Surveys collected responses from firms on a variety of issues, including perceptions of the regulatory environment. The surveys indicate that senior management in Armenian firms spend 12.2 percent of their time dealing with government regulation, a figure that is in line with comparator averages but significantly higher than top performers like Georgia (0.9 percent), Lithuania (6 percent), and Estonia (6.5 percent). Obtaining business licenses is cited as a major constraint by only 4.7 percent of Armenian firms, which is on par with European countries. However, a higher proportion of Armenian firms (10.6 percent) report that they expect to provide gifts in exchange for an operating license (Figure 3.4). Tax administration towers above all other concerns and represents a far higher share than comparators, with nearly one-third of Armenian firms citing it as a major constraint.

Figure 3.4. Firms' Perceptions of the Governance Environment



Source: Enterprise Surveys 2012-2013.

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

INFORMATION AND COMMUNICATION TECHNOLOGY

3.8. In advanced economies ICT production and use has been critical to income convergence. The internet revolution of the 1990s led to a divergence in incomes per capita in advanced OECD economies. While ICT use in many OECD economies remained limited, U.S. productivity growth began to accelerate due to the diffusion of ICT technology across most sectors of the economy. This halted a secular process of income convergence that began after the Second World War. Disparities in productivity growth among OECD countries reflected differing degrees of adaptability to technological shocks, with the countries enjoying higher levels of competition in factor and product markets benefiting the most.¹⁵

¹⁵ See Conway et al. (2006).

3.9. The productivity benefits of ICT use are not automatic and depend on complementary investments in skills development and organizational restructuring.¹⁶ More productive firms use digital technologies more effectively. Evidence from high-income countries suggests that investing in digital technologies but not in reorganization may even reduce firm productivity growth.¹⁷ Investment differences partly explain the heterogeneity in the use and impact of digital technologies. Investments in computerized information for instance are comparable among firms in the U.S. and Brazil. However, U.S. firms focus significantly more on training, skills development and business process improvements; as a result, the impact of digital technologies on productivity is higher among U.S. firms. In addition, firms are more likely to develop new management practices in countries with less distorted labor and product market regulations.¹⁸ Similarly, firms in more contested industries—those with more competitors or higher firm entry and exit rates—are more likely to use the internet to sell or purchase their products or services.

3.10. ICT production in Armenia has steadily grown in recent years. In 2003 the ICT sector only employed 3,000 professionals. In 2014 the sector employed 11,600 and accounted for 4.4 percent of GDP and 4.6 percent of total goods and services exports.¹⁹ The majority of ICT exports are destined for North America and Europe, allowing Armenia to innovate through interactions with developed economies (see Box 3.2).²⁰ The Armenian ICT sector is comparatively small, however its rapid development and growth prospects make it an attractive option for foreign investment. Nearly 80 percent of the companies now active in the sector were formed from 2000-2010. This includes local startups as well as international subsidiaries. The number of operating IT companies reached 200 in 2010, of which 72 were subsidiaries of foreign companies with a market share of 52 percent. The sector is primarily oriented towards exporting software.²¹ Since 1991 there has been a shift towards developing software and applications and modernizing telecommunication infrastructure, in addition to outsourcing and IT-based services.

Box 3.2. The Information and Communication Technology Sector in Armenia

The Armenian ICT sector has matured in recent years and is primed for further expansion. While comparatively small in size, the sector's rapid growth and development prospects have helped attract foreign investment. North America in particular is a major source of foreign investment. Local companies moreover, are becoming increasingly active in engineering, systems development, and research and development. Armenia has a comparative advantage in several areas important for further ICT development, including a competitive cost base and a large number of graduates with relevant higher education credentials. Armenia faces a number of competitive disadvantages as well, including poor internet connectivity, lack of office space and a relatively high risk profile.

The ICT sector is creating jobs, particularly for women who make up 35 percent of the sector's workforce. Between 2008 and 2010 the sector employed nearly 5,000 professionals, 83 percent of whom were technical specialists. The average monthly salary of IT specialists in Armenia is US\$1,200–1,500, which is 4 to 5 times higher than the national average.

Since 1991 the sector has focused increasingly on developing software and applications and modernizing telecommunication infrastructure, as well as on outsourcing and IT-based services. In the early 2000s the Armenian government declared ITC as a priority growth area for the country's economic development. Nearly 80

¹⁶ “Firms investing in the skills of their workforce use digital technologies more productively. It follows that a shortage of skills at the country level lowers aggregate productivity growth despite investments in broadband infrastructure. And, countries also need to provide other backbone infrastructure such as energy or logistics. For instance, selling goods over the internet to customers in foreign countries requires basic trade logistics such as ports, air, or land transport” – World Bank (2015).

¹⁷ Bresnahan et al. (2002); Brynolfsson and Hitt (2003); Bloom et al. (2012).

¹⁸ De Rosa and others (2009) estimated that removing anticompetitive regulation in energy, telecommunications and transport in Croatia would increase GDP per capita by 1.35–2.77 percent.

¹⁹ Employment, GDP and export estimates for the ICT sector are from EIF and are not corroborated by other sources.

²⁰ EIF Armenia IT Sector Reports.

²¹ World Bank (2013).

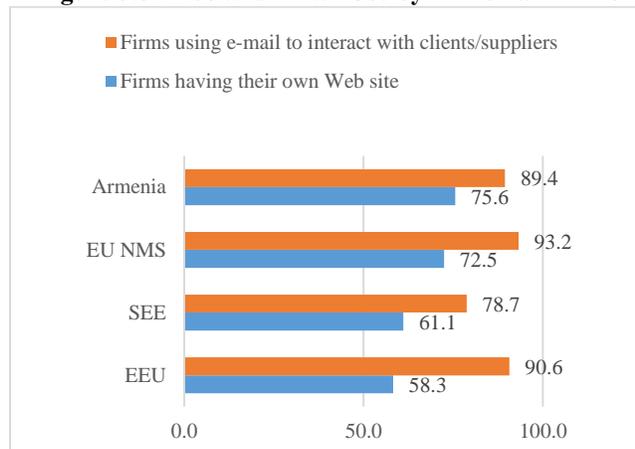
percent of firms now active in the sector were formed between 2000–2010. This includes local startups as well as international subsidiaries. The number of operating IT firms reached 200 in 2010, of which 72 were subsidiaries of foreign companies with a market share of 52 percent. Foreign companies in Armenia employ over half the ICT workforce.

The ICT sector is primarily oriented towards exporting software, with a majority of firms specializing in internet services, web development and IT consulting. Internet services generated more than 34 percent of the sector’s revenues in 2010. The size of the domestic market totaled US\$91 million in 2010, and the turnover of the software and services sector reached US\$150 million.

Source: World Bank (2013).

3.11. ICT use among Armenian firms compares favorably with peer countries, but businesses outside the ICT sector are not leveraging the full potential of information technology. In the World Bank’s 2013 Enterprise Surveys 75.6 percent of Armenian firms reported having their own website. 89.4 percent of firms stated that they use email to interact with clients and suppliers. Armenia scored higher than most comparators in web use, on par with new EU member states and better than both Western Balkan economies and EEU partners (Figure 3.5). Local internet content production is still relatively underdeveloped compared to neighboring countries. During focus group interviews the majority of ICT firms stated that domestic companies outside of the sector are not investing in digital technologies. For example, relatively few firms buy and sell products and services online.

Figure 3.5. Web and Email Use by Armenian Firms



Source: Enterprise Surveys 2012-2013.

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

HUMAN CAPITAL

3.12. While it has narrowed the gap since 2009, Armenia lags behind the OECD and Russia in tertiary enrollment. The average tertiary enrollment rate in Armenia was 46 percent in 2014, substantially below the OECD average of 71 percent and the Russian rate of 76 percent (Figure 3.6). Armenia’s neighbors Georgia and Azerbaijan had lower enrollment rates at 27.9 percent and 20.4 percent, respectively. Albania and Serbia showed higher rates of enrollment at 55.5 percent and 52.4 percent, respectively.

3.13. Tertiary graduates make up a quarter of the labor force, but Armenia’s supply of science and engineering graduates lags behind comparators. In 2011, the latest year for which WDI data was available, tertiary graduates made up 22.9 percent of the Armenian labor force, which is only 5.1 percentage points below the OECD average. However, only 15.9 percent of tertiary graduates completed degrees in science or engineering, making Armenia the lowest rated country among its peers and substantially below the OECD average (Figure 3.7). Russia ranked highest with 28.1 percent. Belarus came in close second with 27.2 percent, followed by Serbia. These three countries outperformed the

OECD average (22.2 percent). Georgia, Azerbaijan and Albania performed worse than the OECD average, yet ranked higher than Armenia.

Figure 3.6. Tertiary Enrollment
(percent gross)

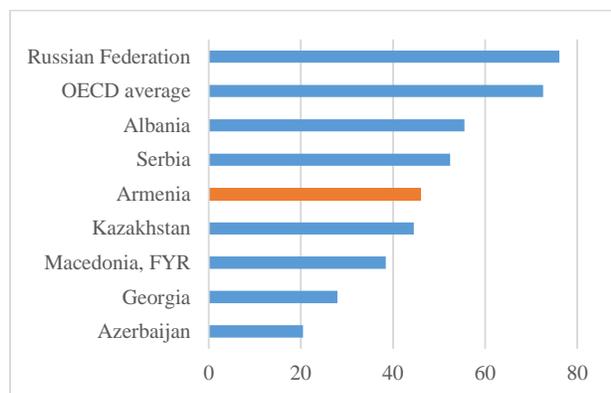
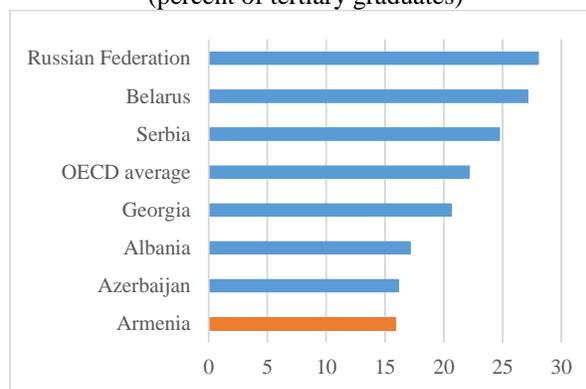


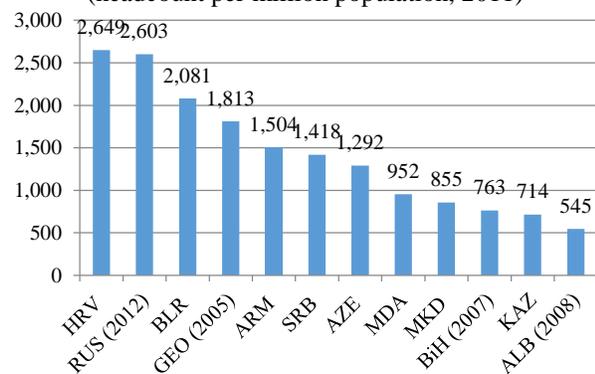
Figure 3.7. Tertiary Graduates in Science and Engineering
(percent of tertiary graduates)



Source: Global Competitiveness Index (2014-2015).

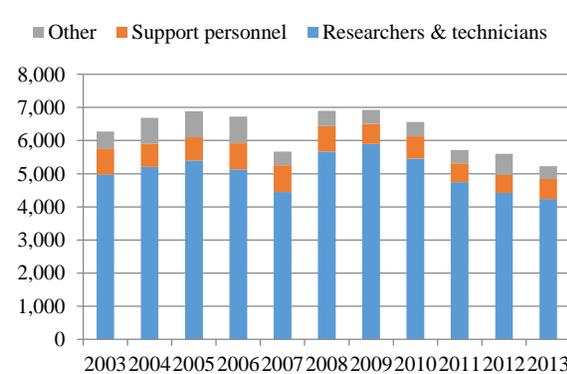
3.14. A dearth of new graduates undermines Armenia’s traditional strength in science and engineering. While Armenia has 1,500 researchers per million people, a higher number than many of its peers (Figure 3.8), this number has been steadily declining in the last few years (Figure 3.9). In 2012 it was estimated that around 5,600 staff, including 4,500 scientists, worked at public research organizations. This represents a decrease of 19 percent since 2008. 42.8 percent of researchers are women according to 2011 UNESCO statistics. Women are underrepresented in engineering and technology (35.1 percent), but are prevalent in medical and health sciences (58.6 percent) and agriculture (54.6 percent). These figures contrast drastically with the situation prior to 1991, when the number of scientists in Armenia surpassed 27,000.

Figure 3.8. Researchers
(headcount per million population, 2011)



Source: UNESCO and Global Innovation Index 2014.

Figure 3.9. R&D Personnel



Source: NSS.

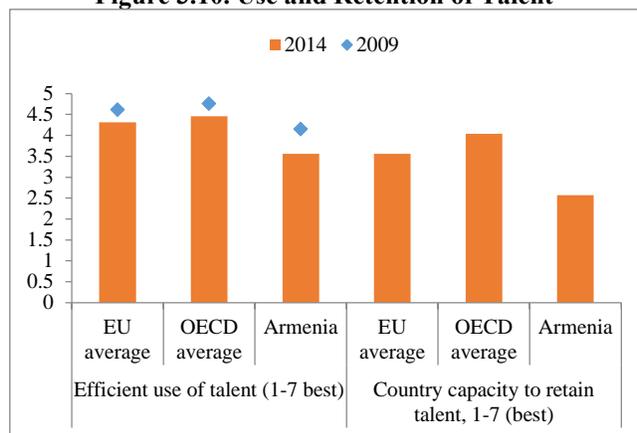
3.15. Emigration has taken a severe toll on the Armenian science sector. Following the fall of the Soviet Union a large number of scientists migrated, primarily to Europe and North America. As in other former Soviet countries the emigration of skilled professionals spurred a further deterioration in human capital as former scientists began pursuing careers outside of science.

3.16. With its networks and financial resources, the Armenian diaspora is a potential source of expertise, scientific collaboration and funding. Created in 2002 the Diaspora Ministry has taken steps

to promote linkages with the diaspora and incentivize return migration. More systemic measures are needed to promote innovation and enhance interactions in science and technology with Armenians located abroad.²² The Armenian diaspora can serve as a valuable source of expertise and funding for innovative entrepreneurship domestically. While brain drain reduces opportunities for the most educated and entrepreneurial, the diaspora represents an asset of networks and resources.

3.17. Armenia’s capacity for attracting and retaining highly educated professionals is limited. On a scale of 1 to 7 (with 7 being the highest), Armenia scored 3.6 on the Global Competitiveness Index (GCI) for its efficiency in using talent. This is far behind more developed economies and reflects a downward trend since 2009. Armenia’s ranking for its ability to retain talent is even lower at 2.6 (Figure 3.10). This places Armenia near the bottom of its peer group, and only above Serbia (1.8) and Macedonia (2.5). The OECD average is 4.13, which is significantly higher than Armenia and its highest scoring peer Azerbaijan (3.5). Armenia’s score is, however, roughly in line with that of new EU members. Armenia ranked 2.5 in its ability to attract talent again placing it above Serbia and Macedonia but below other comparators and substantially below the OECD average (4.0).

Figure 3.10. Use and Retention of Talent



Source: GCI (2014-2015).

3.18. Armenian businesses do not perceive the supply of educated labor to be an issue, but they are concerned with the quality of education. A significant gap exists between the quality of professionals the economy requires and what is supplied by the Armenian education system.²³ According to a recent study the inadequate quality of human capital is a binding constraint on economic growth.²⁴ Similarly, the World Bank Enterprise Survey found that an inadequately educated workforce is among the top ten constraints for businesses in Armenia. Yet another survey revealed that a lack of highly qualified labor is the second most important constraint for business expansion after limited market size.²⁵

Box 3.3. Skills not just diplomas

The skills problem in the ECA region relates more to the quality and relevance of the education than to problems of access. Ministries of education are constrained in a number of ways from effectively managing their education and training sectors. The three most important and interrelated impediments to improving quality and relevance are the lack of systematic data on key skills-related performance issues (i.e., how much students are learning and whether they are finding jobs after they graduate), the legacy of central planning, and inefficient use of resources. Lack of data on student learning and employment outcomes makes it difficult for education ministries to address the legacy of central planning, which emphasizes centralized management based on inputs. Ministries of education in the region continue to micromanage the sector using detailed norms and regulations. This input-

²² In Spring 2008 the government initiated reforms aimed at implementing a coordinated and productive state policy on Armenia-diaspora relations. The Diaspora Ministry of the Republic of Armenia was created and was commissioned with the Elaboration of the Concept on Armenia Diaspora Partnership Development and the Elaboration of the Charter of the RA Ministry of Diaspora. The policy approach national authorities follow is the provision of incentives for the diaspora to visit Armenia (“Come Home”) in order to encourage return migration. Several initiatives also exist for collaboration with the Armenian diaspora: “Ayastan” All-Armenian Fund and support to Armenia Diaspora Conferences.

²³ EV Consulting (2014).

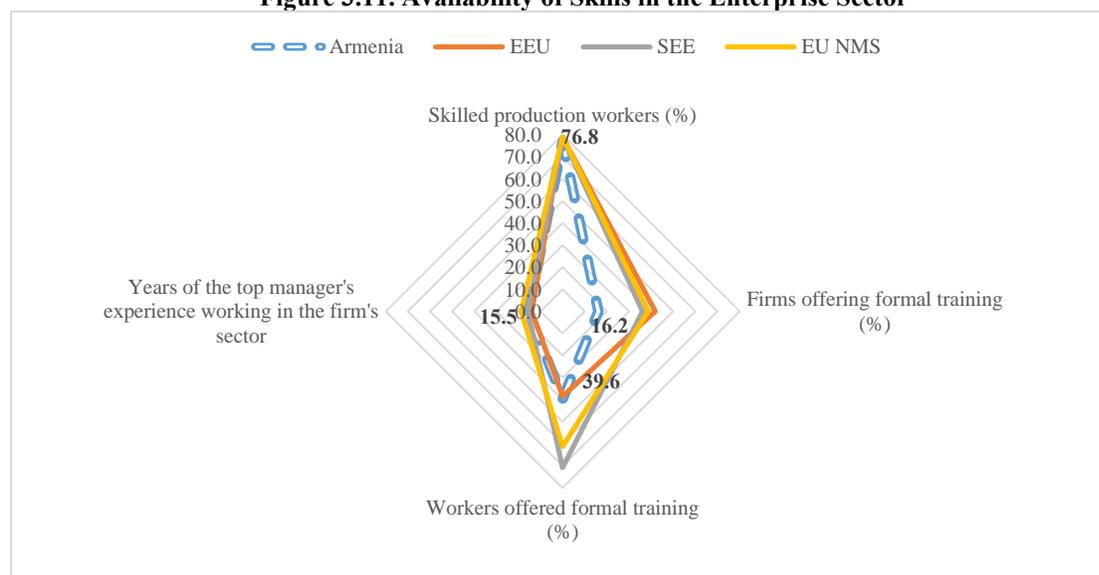
²⁴ Survey on Growth Constraints, EV Consulting, 2013; sample size – 48 local companies.

²⁵ EV Consulting (2014).

oriented style of management leads to the inefficient use of resources and results in a rigid education sector not the type of flexible sector needed to create modern, skilled workforces.

Source: Sondergaard et al. (2012).

Figure 3.11. Availability of Skills in the Enterprise Sector



Source: Enterprise Surveys 2012-2013.

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

3.19. While average skill levels in the private sector are high and managers are experienced, insufficient on-the-job training has limited worker productivity. According to the World Bank's 2013 Enterprise Surveys the Armenian manufacturing sector employs a large proportion of skilled workers (76.8 percent), which is in line with new EU members (79.3 percent), EEU partners (79.1 percent) and SEE countries (78.8). Average managerial experience levels are also on par with comparators at 15.5 years. However, Armenian firms lag behind their peers in providing on-the-job training to employees. Only 16.2 percent of Armenian firms provide such training, compared to around 40 percent in comparable countries. The share of workers receiving training is also relatively low at 39.6 percent. Insufficient on-the-job training opportunities can negatively affect labor quality, since this type of learning increasingly takes place after secondary or tertiary education. In the US it is estimated that on-the-job training contributes between 25 and 50 percent of all human capital.²⁶ Studies in OECD countries demonstrate that adult education and training significantly enhance worker productivity.²⁷

THE CREATION AND USE OF KNOWLEDGE

3.20. Armenia was an important center for science and technology during the communist period, and at its height it accounted for one-third of the electronics output of the USSR. The collapse of the

²⁶ Heckman et al. (1998).

²⁷ A study by the OECD (2004) shows, among other things, that employee training affects wage growth of young or highly educated employees, and that training of employees allows them to attain and maintain the competences required to bring productivity into line with market wages of older and low-educated workers.

Soviet Union weakened Armenia’s economic ties, disrupted financial flows, and radically altered supply and demand for R&D. Before 1991 the Armenian Academy of Sciences encompassed 25 institutes. 30 more operated under other state agencies and ministries, as well as 26 project institutes, 16 construction bureaus, 5 scientific laboratories, and 7 science research and normative research outlets. The government also operated more than 10 higher education and professional development institutions.

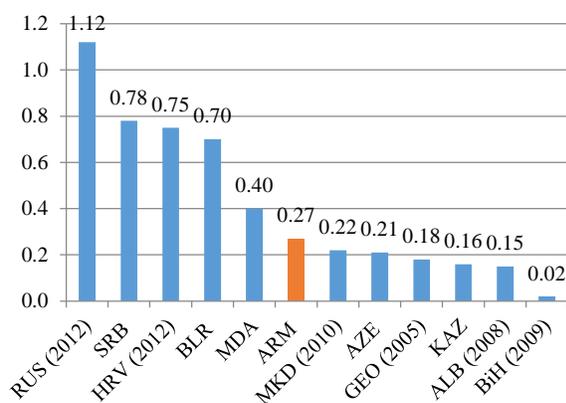
3.21. Armenia’s public research and science sector is part of its legacy as a former member of the Soviet Union. Under the USSR the country excelled in applied physics, chemistry and material sciences, particularly for military uses, and several private and public institutions were integrated into regional value chains. As in other former Soviet republics, however, the end of Soviet subsidies left many scientific professionals without work and encouraged an exodus of skilled scientists that continues today.

3.22. R&D intensity has decreased dramatically since the collapse of the USSR. Gross domestic expenditures on R&D as a share of GDP fell from 2.5 percent in 1990 to 0.27 percent in 2011.²⁸ This decline is also reflected in the number of researchers and research institutes. The former decreased by nearly 75 percent, while the latter fell by 50 percent.

3.23. Armenia displays low levels of R&D intensity compared to other transitional economies. Armenia invests much more than Georgia, Kazakhstan or Macedonia, but its level of R&D intensity is lower than Bulgaria, Croatia or Serbia. In 2011 R&D investment in Armenia represented 0.27 of GDP, when Bulgaria and Croatia invested 0.7 and 0.75 respectively. Average R&D intensity in EU countries stands at 2.1 percent of GDP.

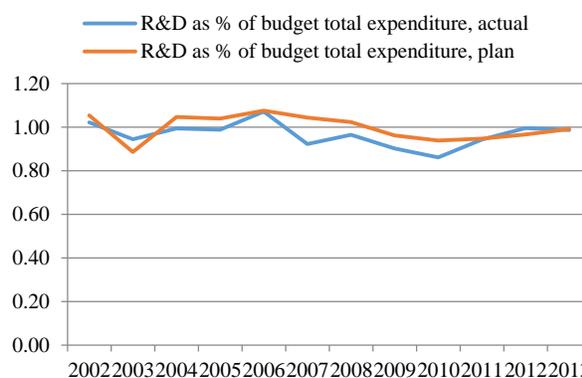
3.24. Most R&D spending is public, yet it amounts to just one percent of the national budget. The central government plays an important role in financing R&D, but expenditures have remained at around 1 percent of total spending (Figure 3.13). There is no information available on R&D spending by private firms, but the available evidence suggests that private research spending is minimal.

Figure 3.12. Gross Expenditures on R&D, 2011
(% of GDP)



Source: UNESCO Institute database.

Figure 3.13. Budgeted and Actual Expenditures on R&D, 2002-2013
(% of total government spending)



Source: Staff calculations based on MoF data.

3.25. Armenia’s science sector performs well by some measures. The 2014 Global Innovation Index (GII) notes the country’s weaknesses in education²⁹ and limited connectivity between the public and

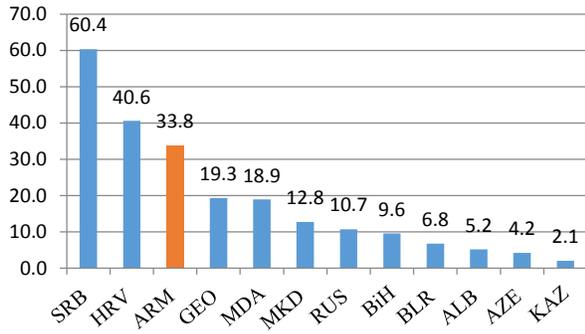
²⁸ See UNECE, 2014; INCONet 2014.

²⁹ Armenia ranks low in terms of public expenditure on education relative to GDP.

private sectors. Nevertheless, Armenia performs relatively well in terms of scientific publications. In 2013 it ranked above most of comparator countries and just below Croatia and Serbia. The quality of its publications is also high compared to peer economies.

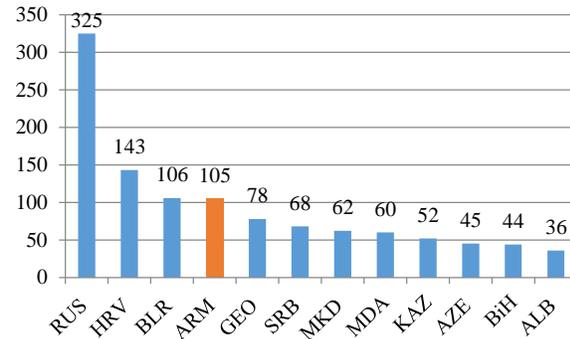
3.26. Armenian institutions tend to focus on basic research rather than applied sciences. Most Armenian research institutions specialize in different forms of basic research, focusing on chemistry, Earth and planetary sciences, material sciences, mathematics, physics and astronomy. During 2004-2013 physics and chemistry led overall publications, with 2,724 and 793 articles, respectively. By contrast, Armenian scientists made few contributions to applied fields such as engineering, which offer greater opportunities for productivity spillovers. Cross-cutting disciplines such as computer science also performed poorly despite the relative importance of Armenia’s ICT sector.

Figure 3.14. Scientific Publications, 2013
(per billion US\$ GDP)



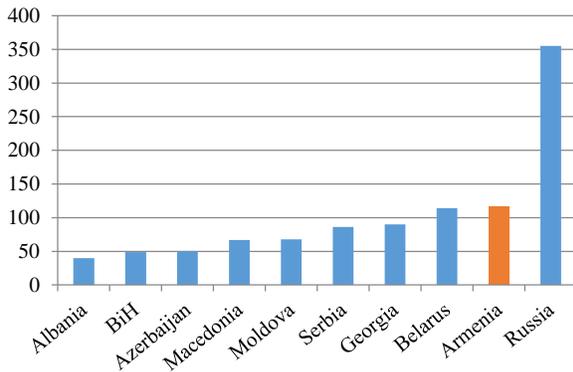
Source: World Bank and Global Innovation Index based on SCIMAGO Database (SCOPUS).

Figure 3.15. Citable Documents 2013



Source: SCIMAGO.

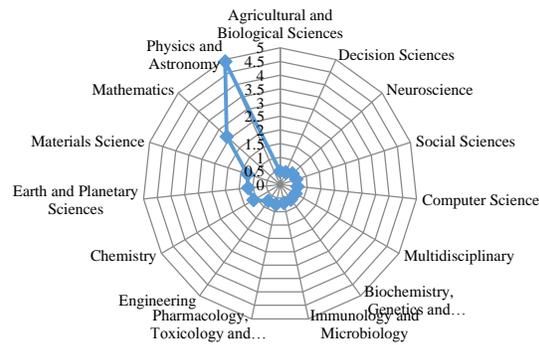
Figure 3.16. Quality of Armenian Research: H-Index of Scientific Publications (1996-2013)



Source: Staff calculations based on SCIMAGO (February 2015).

Note: The H index is the economy’s number of published articles (H) that have received at least H citations in the period 1993-2013.

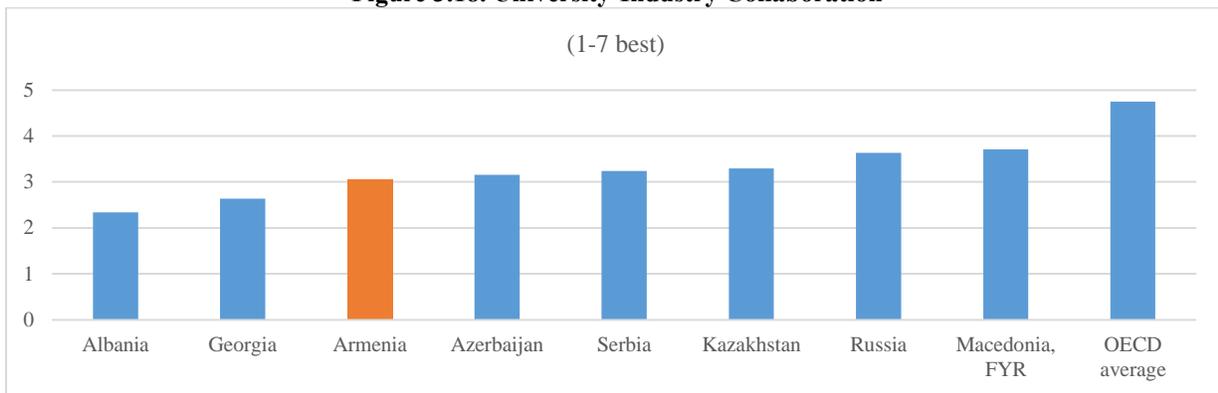
Figure 3.17. Revealed Scientific Advantage –The first 15 Scientific Disciplines (1996-2013)



3.27. Scientific achievements do not seem to impact national technological performance or firm-level innovation. Armenia ranks 90th out of 140 countries on GCI measures of business sophistication, which include knowledge-intensive employment, the number of firms offering formal training, the amount of R&D performed by businesses, cluster development, and the maturity of innovation linkages. This indicates that scientific output is not translated into economic value or diffused into the rest of the economy.

3.28. Cooperation between scientific institutions and private firms is infrequent due to supply and demand factors. Armenia scores poorly on the GCI dimension of university-industry collaboration, an area that is key for transforming academic research to commercial applications (Figure 3.18). Armenia scored 3.05 out of 7, above Albania and Georgia but behind most of its peers, including Azerbaijan (3.15), Russia (3.6) and Macedonia (3.7), and far behind the OECD average (4.7). Overall, Armenia's GCI score reflects an inability to foster knowledge diffusion. The overall orientation of research towards basic research discourages private-sector collaboration. Furthermore, the legal framework governing cooperation and linkages between the public and private sectors are not clearly defined, and there is no intermediary institution tasked with facilitating public-private collaboration. As discussed in the next chapter, a number of vital elements of a well-functioning national innovation system, such as efficient cooperation between education, science, R&D and industry are not yet in place, and their establishment will require a well-targeted long-term policy agenda.

Figure 3.18. University-Industry Collaboration



Source: GCI (2014-2015).

3.29. Armenia's weak technological performance is reflected in its relatively low number of patent applications per capita. Armenia is near the bottom of its benchmarking group with just 44 patent applications in 2013. The number of patent applications has decreased in the last decade from 68 per million people in 2002 (Figure 3.19). However, Armenia has performed better in trademark applications, which doubled from 811 to 1623 over the same period (Figure 3.20).

Figure 3.19. Patent Applications
(per million people)

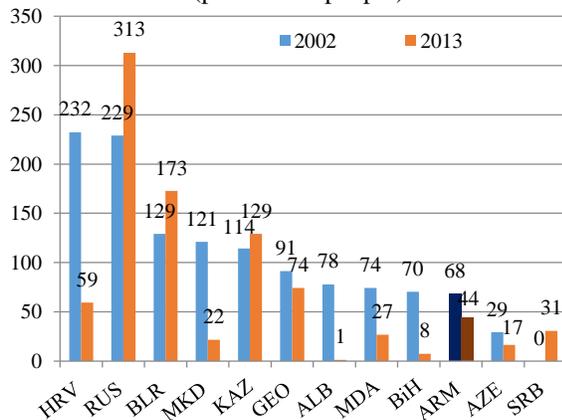
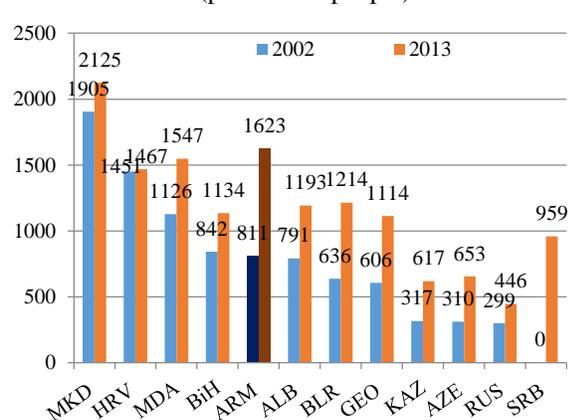


Figure 3.20. Trademark Applications
(per million people)



Source: World Development Indicators (World Bank).

3.30. Quality certification is relatively infrequent, which reduces economic confidence in Armenian firms. The number of ISO-9001 certificates remained at around 35 over the 2010-13 period, while ISO 14001 certificates were below 10 per year. The adoption of internationally recognized quality standards is critical to global competitiveness. By alleviating asymmetric information and signaling performance to external parties quality certification facilitates firms' integration into global value chains. Certification facilitates firm growth, and this effect tends to be more intense in developing countries, where buyers have greater difficulty acquiring information about sellers. Weaknesses in Armenia's quality infrastructure constrain the ability of Armenian firms to reap these benefits (Box 3.3).

Box 3.4. Armenia – National Quality Infrastructure

Armenia's national quality infrastructure suffers from significant weaknesses that hinder technology upgrading and undermine the competitiveness of its exports. Lack of modern quality infrastructure has severely constrained the ability of Armenian firms to move up the value chain or to find export markets. Most of Armenia's potential export destinations, including the EU, USA and Russia, often require higher certification standards than those applied domestically. As identified in the report on Quality Infrastructure prepared by the World Bank and PTB (the German Authority for Metrology), less than half of Armenia's domestic enterprises have obtained international quality certifications.

Significant reforms have taken place in the National Quality Infrastructure in recent years. Since the adoption of the "Strategy for the Reform of the Republic of Armenia's Quality Infrastructure (2010-2020) by the government in 2010, several major reforms have taken place; most notably new laws on Metrology, Standardization, Accreditation, and Certification in line with international best practice were developed with the support of donors and adopted in 2012. One of the most important reforms implemented as a result of the new laws was the transformation of the accreditation function from being a department within Ministry of Economy (MoE) into an independent NAB established in 2013 with an accreditation council represented by public and private sector stakeholders.

The major gaps identified in the National Institute of Metrology (NIM) include the fact that: (i) while the agency is overstaffed, personnel skills are obsolete due to lack of training, and therefore staff are not well versed in industrial metrology procedures, (ii) the premises for metrology activities is not suitable for operations and in dire need of renovation, (iii) equipment is outdated and non-functional and needs to be upgraded, and (iv) as a consequence of the above, internationally recognized metrology procedures are not currently applied and need to be adopted. The newly created National Accreditation Body (NAB) does not have the skills or funding to fulfill the mandate of NAB or to achieve the goal of international recognition in the future. The National Institute of Standards (SARM) is in better condition than the other Quality institutes; however, significant effort is required to attain the goal of the government to be able to support the dual standards of GOST and the ISO.

LEVERAGING KNOWLEDGE

3.31. Strong institutions and complementary markets are essential to a knowledge-based economy. As illustrated by the benchmarking exercise presented above, Armenia suffers from weaknesses in governance, limited ICT use, low workforce skills and an inadequate knowledge base. Institutional deficiencies are the most critical, since they shape the incentives of knowledge creators and users, affecting all four dimensions of the knowledge economy.

3.32. Armenia has made significant progress in strengthening the formal rules for doing business, but informal norms prevent the creation of a level playing field. Armenia has made remarkable strides in improving regulatory efficiency, and it performs well on most dimensions of doing business. However, these reforms will be unable to stimulate investment and innovation so long as informal practices continue to pervade the private sector. Altering established behaviors is not easy, as it requires confronting powerful vested interests that have a strong stake to impede the creation of a level playing field.

3.33. ICT production is robust in Armenia, but ICT use is limited. In recent years Armenia has developed a vibrant ICT sector, which is almost entirely focused on exports. Its success is due to in large part to its limited interaction with the domestic governance environment, and it has little incentive to integrate into domestic markets. Yet the experience of more developed countries shows that sustained growth comes from the diffusion of ICT to the entire economy. In Armenia ICT use is limited to basic functions, and local internet content and e-commerce systems are underdeveloped.

3.34. The supply of workers with advanced qualifications in science and engineering is very limited, and enterprises do not invest in workers' skills. Armenia's human capital stock has been significantly depleted since the collapse of the Soviet Union. The persistent effects of brain drain and a paucity of new graduates, especially in science and engineering, have diminished the pool of scientific professionals available to both the public and private sectors. Furthermore, private firms do little to invest in the skills of their employees, which is a crucial supplement to formal education.

3.35. Public and private investment in the creation of knowledge is low, and knowledge use in the economy is inadequate. Armenia's scientific and technological base is eroding over time. Public investment in R&D is low, and private investment is almost nonexistent. Armenian firms have few incentives to innovate and rarely collaborate with research institutions. The economic impact of public R&D is diminished by a general focus on basic research rather than applied sciences, administrative capacity constraints in the research sector, and a lack of market incentives for firms to seek scientific and technological support.

4. The National Innovation System

A national innovation system is the set of institutions, policies and funding arrangements that support the creation and use of knowledge. The Armenian authorities have taken important steps to establish the legal and regulatory framework for science, technology and innovation (STI). However, the government's STI policies are not well aligned with the objectives of the country's research institutions or the incentives of the private sector. Just 1.2 percent of the government budget is devoted to STI, and public funding is primarily focused on basic research. Meanwhile, direct collaboration between scientific institutions and private firms is almost nonexistent due to regulatory obstacles, capacity constraints and a lack of private-sector demand. Progress has been made in facilitating international cooperation, but opportunities to connect with the country's scientific diaspora remain underexploited.

4.1. A sound innovation framework is fundamental to the development of a knowledge economy. A country's aggregate ability to create and use new forms of knowledge depends on a wide range of factors, including education levels, international openness, the quality of governance, the intensity of domestic market competition, and the protection of intellectual property. However, many governments ignore these fundamental prerequisites and instead focus on a narrower set of policies intended to stimulate science, technology and innovation (STI). Yet the STI output cannot be accelerated without first establishing an adequate legal and institutional framework based on the four pillars of a knowledge economy: good governance, ICT development, human capital and knowledge creation.

4.2. This chapter describes Armenia's national innovation system. A national innovation system is the network of public and private actors, policies and funding arrangements through which new forms of knowledge are produced. According to the OECD (1997), "The concept of national innovation systems rests on the premise that understanding the linkages among the actors involved in innovation is key to improving technology performance. Innovation and technical progress are the result of a complex set of relationships among actors producing, distributing and applying various kinds of knowledge. The innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a collective system of knowledge creation and use as well as the technologies they use. These actors are primarily private enterprises, universities and public research institutes and the people within them."³⁰ In light of the potentially transformative role of the national innovation system, this chapter focuses on two key questions:

- Is Armenia's legal and strategic framework capable of supporting the development of a successful and dynamic national innovation system?
- Are the country's policy implementation mechanisms and funding arrangements adequate to achieve the government's objectives for the knowledge economy?

THE LEGAL AND STRATEGIC FRAMEWORK FOR INNOVATION

4.3. Armenia's primary public research and development (R&D) agency is the State Committee of Science (SCS).³¹ Established in 2007 as part of the Ministry of Education and Science, the SCS is tasked with developing and implementing the government's STI policies and R&D programs. Its main objectives include: (1) increasing STI output and training scientific personnel; (2) promoting the development of a science sector that supports economic productivity, government efficacy, national defense, and positive

³⁰ OECD (1997), p. 9.

³¹ The SCS was established by Presidential Resolution N 231, 1 October, 2007.

social and cultural outcomes; (3) elaborating and implementing national STI policy; and (4) supporting investment in basic and applied research. It operates under three principal financing mechanisms: (i) current expenditures, (ii) targeted programs, and (iii) additional contractual or thematic funding.

4.4. The National Academy of Sciences (NAS) is Armenia’s main implementing agency for R&D projects. The NAS coordinates the country’s network of public research institutions, and it plays an important role in elaborating and implementing the national STI strategy. The Ministry of Economy is responsible for designing and implementing innovation policy in coordination with the Ministry of Education and Science and other ministries and organizations. These stakeholders jointly invest in R&D and, in principle, provide a two-way link between research institutions the public and private sectors.

4.5. Since the early 2000s the government has produced a series of policy documents establishing the current legal framework and strategy for the STI sector. The Law on Scientific and Technological Activity passed in 2000 defines the relationship between R&D organizations, public agencies, and consumers in the public and private sectors. It emphasizes the importance of promoting innovation and commercializing research outcomes as a driver of economic growth. The 2006 Law on State Support for Innovation and the 2011 Law on the National Academy of Sciences complete the modern framework for STI.

4.6. These laws establish the NAS as the highest self-governing scientific organization, with the authority to undertake and coordinate basic and applied research. The NAS is a major government agency, and the head of the NAS participates in government sessions. Its current expenditures are included as a line item in the national budget. However, additional funding for targeted programs or under contractual arrangements involves a competitive bidding process with the SCS and other Armenian research institutes.

4.7. The government has drafted a set of complementary strategies aimed at building a knowledge-based economy. Armenia is striving to create a private sector in which intellectual power and knowledge-creation accelerate economic growth and promote social development. This is reflected in the current national strategies for innovation, industrial development and science.³² These documents focus on short- and medium-term objectives, some highly ambitious, and include a number of specific policy measures.

4.8. The authorities are working to modernize Armenia’s innovation system. Its efforts include reforming public institutions and strengthening the country’s research networks. The government is also attempting to build the national capacity for R&D and develop an STI sector capable of meeting the challenges set out in its national strategies.

Box 4.1. The Three Horizons of the National Innovation Strategy

In February 2011 the government approved the concept paper for the Initial Strategy for the Formation of an Innovation Economy, based on research conducted by the Ministry of Economy, as well as measures to build the country’s legal, business, educational, financial and innovation infrastructure. The government’s strategy is based around a set of three “strategic horizons.”

³² National strategies for STI serve several functions. First, they articulate the government's vision regarding the contribution of STI to social and economic development. Second, they set priorities for public investment in STI and identify the focus of government reforms (e.g. university research funding and evaluation systems). Third, the development of these strategies can serve to engage stakeholders ranging from the research community, funding agencies, business, and civil society to regional and local governments in policy making and implementation. In some cases, national strategies outline the specific policy instruments to be used to meet a set of goals or objectives. In others, they serve as visionary guideposts for various stakeholders (OECD, 2013).

- **Horizon 1: The Development of Existing Resources (2011-2014)**

Goals: Formation of the NAS

Measures: (i) Legal reforms; (ii) Development of supportive financial and physical infrastructure; (iii) Private-sector engagement; (iv) Educational modernization; and (v) System-forming measures.

- **Horizon 2: Expansion and Capacity Building (2011-2017)**

Goals: (i) Adoption of international standards in the private sector; (ii) Harmonization of educational credentials with international standards; (iii) Establishment of new STI institutions; (iv) Support for innovative startup firms; and (v) Technological modernization of existing firms.

- **Horizon 3: Establishing Armenia as a Global Center for R&D (2011-2020)**

Goals: (i) Creation of an internationally recognized engineering university and national science laboratory; (ii) Global leadership in R&D on par with Israel, Singapore and Ireland; and (iii) Worldwide expansion of Armenian technology companies.

The strategy's ultimate goal is to attract leading global technology companies to Armenia and support the globalization of Armenian technology firms.

Source: Initial Strategy for the Formation of an Innovation Economy, concept version, February 7, 2011.

4.9. STI policies are guided by the Strategy for the Development of Science (SDS) and the Science Development Action Plan (SDAP). The SDS (2011-2020) lays out the government's strategic vision for building a competitive knowledge-based economy, while the SDAP (2011-2015) operationalizes this vision through active support to R&D activities. The overarching objective of the SDS and SDAP is for Armenia to become competitive within the European Union in basic and applied research. The SDS targets: (i) the creation of an institutional system for the sustainable development of science and technology; (ii) the efficient production of scientific outputs and the modernization of research infrastructure; (iii) the promotion of advances in basic and applied research; (iv) the exploitation of synergies in education, science and innovation; and (v) the development of an international reputation for scientific excellence.

4.10. The SDAP focuses on a set of operational objectives. These include: (i) improving the management of the STI sector and ensuring its sustainable development; (ii) increasing the number of new specialists entering the research, education and technological development fields, and upgrading educational and research infrastructure; (iii) creating the necessary conditions for the development of integrated STI systems; and (iv) fostering international cooperation in R&D. Disciplines of particular focus include Armenian Studies; Humanities and Social Sciences; Life Sciences; Renewable Energy and New Energy Sources; Advanced Technologies, Information Technology; Astronomy and Space Sciences; Earth Sciences and Ecological Sustainability; and Foundations of Applied Research.

4.11. Innovation policy is set by the Ministry of Economy. Its primary strategic documents are the Initial Strategy for the Formation of the Innovation Economy (ISFIE) and the Strategy for Export-led Industrial Policy (SEIP). ISFIE envisions Armenia's transformation into an R&D center for multinational corporations, with key milestones up through 2020 including legal reforms, the development of innovation and business support institutions and instruments, educational modernization, the adoption of international standards, the establishment of national centers of excellence in innovation, and the global expansion of Armenian technology companies. The ISFIE explicitly addresses the development of the NAS's infrastructure and systemic capabilities. The strategy enjoys broad political support and makes use of a wide range of policy instruments.

4.12. The SEIP guides industrial policy toward the objective of transforming Armenia into a producer of high-value, knowledge-intensive goods and services. Armenia is attempting to shift its export profile from a focus on resource-based industries toward increasingly skill- and knowledge-

intensive sectors. Its long-term goal is to foster economic diversification by expanding currently export sectors and those with export potential, with particular emphasis on small and medium enterprises.³³ Priority industries include mining and metallurgy, light manufacturing, food production, jewelry, machinery, precision instruments and industrial chemicals.

4.13. **Armenia has also promulgated a national strategy for the growth of the ICT sector.** In December 2000 the government declared ICT a priority sector and established the ICT Master Strategy, and in July 2001 the IT Development and Support State Council was founded. The Master Strategy identifies goals and proposes measures designed to increase the global competitiveness of the Armenian ICT industry.³⁴ In 2008 the government followed up by adopting a 10-year ICT development strategy focused on building infrastructure, increasing workforce skills, and creating financing mechanisms for start-up companies.

INSTITUTIONS, FUNDING MECHANISMS AND POLICIES

Key Agencies

4.14. **The NAS and SCS are Armenia’s two main implementing agencies for R&D, but they are not the only important actors in the sector.** While the NAS is the highest self-governing organization devoted to basic and applied research, other relevant agencies include the National Center of Innovation and Entrepreneurship (NCIE) and the Enterprise Incubator Foundation (EIF).

Box 4.2. The Enterprise Incubator Foundation (EIF)

The EIF is one of the largest technology startup promoters and consulting companies in the region. Established in 2002 under the framework of the World Bank’s “Enterprise Incubator” project, its stated goal is to support the development of the Armenian technology sector by creating a supportive environment for innovation, technological advancement and company growth. EIF activities cover every aspect of sector development, including technology-related legal, business and educational reforms, opening investment channels and creating funding schemes for startups, and providing business consulting and workforce development services. The EIF is a nexus for public and private institutions, international organizations, government agencies, and firms ranging from major multinationals to small startups.

The objectives of EIF are to: (i) develop an effective ICT infrastructure to enhance technological progress and speed the transition to a knowledge-based economy; (ii) expand nationwide access to computers and internet; (iii) promote Armenian technology firms and increase their global competitiveness; (iv) create new channels for attracting FDI to the Armenian technology sector; (v) build linkages with businesses and research networks both in Armenia and abroad; (vi) foster the establishment and growth of startups; (vii) enhance the professional skills of the domestic workforce; and (viii) improve local firms’ access to international experience and best practices.

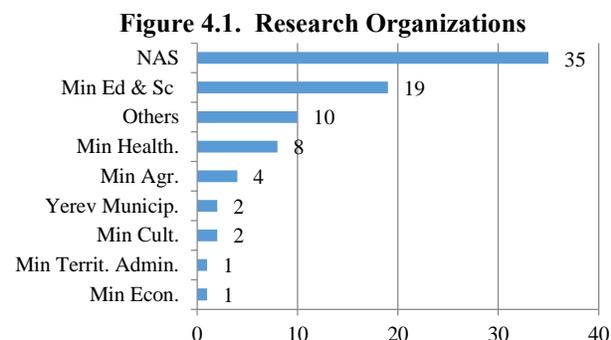
Source: USAID (2013).

4.15. **The NCIE operates under the authority of the Ministry of Economy and plays an important role in shaping innovation policy.** The NCIE promotes the commercial application of innovative ideas and new forms of intellectual property, and it provides scientific and technical information services to entrepreneurs. The NCIE also finances the gathering of information on industries and markets, as well as assessments of potential investment projects.

³³ This policy framework attempts to coordinate all the activities and tools used by the government to boost the development of the real economy. Sectoral strategies are being developed based on this policy framework, and the initiative will complement other sectoral and cross-cutting initiatives.

³⁴ The strategy identifies the following actions as critical to boost Armenia’s global competitiveness of the Armenian ICT sector: (1) make better use of the strong mathematical, algorithmic, and logical capacities of the country’s existing professionals; (2) leverage the ICT resources of the Armenian diaspora to promote investment; (3) attract and retain educated professionals to the ICT sector; and (4) maximize the value of limited resources by creating a culture of collaboration among Armenian ICT firms.

4.16. **A number of other agencies are involved in innovation.** The Armenian Development Agency (ADA) is tasked with implementing the Strategy for Export-led Industrial Policy and with attracting increased FDI. It serves as a one-stop shop for foreign investors. The Industrial Development Fund, a separate organ of the Ministry of Economy, is charged with implementing industrial policies, including those administered by ADA. The Small and Medium Entrepreneurship Development National Center of Armenia supports small and medium enterprise (SME) development by providing information, training and consulting services. It also offers financial support through a number of instruments, such as loan guarantees for startups and SME expansions, as well as franchising programs and international assistance. The National Competitiveness Foundation is a public-private partnership that draws on international business executives of Armenian origin to attract FDI and promote economic development and international competitiveness.



Source: SCS.

Research Institutes

4.17. **In 2012 there were 82 research organizations in Armenia.** These organizations operate under various ministries, as well as the NAS and the Yerevan Municipal Government. The NAS alone encompasses 35 research institutions. Leading organizations include the Yerevan Physics Institute, a prominent center for high-energy physics research, as well as the Yerevan Computer Research and Development Institute and the Yerevan Automated Control Systems Research Institute.

4.18. **Most of these organizations are focused on basic research.** In many developed countries public research organizations concentrate on specific technologies and applied research, but the NAS institutes are oriented toward basic research, often with no clear application. And whereas public research organizations in OECD economies often enjoy strong linkages with the private sector, few NAS institutes have meaningful connections with private firms.

4.19. **The SCS is currently developing an evaluation system for public research organizations and projects.** Two types of evaluation are being considered: (i) an evaluation of ongoing research activities based on 7 criteria and 43 sub-criteria, and (ii) an evaluation of 3- and 5-year scientific programs. The 7 criteria used by type (i) evaluations are: research; personnel; infrastructure; integration with international research; integration with the higher education system; commercialization of research results; and financial activities. The results of the evaluation will influence future financing decisions.

4.20. **Steps have been taken to improve coordination among research organizations.** Acknowledging the fragmentation of resources across institutions and the need for better public research management, the NAS has pursued a set of reforms designed to improve research performance and maximize the impact of limited resources. In 2006 the government adopted a resolution to strengthen the NAS's infrastructure and reorganize some of its institutes. For example, the government created the Scientific and Technological Center for Organic and Pharmaceutical Chemistry by merging of the Institute of Fine Organic Chemistry with the Institute of Organic Chemistry and the Molecular Structure Research Center.³⁵

³⁵ IncoNet (2014).

4.21. **However, little progress has been made in promoting the commercial applicability of public research.** The 2011 Law on the National Academy of Sciences emphasized the commercialization of public research, but few practical steps have been taken to accomplish this objective. Nevertheless, the law explicitly empowered the NAS and its institutes to actively promote commercial applications.

4.22. **Current legislation does not regulate attribution and the commercial exploitation of intellectual property rights resulting from publicly financed research.** Unlike many advanced economies, Armenian universities and other academic institutions are not guaranteed ownership over their research products. This greatly reduces incentives to develop commercially applicable outputs. Rules governing ownership and revenue rights for intellectual property differ widely across institutions, and few organizations have adopted policies based on international best practices. There is no legal obligation for research organizations to specify internal rules for intellectual property or include such rules in employment contracts. Moreover, there are currently no national laws establishing ownership of collaborative research products.

4.23. **Government approval is required to commercialize new technologies, which reduces prospective revenues for research organizations.** The Law on State Non-Commercial Organizations mandates that research institutions acquire government approval before selling their research products. However, there are some exceptions, including the Charter of Yerevan State Medical University, which allows university involvement in a wide range of business activities. And several institutions, including the State Agrarian University, have started reforming their legal status in order to access new funding sources and expand their private sector linkages.

Universities

4.24. **The Armenian higher education system consists of 22 public institutions and over 70 private institutions.** There are also 4 international universities established through bilateral agreements. Armenia's leading universities are Yerevan State University, the State Engineering University of Armenia, the State Medical University, the State Agrarian University, the Russian-Armenian State University, the French University, and the American University of Armenia.

4.25. **After the fall of the Soviet Union research and teaching in Armenia were administratively divided, with the former exclusively confined to the NAS.** There are no aggregate statistics on R&D among Armenian universities that would allow an analysis of recent trends. However, observations and interviews indicate that university R&D is modest but gradually increasing, particularly in leading state universities. One advantage of universities over public research institutes is that the latter have greater flexibility in allocating revenue.³⁶ Yet Armenian universities lack modern technological infrastructure, including internal information networks and digital libraries linked to international databases.

4.26. **From a public policy perspective research undertaken by higher education institutions and individual academics is underdeveloped and undervalued.** In a recent study Armenian academics consistently described the purpose of university education as reproducing existing knowledge rather than producing new knowledge, and stated that knowledge creation plays a negligible role in universities.³⁷

4.27. **Public policies do little to stimulate university research.** A 2013 World Bank report found that the existing legislation “neither allows nor motivates [higher education institutions] to be actively engaged in R&D”. University professors are not required to conduct research, and those who wish to do so often have limited time and resources—particularly since Armenian professors often work for multiple

³⁶ *Ibid.*

³⁷ See: “Higher Education in Armenia Today: a focused review”-Report for the Open Society Foundation, Armenia CEU Higher Education Observatory, Budapest, July 2013.

institutions. Of the professors who do conduct research many appear to prefer theoretical inquiries, which require fewer financial resources.

4.28. **The lack of university research undermines the quality of higher education.** Many advanced degree programs, especially in science, technology, engineering and math, should require research studies as an essential component of the discipline. University research also helps promote new research careers, and it can attract talented, inquisitive students to science and technology.

4.29. **The quality of higher education in Armenia is generally weak.** Armenia ranks low in key indicators, including the effectiveness of management schools, the availability of research and training services, and access to on-the-job training opportunities. Public spending on education relative to GDP is also very low by international standards.

4.30. **Higher education reforms have allowed the establishment of private universities and introduced a quality-assurance system.** In 2005 Armenia officially joined the Bologna Process, and in 2010 it became part of the European Higher Education Area. The Ministry of Education and Science is currently reforming the structure, content and management of higher education, in an effort to further integrate Armenia into the European Higher Education Area. In addition, higher education institutions are subject to national quality standards set out by the Armenian National Centre for Professional Education Quality Assurance Foundation.³⁹

4.31. **Current legislation limits the ability of higher education institutions to engage in commercial activities and collaborate with industry.** Both the Law on Higher Education and the Law on State Non-Commercial Organizations, mentioned above, constrain university engagement in the private sector. The Law on Higher Education defines higher education institutions as separate legal organizations and the Law on State Non-Commercial Organizations stipulates that the founder is responsible for final decisions. Higher education institutions are not legally required to follow a sample charter developed by the Ministry of Education and Science. Most state universities, however, have adopted the sample charter voluntarily.

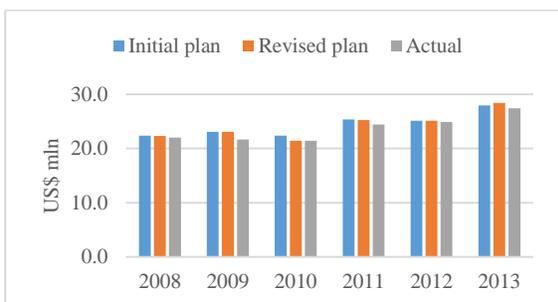
4.32. **Aligning education programs with private sector demand is a priority challenge.** Greater educational responsiveness to changing labor market conditions is an essential prerequisite for the development of a knowledge-based economy. As discussed in Chapter 3, a lack of human capital is a binding constraint on business development in Armenia.

Funding for Science, Technology and Innovation

4.33. **STI spending is not a high priority in the national budget.** In 2014 the STI budget was just 1.2 percent of the total government budget. The annual STI budget averaged US\$24.3 million during 2008-2013. The budget-execution rate was close to 100 percent (Figure 4.2), though actual disbursements have fallen short of allocations in recent years, reflecting a government-wide trend in the capital budget. STI spending declined marginally in real terms in 2009 and 2010, falling by 1.6 and 1.2 percent, respectively, then grew by 8.6 percent per year over 2011-2013 (Figure 4.3).

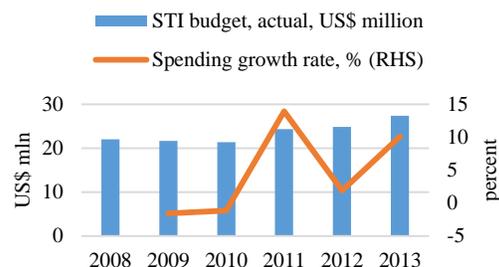
³⁹ This organization conducts external quality assurance in accordance with the norms set by the national legislation and regulations, as well as with European Standards and Guidelines. It also developed Guidelines, Criteria and Standards for Quality Assurance taking into account the local needs and international good practices, and it has developed a Strategic Plan for the Transitional Period 2011-2015 to establish a quality culture at tertiary level. The quality assurance framework includes mandatory institutional audit and voluntary program accreditation.

Figure 4.2. STI Budget, 2008-2013
(in US\$ millions)



Source: MOF and World Bank staff calculations.

Figure 4.3. The Evolution of the STI Budget, 2008-2013
(in US\$ millions and %)



4.34. The STI budget is executed more consistently than the overall budget. During 2009-13 the STI budget grew at a lower average rate than total expenditures. At the budget-revision stage total expenditures were increased by between 3.2 and 9.2 percent, while STI spending was either left unchanged or decreased. The only exception is 2013, when the STI budget was revised upwards by 1.7 percent due to an increased allocation for the Center for the Advancement of Natural Discoveries using Light Emissions.

Figure 4.4. Composition of the STI Budget by Program, 2008-2013
(in %)

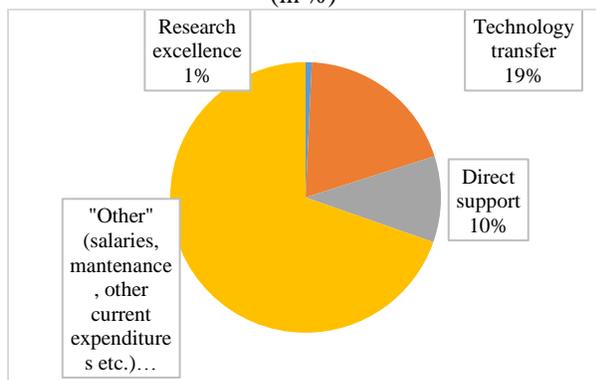
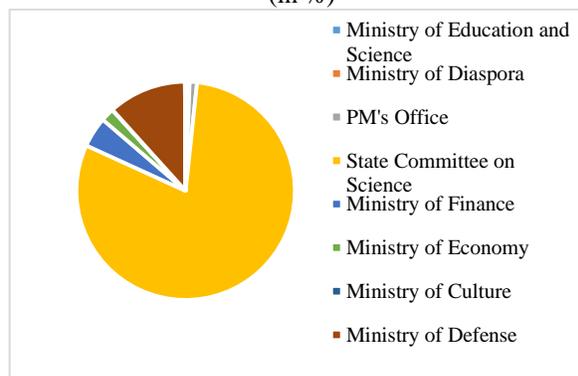


Figure 4.5. Execution of the STI Budget by Agency, 2008-2013
(in %)



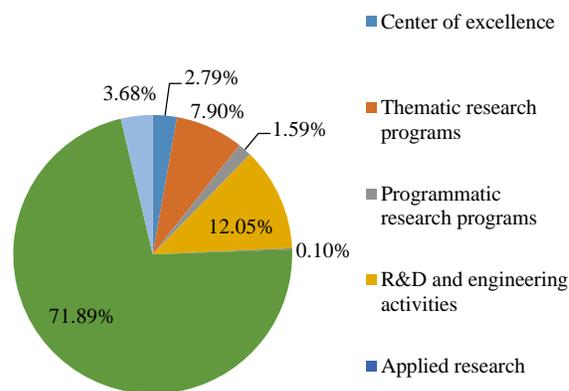
Source: MOF and World Bank staff calculations.

4.35. Total STI budget is heavily concentrated in terms of both programs and spending agencies. 70 percent of the total budget is devoted to “Other Expenditures” (Figure 4.4), which primarily covers the basic operating costs of the country’s research institutes. The SCS is the major spending agency, responsible for 80 percent of the total STI budget, followed by the Ministry of Defense at around 12 percent (Figure 4.5).

4.36. Little funding is allocated to programs directly linked to R&D. Direct R&D support represents only 10 percent of the STI budget. More resources are distributed through the SCS, which limits the role of line ministries in mainstreaming R&D into policymaking and program implementation.

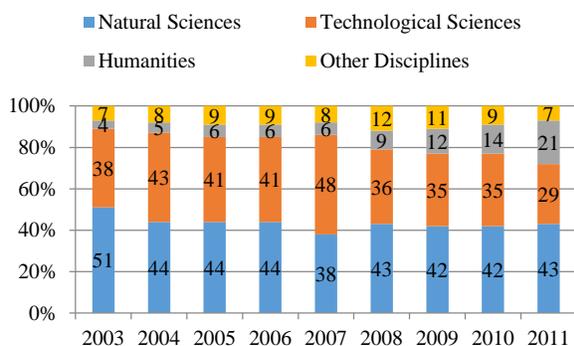
4.37. **Only 15 percent of the total STI budget goes to applied research.** In 2013 the three largest STI programs focused on maintaining infrastructure and building scientific capacity (72 percent); R&D and engineering activities (12 percent); and thematic research programs (8 percent). Applied research programs represented only 3 percent of the budget and programmatic research programs 0.02 percent (Figure 4.6). While some R&D and engineering programs involve applied research, combining this category with “applied research programs” yields a total of just 15 percent of the STI budget dedicated to applied research. This share is far below global averages. Although cross-country data are not directly comparable, applied research⁴⁰ represents more than 30 percent of gross STI expenditures in most new EU members, such as Bulgaria (72.5 percent in 2013), Romania (39.2 percent in 2012), Croatia (36.9 percent in 2011) and Hungary (36.3 percent in 2012).

Figure 4.6. The STI Budget by Program, 2013
(in %)



Source: MOF and World Bank staff calculations.

Figure 4.7. Public Research Spending by Discipline
(in %)



Source: Statistics on Science 2003-2013, Armstatbank.am.

of the ISFIE and SDS, both of which target the creation of a technology-driven economy based on the commercial application of science.

4.39. **Consolidating the Ministry of Economy’s science programs within the 2014 STI budget increases the total by 13.1 percent.** In addition to programs listed under the “science” category, the Ministry of Economy implemented several STI-related programs under other budget lines. In 2014 these programs included: (i) ICT support; (ii) sector-specific R&D; (iii) financing for the National Competitiveness Foundation; (iv) certain export-oriented industrial policies; (v) the establishment of a

4.38. **Armenia’s expenditure patterns are not consistent with national strategies, which emphasize the development of new technologies and the commercial application of research.** Over 2003-2011 the share of natural sciences in total research spending has fallen from 89 percent to 72 percent. Technological sciences experienced the largest single drop, from 51 percent to 43 percent. Spending on humanities research, meanwhile, has dramatically increased, rising from 4 percent to 21 percent over the period. The share devoted to agricultural sciences is small and has been gradually diminishing. Public funding for R&D does not appear to be well aligned with the goals

⁴⁰ Applied research is defined according to the OECD’s Frascati Manual. See: <http://www.oecd.org/innovation/inno/frascatiannualproposedstandardpracticeforsurveysonresearchandexperimentaldevelopment6thedition.htm>

nuclear medicine center; and (vi) the protection of intellectual property rights. The overall budget-execution rate for the Ministry of Economy's STI-related programs was 96.1 percent, and spending on categories (ii), (iii) and (v) was executed at 100 percent. Category (vi), the protection of intellectual property rights, had the lowest execution rate at 84.8 percent.

Public Research Programs

4.40. **State R&D programs are financed through basic, targeted or thematic funding.** Basic funding covers 191 programs in public research institutes and universities. Targeted funding covers 12 programs in both public and private research institutes and universities. Thematic funding targets individual researchers, doctoral students and research teams with a maximum of 5 members. It encompasses researchers from both public and private research institutions.

4.41. **Competitive financing, including peer review, supports one-third of scientific research projects.** Shortly after the creation of the SCS in 2007 competitive financing was introduced to complement basic funding of public R&D institutions. Targeted and thematic funding are both competitive, and projects are evaluated by independent peer reviewers. In 2013 the peer-review system comprised 1,500 independent experts.

4.42. **Funding for large-scale public research projects is being expanded.** In accordance with the strategic orientation of the ISFIE and SDS the government's priority public research initiatives include the Alikhanyan National Science Laboratory's Yerevan Physics Institute, the Center for the Advancement of Natural Discoveries using Light Emission, and the Armenian Center for Excellence in Oncology.

Human Capital Development and Labor Mobility

4.43. **The authorities have launched a number of initiatives designed to support the professional development of young scientists.** Special funding programs for researchers under the age of 35 include project-based financing, stipends, funding for international conferences and summer courses, financial support for publications, funding for equipment and materials, and thematic funding for scientific teams comprised mainly of young scientists.

4.44. **However, much more could be done to encourage return migration among young scientists and to strengthen links with Armenian scientists studying or working abroad.** Few post-doctoral positions are available in Armenian universities, which discourages the return of doctoral students studying abroad. Low salaries for Armenian scientists create a further disincentive. While some funding is available for international collaboration, there are no specific programs aimed at connecting national researchers with Armenian scientists working outside the country.

Research and Innovation Infrastructure

4.45. **Steps have been taken to improve research infrastructure.** In 2008 the government published two key strategic documents, "The Creation of Scientific Innovation Structures at Universities and Large Scientific Centers" and "The Order, Criteria and Principles for Establishing Scientific Centers." Policy guidelines for the establishment of research universities are currently being developed, and the SCS recently established a funding program for research infrastructure.

4.46. **The NAS is actively supporting innovation through targeted initiatives.** These include the creation of the Science Development Foundation to support research activities with innovative potential, develop commercial applications for research outcomes and promote infrastructure modernization. A set

of innovative research projects has been compiled and will be submitted to the authorities together with plans to establish a dedicated technology transfer office.

4.47. Innovation centers are a key element of the national innovation infrastructure, and many operate with a combination of public and private financing. The Gyumri Technology Center (GTC) focuses on the development of technical and business skills. It supports technological entrepreneurship, facilitates the commercialization of innovative research, promotes the creation of new technology companies, and works to increase foreign investment in the sector. The Armenian-Indian Center for Excellence in ICT is a joint initiative between the Armenian and Indian governments. The center provides specialized infrastructure for the delivery of IT-related training and R&D. The Microsoft Innovation Center of Armenia (MIC Armenia) was established in May 2011 and focuses on providing support to IT startups. The IBM Innovative Solutions and Technologies Center works to develop and strengthen the technological educational capabilities of Armenian higher educational institutions. Since 2008, the Ministry of Economy has received allocations from the state budget to support Gyumri Technopark. The aim is to turn Gyumri into a Center of Excellence for education and research, for IT, and generally hi-tech projects and startups.

4.48. The standardization of academic qualifications credentials, and accreditation systems is an important component of the government's agenda for upgrading the national STI infrastructure. The 2010-2020 reform strategy is aimed at achieving compliance with international and European standards. Reforms will focus on qualitative metrics, certification standards, technical regulations and market controls. Issues that significantly impede the development of export sectors will be prioritized.

Collaboration with the Private Sector

4.49. The current legal framework does not encourage the development of productive relationships between the science sector and private firms. The regulatory constraints described above and an overall lack of clarity regarding rules and procedures limit scientific organizations' engagement in commercial activities.⁴¹ Consequently, the current system does not encourage the commercial application of research.

4.50. The absence of a mediating organization is a major obstacle to public-private collaboration in STI. Public research organizations face an unclear and generally adverse regulatory environment that inhibits their engagement with the private sector; meanwhile, private firms lack information on the potential benefits of working with public researchers. Without an institutional catalyst to promote public-private collaboration even the recently created "technoparks" and other modern research facilities cannot effectively commercialize R&D outcomes.⁴²

STI in the Private Sector

4.51. The government offers a small matching grant program to support R&D by private firms, but venture financing is virtually absent. In 2011 the SCS launched a new program to provide competitive matching grants for research projects undertaken by private firms. Currently, 75 percent of these grants are publicly financed, with the other 25 percent financed by the firm. In 2011 17 projects were funded by matching grants, and 16 more were funded in 2013. Financing is provided for up to 16 months, with a maximum amount of AMD 25 million.

4.52. Armenia's tax code includes incentives for private R&D investment. Scientific research, experiments and product development expenses can be deducted from a company's taxable income, as

⁴¹ UNECE (2014).

⁴² European Commission (2014a).

can investments in ICT systems. Transactions related to scientific and research work are exempt from VAT, and there is a 50 percent exemption on land tax for scientific and research institutes and organizations.

4.53. Tax incentives have both advantages and limitations. There are no data available to assess the impact of scientific tax incentives in Armenia. However, in developing economies worldwide such tax exemptions have proven difficult to implement. For instance, they may exclude startups (with no imposable revenue). Incentives may tend to benefit large firms and can increase incentives for tax evasion if monitoring is inadequate or legal provisions are not clearly defined. Nevertheless, tax incentives may be preferable to grants or loans if they are sufficiently demand-driven and market-based.⁴³

4.54. The government's industrial policies include specific measures to promote innovation. The Ministry of Economy's export-promotion strategy supports innovation through reforms to improve the general business environment,³⁸ as well as targeted policies such as tax exemptions, co-financing for training and business services, and export requirements. These are implemented through the SME Development National Center and complementary initiatives such as the SME Investments program. However, a lack of impact evaluation makes the effectiveness of these policies difficult to assess.

International Collaboration

4.55. Increasing Armenia's integration into the global scientific and technological community is among the government's main objectives for the sector. The SDS sets ambitious targets for international scientific cooperation, and its overarching goal is for Armenia to become competitive with the European Research Area by 2020. The SDS Action Plan includes objectives for developing international R&D and technological cooperation. Armenian scientists are involved in several European research projects, including scientific resource databases, the operation of the Large Hadron Collider, and environmental monitoring in the Black Sea.

4.56. The SCS has established several bilateral cooperation programs in recent years. Programs with Belarus, France, Germany and Russia provide a framework for exchanging scientists and implementing joint initiatives supported by financial contributions from both partners. These programs are thematically broad, but relatively small-scale in terms of budget costs.

4.57. The NAS has created an extensive network of international academic partnerships, but a lack of financing has limited its impact. The NAS has collaboration agreements with institutions in Russia, Georgia, Moldova, Belarus, Ukraine, Turkmenistan, Hungary, China and Romania. However, due to financial constraints only the agreement with Russia, which is financed by Russian partners, has yielded significant results. Yerevan State University, the State Engineering University of Armenia, and Yerevan State Medical University maintain their own international cooperation networks supporting education and research activities with academic institutions in more than 30 countries worldwide. The Yerevan Physics institute alone participates in 37 international projects, receiving around US\$10 million in external support.

4.58. Armenia actively participates in EU research networks. Under the EU's Seventh Framework Program Armenia is involved in 45 projects financed by a total EU contribution of €3.22 million. Three

⁴³ Countries around the world are increasingly introducing special fiscal incentives for business R&D. In 2012 27 of the 34 OECD countries and a number of non-OECD economies give preferential tax treatment to R&D expenditures.

³⁸ Measures include reforms to the regulatory business framework, reinforcing infrastructure, access to credit and attraction of FDI.

new FP7 projects involving Armenian stakeholders aimed at fostering research-industry partnerships were recently launched with a €3 million commitment.³⁹

4.59. Advanced cooperation is underway with French and US counterparts. The SCS and the French National Center for Scientific Research signed a bilateral cooperation agreement in January 2009, which provides a framework for exchanging scientists, implementing joint scientific and research programs, and organizing joint scientific conferences and seminars. Over the past few years USAID has invested nearly US\$45 million in STI partnership projects. In addition, the Microsoft Innovation Center and the Armenian National Engineering Lab, as well as the Enterprise Development and Market Competitiveness, Clean Energy and Water, and Energy Assistance to Strengthen Energy Security and Regional Integration programs all aim at increasing the use of technology for economic growth.

TOWARD AN INTEGRATED INNOVATION SYSTEM

4.60. The Armenian government is aware of the importance of developing a national innovation system, but its efforts are still in a nascent stage. Armenia has developed a strategic vision for the STI sector and established policies and tools to encourage innovation. Yet most of the government's initiatives are at an early stage in their implementation, and in many cases the multiple actors involved are not effectively pursuing their shared priorities.

4.61. The effectiveness of the national innovation system is compromised by conflicting priorities and the duplication of efforts. While national strategies are critical to sound policy, overlapping mandates by the Ministry of Education and the Ministry of Economy have resulted in ambiguous and conflicting policies. While both strategies share several common objectives, including the need to increase aggregate R&D investment and promote the commercial application of research, closer inter-ministerial collaboration will be necessary to create a more efficiently coordinated framework for STI policy.

4.62. Financing mechanisms and regulatory policies are not fully developed. Public spending on STI is inadequate to achieve the government's objectives, and the composition of STI spending does not accurately reflect its priorities for the sector. Funding levels stagnated over the 2008-2013 period; applied research accounts for only a small fraction of total R&D expenditures; and support for innovation and technological diffusion among firms is minimal. The implementation of sector strategies is undermined by inadequate monitoring and evaluation mechanisms, and financing is rarely tied to performance. As a result, individual and institutional incentives are poorly aligned with the objectives of STI policy.

³⁹ European Commission (2014b).

5. The Policy Environment

Policy actions affect the incentives of firms to become more productive, internationally oriented and innovative. Over one-third of productivity at the firm level can be explained by the policy environment, particularly the quality of governance and workforce education and training policies. International orientation is also influenced by policy, and external openness can have important spillovers on domestic productivity. Exporters tend to have better access to finance and higher rates of ICT use, while foreign-owned firms are associated with better workforce skills and higher productivity. Overall Armenian firms are characterized by low levels of innovation, with negligible investment in R&D and little propensity to introduce new products and processes. Innovation is most likely among older, larger and foreign-owned firms. The quality of governance, particularly its ability to combat corruption, and the availability of workforce skills are the most relevant constraints to the emergence of an innovative enterprise sector.

5.1. The policy environment shapes incentives for doing business and ultimately determines the dynamism of an economy. The competitiveness of an economy depends on the efficiency of its producers, and their ability to optimally employ labor, capital, technology, and other inputs in the production process. Whereas exogenous factors such as historical legacies or geographic conditions play an important role, governments make choices that shape firm incentives to be efficient, invest and innovate. Some of the areas under the control of policymakers include macroeconomic stability; taxation; openness to international trade flows, capital, people and data; investment in infrastructure and education; regulation of capital and labor markets; and public sector governance.

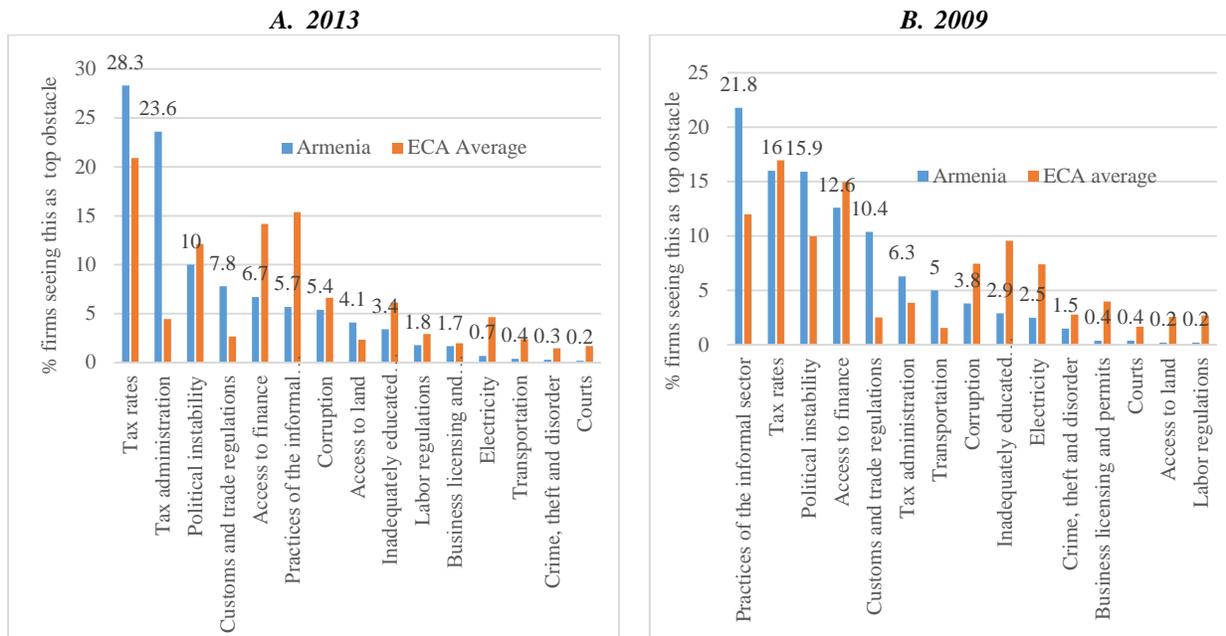
5.2. Armenian firms perceive the policy environment to be an obstacle to doing business. Based on responses to the 2013 Enterprise Survey (Box 5.1), over half of Armenian firms cite tax rates and tax administration as the most important constraints on doing business. 10 percent of firms are primarily concerned with political instability, 7.8 percent with customs and trade regulation, and 6.7 percent with access to finance (Figure 5.1A). Taxation and customs, along with corruption, affect the quality of public governance. Firm perceptions appear to have shifted since 2009, when informal practices and access to finance were the most frequently cited obstacles (Figure 5.1B).

Box 5.1. The Enterprise Survey and BEEPS V

The empirical analysis in this section is based on firm-level data from the 2009 and 2013 Enterprise Surveys (ES) for Armenia and other Europe and Central Asia (ECA) countries. The ES takes a representative sample of each economy's non-agricultural business sector and assesses constraints on firm-level growth. A standardized methodology is applied allowing for cross-country comparisons and analysis. The data for ECA were collected through a joint initiative between the World Bank and the European Bank for Reconstruction and Development known as the 5th Business Environment and Enterprise Performance Survey (BEEPS V). The BEEPS V sample includes countries in the MENA region and comparisons with Israel are used in this section as a benchmark for Armenia's performance in innovation.

The sampling frame for the most recent Armenian ES is the 2013 Armenia Business Directory, which contains 1,737 non-agricultural businesses. The ES sample was obtained through a stratified, random sampling process across three dimensions: industry, firm size, and region. Industry strata include manufacturing, retail and non-retail services, with one-third of surveyed firms coming from the manufacturing sector. Firms were divided into small (5-19 permanent full-time employees), medium (20-99) and large (more than 99) enterprises. Firms were also divided geographically into the northern, southeastern, southwestern and Yerevan regions.

Figure 5.1. Key Obstacles to Doing Business, 2009 and 2013



Source: Enterprise Survey.

Note: The Enterprise Survey presents firms with a list of potential business obstacles and asks respondents to select the one they perceive to be the most important.

5.3. Econometric analysis can be used to isolate the effect of different policy variables on enterprise performance. The following sections use Enterprise Survey data for the manufacturing sector in Armenia and other countries to assess the effect of government policy changes on firm-level productivity, export propensity, and the ability to attract FDI and encourage innovation (see Annex 3-A). To reinforce the validity of results and overcome the small size of the Armenian sample, data for Armenia are compared to those of other countries in the region and the sample for each country uses combined observations from the 2009 and 2013 surveys.⁴⁰ The effect of the policy environment on productivity, international orientation (as measured by exports and FDI) and innovation is isolated from other possible influences, such as idiosyncratic firm-level characteristics or industry and regional fixed effects. The following questions are addressed:

- Which policy areas have the largest impact on the productivity of Armenian manufacturing firms?
- Which policy areas are associated with export competitiveness and FDI attractiveness?
- Which policy areas have the largest effect on enterprise innovation?

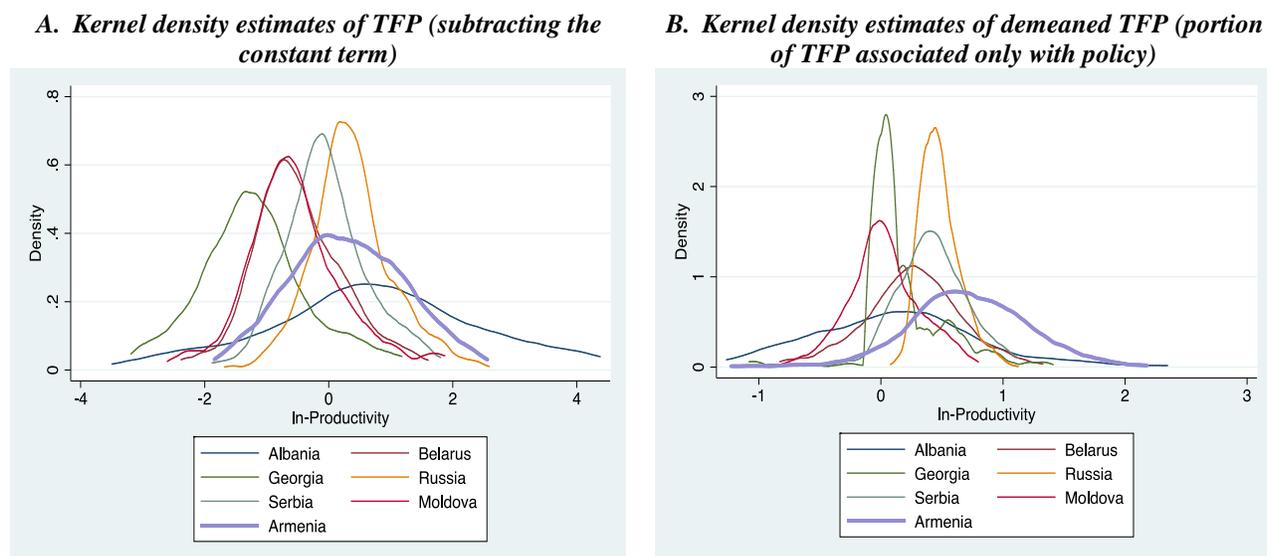
⁴⁰ The underlying assumption for all countries is that the 2009 and 2013 samples are independent random draws from the same populations. This is not an unreasonable assumption considering that the population of manufacturing firms is not likely to have substantially changed in four years.

PRODUCTIVITY

5.4. Firm-level decisions influence the overall productivity of an economy. GDP per capita growth may be decomposed into labor productivity growth and labor force participation growth. An economy’s labor productivity is affected by aggregate total factor productivity (TFP)—the efficiency with which labor and capital are employed—and factor accumulation (the capital/labor ratio). Each of these aggregate components is determined at the level of individual enterprises. The sum of firm-level decisions to increase capacity utilization, introduce process innovation or adopt better management practices leads to efficiency gains in the economy as a whole. Firm-level decisions to invest in physical or human capital and employ additional workers likewise translate into higher aggregate levels of physical and human capital and greater labor force participation.

5.5. Econometric analysis allows isolation of policy environment effects from the effects of other possible determinants on firm-level productivity. This section examines the effect of the policy environment on total factor productivity, a measure of the efficiency with which factors of production are employed by firms. The effects of the policy environment are isolated from those of other possible determinants of firm performance, in particular those that are not directly and immediately influenced by government policy. These include a firm’s region and sector of operation and idiosyncratic firm-level features. The analysis uses the concept of *demeaned productivity*, the share of TFP that is exclusively associated with the policy environment.⁴¹

Figure 5.2. Armenia Shows a Wide Dispersion in TFP Across Firms



Note: Kernel density estimates of $\ln(\text{TFP})$ estimated as the Solow residual with constant by country input-output elasticities. Panel A plots the distribution of $[\ln(\text{TFP}) - \alpha_p]$, where the latter is the constant technical efficiency term capturing measurement errors, differences in deflators, and unobserved idiosyncratic firm characteristics. Panel B plots $[\ln(\text{TFP}) - \alpha_p - W - D - u]$, i.e. the distribution of $\ln(\text{TFP})$ exclusively due to X , the policy environment. See Annex 3-A and Pena (2015).

5.6. In Armenia a large number of relatively efficient firms coexist alongside significantly less efficient competitors. This is reflected in a flat distribution of productivity across firms with very long tails on both ends (Figure 5.2). Among comparator countries only Albania has a more spread out distribution of productivity across firms. Panel A shows the distribution of productivity correcting for possible measurement errors and for unobserved firm-level features as captured in the constant term.

⁴¹ See Pena (2015) and Annex for details.

Panel B shows the distribution of demeaned productivity, or the portion of TFP that is explained solely by the policy environment, discounting other possible determinants such as firm-level features, region and sector of operation. In each case a very heterogeneous business sector is observed, with the policy environment preventing the exit of less efficient firms and their replacement by more efficient firms, an outcome which would increase aggregate productivity and the efficiency of the economy as a whole.

5.7. Firm-level productivity is influenced by enterprise characteristics, invariant external conditions and the policy environment. A firm's sector, region of operation and individual characteristics (i.e. age, size, ownership structure, inherited market power, etc.) all affect its efficiency. Most of these factors are not influenced by public policy. The policy environment does, however, influence firm behavior, as policy decisions affect the quality of infrastructure, the provision of public services, the effectiveness of governance, access to finance, innovation incentives, the availability of skilled labor, and economic openness.

5.8. The policy environment in Armenia has a larger impact on firm-level productivity than in other countries in the region. Policy factors account for 35.7 percent of the overall variation in firm-level productivity in Armenia, a higher share than in comparator countries (Figure 5.3). While the majority of variation in productivity is linked to firm characteristics and exogenous factors, public policy nevertheless plays an important role in determining economic efficiency.

5.9. Among policy factors the overall quality of governance and the availability of skilled labor have the largest impact on firm-level productivity. When non-policy-related factors are removed from the equation, the variables connected with formal and informal interactions between firms and the state account for 42.1 percent of productivity variation (Figure 5.3). The second most significant contributor is the availability of skilled workers (21.6 percent). Access to finance is the third most significant contributor with 14.8 percent, followed by international orientation (12.8 percent), innovation, and ICT use.

5.10. The policy environment can affect both the productivity within firms and the efficiency of resource allocation across firms. Figure 5.3, Panel C, compares the Olley and Pakes (1996) decomposition of demeaned TFP for Armenian firms in 2009-2013 with other countries. The aggregate demeaned TFP of the Armenian manufacturing industry is positively influenced by the policy environment. This implies that favorable policy conditions are conducive to greater productivity. The Olley and Pakes method allows for the decomposing of aggregate TFP into an average component and an allocative efficiency component. The former reflects the productivity of the average firm, while the latter provides a measure of the efficiency with which resources are distributed among firms. The positive sign for both components indicates that the policy environment can positively influence both average productivity and the efficient allocation of resources, limiting the waste that would result from allowing less efficient firms to employ more labor and capital.

Table 5.1. Policy Environment and Firm-Level Variables

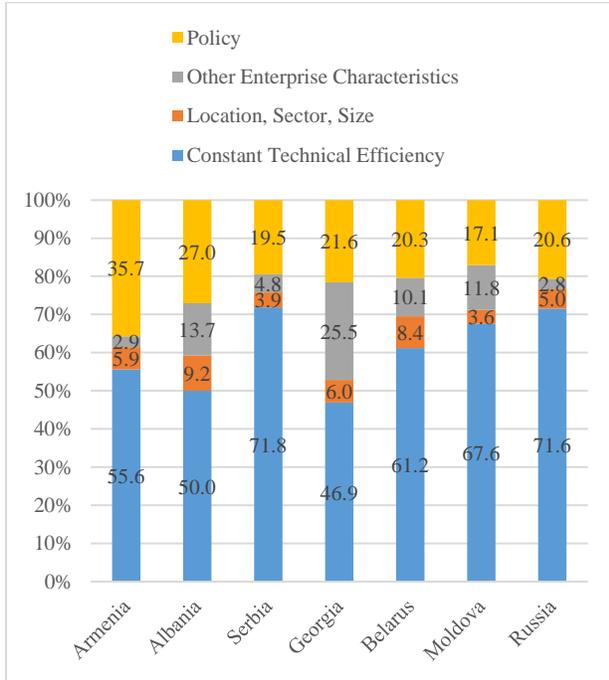
Policy Environment: Infrastructure	
Shipm. lss. exp. (%)	Shipment losses, exports
Power outages (ln)	Total duration of power outages in one year
Generator (d)	Electricity from a generator
Policy Environment: Governance	
Customs exp. (ln)	Days to clear customs to export (exporters only)
Customs imp. (ln)	Days to clear customs to import (importers only)
Manager's time (%)	Manager's time spent in bureaucratic issues
Inf. payms. taxes (d)	Gifts in tax inspections
Security (d)	Security expenses
Auditory (d)	External auditory
Courts (d)	Conflicts with clients with a court involved
Inf. comp. (d)	Informal competitors
Policy Environment: Finance	
Purchs. aft. delivery (%)	Purchases paid after delivery
Sales aft. delivery (%)	Sales paid after delivery
Fix. assets internal (%)	New fixed assets financed by internal funds
Fix. assets equity (%)	New fixed assets financed by equity
Fix. assets banks (%)	New fixed assets financed by private banks
Overdraft (d)	Overdraft facility
Loan (d)	Loan
Subsidy (d)	Subsidies from national, local or supra-national sources
Policy Environment: Innovation and ICT	
ISO (d)	Quality certification
R&D sub. (d)	R&D outsourced with external firms
R&D p.worker	R&D expenditure per worker
Sales new prds. (%)	% annual sales accounted for by new products
Forgn. tech. (d)	Foreign technology
Staff compts. (%)	Staff with computer
Web page (d)	Website use with clients
Policy Environment: Labor skills	
Manager exp. (%)	Experience of the manager
Prod. staff (%)	Staff - production workers
Skilled staff (%)	Staff - skilled workers
High school staff (%)	Staff - university education
Training (%)	Employee training
Policy Environment: Openness	
FDI (d)	Firm owned by foreign firms
Exports (d)	Direct exports (export of total sales \geq 10%)
Exports exp. (ln)	Exporting experience in years
Imports (d)	Direct imports
Firm Level	
Undiversified (%)	Sales from main product
Shareholder (%)	Largest owner's share of firm's capital
Inc. (d)	Publicly listed company
Local (d)	Main market is local
Age (ln)	Age of the firm in years
Market share (%)	Firm's market share

Source: Enterprise Survey. See Pena (2015) and Annex 3-A.

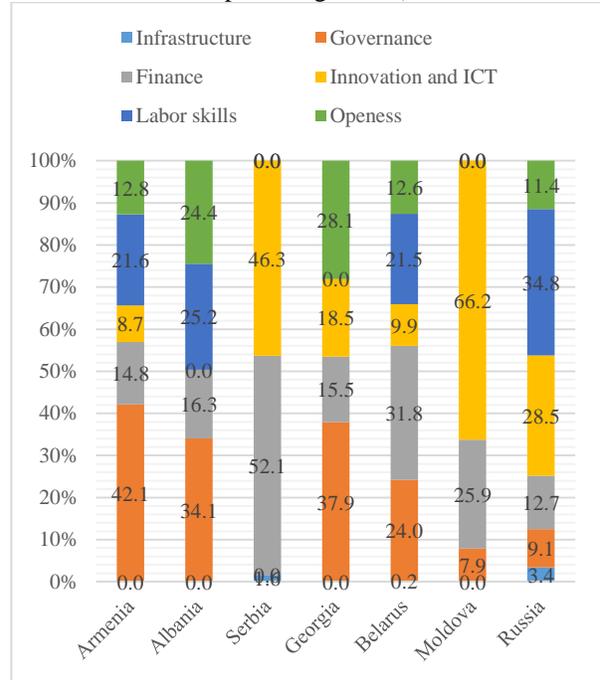
Note: (ln): logarithms; (d): Dummy (binary, yes/no) variable.

Figure 5.3. Determinants of Firm Level Productivity in Armenia

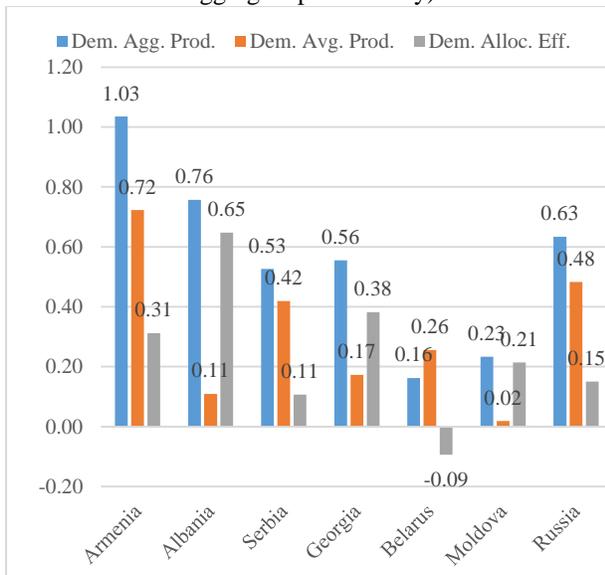
A. Policy explains a large share of firm level productivity (Determinants of TFP, percentage share by variable blocks)



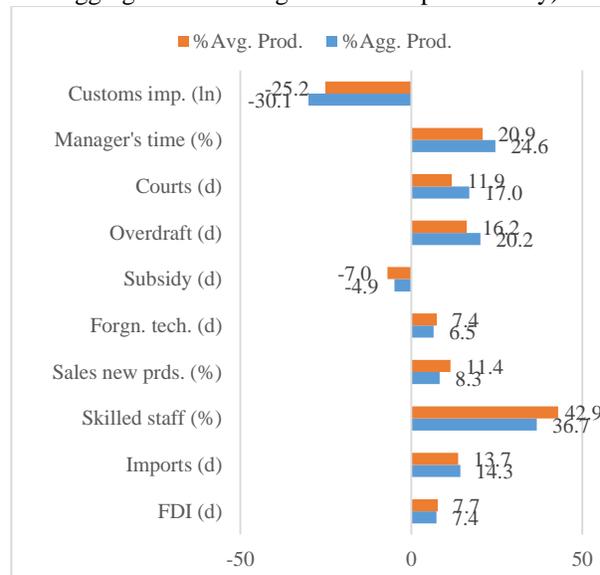
B. Within policy, governance and labor skills are the most important areas (Contributions of policy variables to aggregate demeaned productivity, percentage share)



C. Good policy has a positive influence on both average productivity and efficient resource allocation (Olley and Pakes (1996) decomposition of demeaned aggregate productivity)



D. Better skills and efficient customs have the largest effect on productivity (Percentage relative contributions of policy variables to aggregate and average demeaned productivity)



Source: Staff calculations based on Enterprise Survey 2009 and 2013. See Pena (2015) and Annex 3-A for details.

5.11. The availability of skilled labor has the largest positive effect on productivity, while customs inefficiency on the import side has the largest negative impact. Panel D of Figure 5.3 depicts the percentage contribution to aggregate and average demeaned TFP for individual variables. The availability of skilled labor is clearly the strongest determinant of firm-level productivity. The fact that the effect on the average firm (+42.9 percent) is larger than the aggregate effect (+36.7 percent) indicates that the benefits of a qualified workforce are not limited to high-market-share firms, but evenly distributed across the economy. The number of days to clear customs to import has a larger negative contribution to aggregate TFP (-30.1 percent) than to average TFP (-25.2 percent), indicating that the negative effect is concentrated in high-market-share firms. The amount of time managers spend dealing with bureaucratic requirements is associated with more productive firms. The fact that the aggregate effect (+24.6 percent) is larger than the average effect (+20.9 percent) reflects that larger firms are more likely to face more bureaucratic requirements. Access to finance, an efficient judiciary and importing activities are all associated with higher productivity, with a higher aggregate than average effect reflecting that larger firms benefit more from these areas. Foreign ownership, use of foreign technology and product innovation are also associated with higher productivity. However, the fact that the average effect is higher than the aggregate effect suggests that the benefits are rather evenly distributed regardless of a firm's market share. Government subsidies have a negative effect on productivity, with the higher-average-than-aggregate effect indicating that smaller firms are most negatively affected by the receipt of government transfers.

INTERNATIONAL ORIENTATION

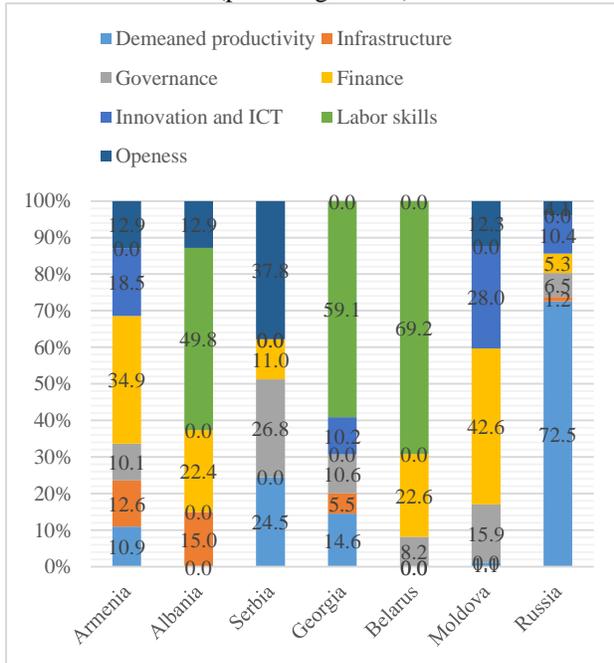
5.12. Export propensity is positively correlated with access to finance, higher rates of ICT use, increased importing activity, access to infrastructure and productivity. The probability of exporting is positively associated with access to external finance (34.9 percent of the total contribution of policy variables) indicating either that exporters have better access to finance or that access to bank credit facilitates their decision to export. ICT use is the second most important correlate of export propensity (18.5 percent). Reflecting the importance of embodied technology, use of foreign intermediate and capital inputs is associated with a greater probability of exporting (12.9 percent), as is access to infrastructure and firm-level productivity (Figure 5.4). It is important to recall that this refers to demeaned productivity, or the portion of productivity relating to the policy environment. The entire effect of TFP is likely to be much larger. This is consistent with worldwide empirical evidence that firm-level productivity, together with prior exporting experience, are the primary determinants of export propensity.⁴²

5.13. Foreign-owned firms employ more highly skilled labor and are more productive. The presence of foreign-owned firms is beneficial for domestic productivity growth. Foreign affiliates tend to be more capital and skill intensive and invest more in R&D.⁴³ Foreign affiliates also generate positive productivity spillovers on the domestic economy by accelerating the diffusion of new technology and management practices among local firms. In Armenia foreign ownership is associated with more sophisticated workforce skills, which accounts for 34.9 percent of the total contribution of policy variables, and higher productivity (31.4 percent) (Figure 5.5).

⁴² See Wagner (2007) for a survey of the empirical evidence on the determinants of exporting.

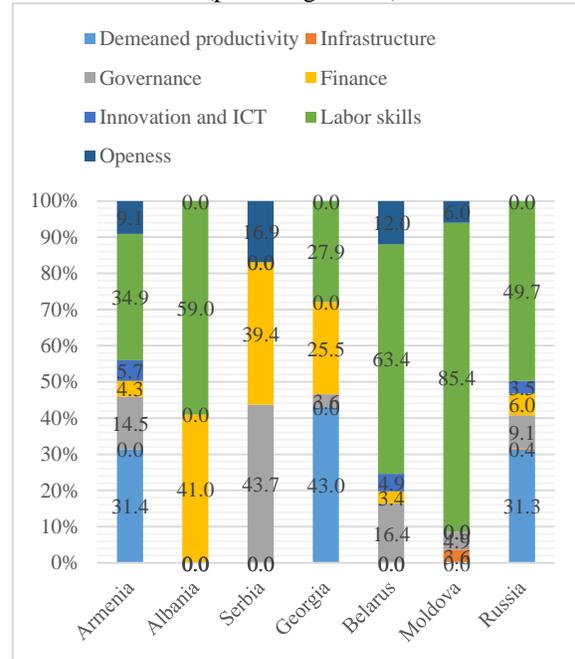
⁴³ See Keller, 2004; Keller and Yeaple, 2003.

Figure 5.4. Contributions of Policy Variables to the Probability of Exporting
(percentage share)



Source: Pena (2015). See Annex 3-A for details.

Figure 5.5. Contributions of Policy Variables to the Probability of Receiving FDI
(percentage share)



INNOVATION

5.14. Product and process innovation lead to greater productivity. From a theoretical standpoint the development of new technologies should lead to greater efficiency in production, increasing the quantity and quality of economic output produced using the same inputs. However, the relationship between innovation and productivity is not easily established on the basis of firm-level empirical data. Whereas there is evidence of a strong correlation among developed countries, in developing countries data-quality issues and the derivative nature of innovation can obscure results. Nevertheless, a recent analysis carried out by the European Bank for Reconstruction and Development (EBRD) utilizes a robust methodology to establish the empirical connection between innovation and productivity in transitional economies.⁴⁴ The analysis reveals that product innovation is associated with a 43 percent increase in labor productivity, while the introduction of new processes is associated with a 20 percent increase. In this section Armenia's performance with respect to innovation is benchmarked against a number of neighboring countries. Comparisons with Israel are also made where relevant data are available (Box 5.2).

⁴⁴ See EBRD (2014) and Crépon et al. (1998).

Box 5.2. Innovation in Israel

Israel is often cited as an example of a relatively small economy that has successfully integrated into world markets by leveraging the innovation of its enterprise sector. Israel shares some commonalities with Armenia, including a complex and difficult relationship with its neighbors and a large diaspora population.

In 1968 the Kachalsky Committee appointed by Prime Minister Levi Eshkol recommended that Israel dramatically increase the amount of R&D activity in the private sector. The Office of the Chief Scientist (OCS) was established in 1976 and empowered to subsidize commercial R&D projects undertaken by private firms. Between 1969 and 1987 industrial R&D expenditures grew at a rate of 14 percent per year and high-tech exports increased from US\$422 million in 1969 to more than US\$3 billion in 1987 (in constant 1987 dollars). Multinational companies have also established R&D centers in Israel. Initial entrants included Motorola (1964), IBM (1972), Intel (1974), and National Semiconductors (1978), with more recent firms including Google and Oracle.

However, government support for R&D can have little impact in the absence of an adequately trained workforce and friendly investment climate. Israel benefited from the large-scale immigration of about 1 million migrants from the former Soviet Union, many of whom had advanced degrees in science and technology. Israel ranked at the top of the World Bank *Doing Business* report in the areas of financial liberalization and international openness to trade and investment. This policy stance enabled Israeli firms to take full advantage of the worldwide ICT boom and leverage the globalization of U.S. capital markets to finance startups and initial public offerings.

Source: Goldberg et al. (2011).

5.15. Armenian firms lag behind comparators in the acquisition of embodied technology, but are more likely to use foreign technology and adopt international quality standards. Firms in countries like Armenia, which operate far from the technological frontier, innovate by adopting foreign production processes and technologies. Enterprise Survey data reveal that only 26.5 percent of Armenian manufacturing firms invest in fixed assets. This compares with a rate of over 40 percent in EEU partners and in the Western Balkans, and over 50 percent in new EU members (Figure 5.6). By underinvesting in fixed assets Armenian firms are not fully exploiting the most common channel for technological growth—the acquisition of technology that is embodied in machinery and equipment. One possible reason for Armenian firms’ relatively low rates of investment in fixed assets may be the comparative scarcity of bank credit. Banks finance fewer than 10 percent of investments in Armenia, a similar share to SEE and EEU countries, but substantially lower than the average for new EU members. However, a large share of Armenian manufacturers widely utilize foreign-licensed technology (23.3 percent), a higher proportion than most comparators, with the exception of Slovakia (35.1 percent) and Estonia (24.9 percent). This may reflect weak linkages between producers and domestic suppliers of technology in Armenia. 23.6 percent of surveyed firms have some form of internationally recognized quality certification. This is lower than the average for new EU members (30.6 percent), but far higher than for EEU partners (13.7 percent).

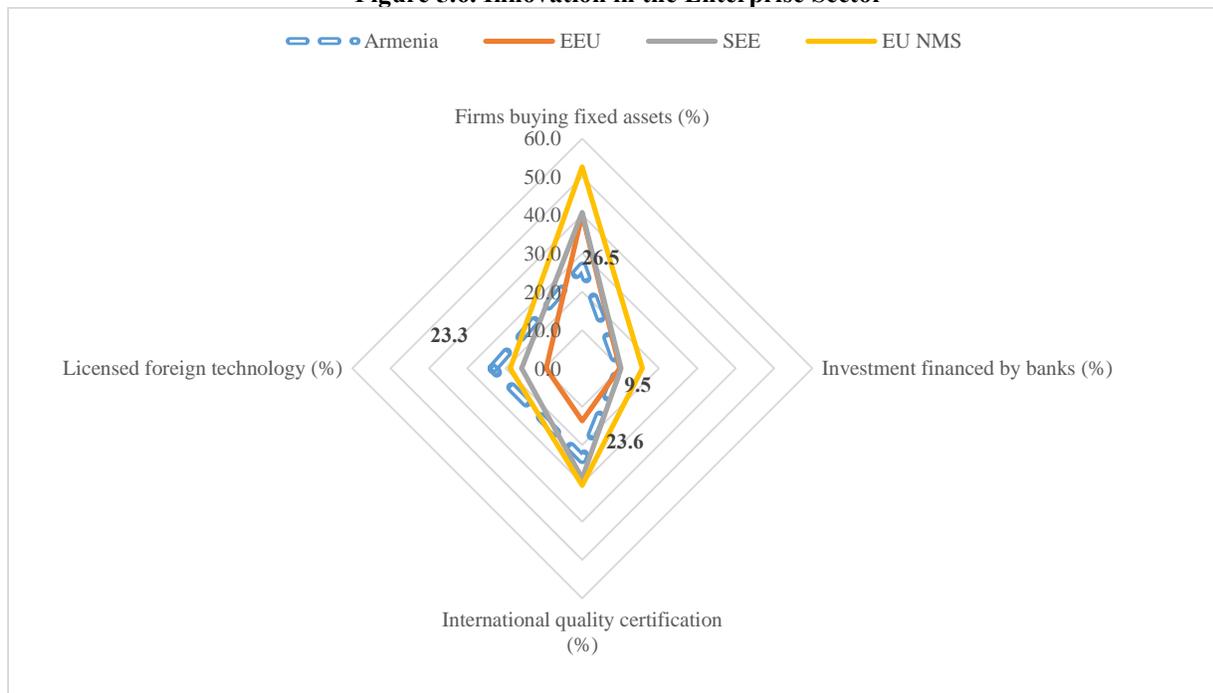
5.16. Business investment in R&D is important for technological adoption and innovation. Embracing new products and manufacturing processes, upgrading antiquated systems, using licensed technology, improving organizational efficiency, and pursuing quality certification are all elements of innovation.⁴⁵ R&D can be defined as the performance of creative work on a systematic basis to increase a firm’s stock of knowledge. Firm-level investment in R&D is necessary to develop new products, adapt existing products for specific markets, and reengineer production processes. According to EBRD (2014) firms in transitional economies that invest in R&D are 22 percent more likely to introduce new products or processes and 20 percent more likely to introduce marketing or organizational innovations.⁴⁶ Product

⁴⁵ Oslo Manual (2005).

⁴⁶ See also Crespi and Zuñiga (2010) for an analysis of South American countries.

or process innovation may not always involve in-house R&D investment. Research and development can be contracted out when there is a functional link between science and industry, and the use of foreign-licensed or patented technologies can improve the ability of firms to innovate.

Figure 5.6. Innovation in the Enterprise Sector

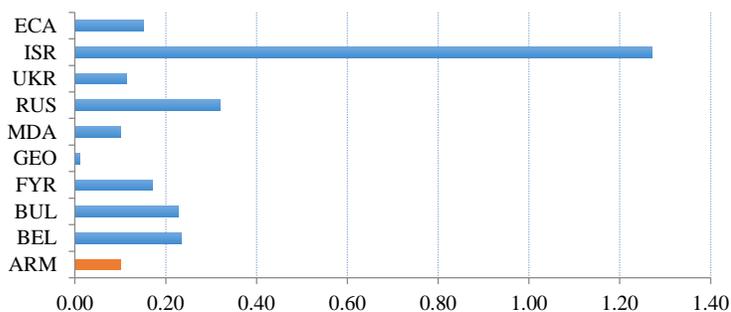


Source: Enterprise Surveys 2012-2013.

Note: EEU is the average of Belarus, Kazakhstan and Russia. SEE is the average of Albania, FYR Macedonia and Serbia. EU NMS is the average of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

5.17. Armenian firms are characterized by low R&D investment. Armenian and ECA firms lag behind Israel in spending on in-house R&D (Figure 5.7). Armenia is just below the ECA average at 0.1 percent, compared with 1.3 percent in Israel. The difference is more pronounced among high-tech and medium-tech manufacturing and knowledge-intensive services. Almost 12 percent of annual turnover is spent on in-house R&D in Israel for firms in knowledge-intensive services compared to less than 0.4 percent in most ECA countries.⁴⁷

Figure 5.7 Average Expenditure on In-House R&D as a Percentage of Annual Turnover



Source: BEEPS V, MENA ES and EBRD (2014).

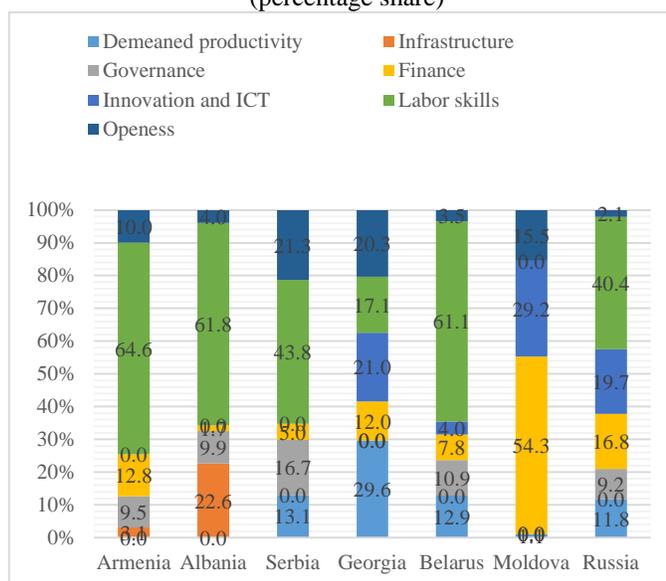
Note: Data represent unweighted cross-country averages.

⁴⁷ EBRD (2014).

5.18. Labor skills and external financing are the two most significant determinants of in-house R&D investment among Armenian manufacturers.

The availability of skilled workers accounts for 64.6 percent of the probability that Armenian firms will invest in R&D. This reflects the importance of qualified engineers, researchers and other specialized personnel to lead research and development activities. Access to external financing is the second most important factor at 12.8 percent. There are a number of factors that make R&D investment risky for banks. It is often difficult to collateralize the intangible benefits associated with R&D and assess the potential profitability of early stage technologies. Cash flows from innovation activities may also be volatile. At the same time banks may be more inclined to provide financing to borrowers with whom they have a long-term relationship. Another important determinant of the probability of investing in R&D is export orientation (10 percent). Exporting firms are able to spread the fixed costs of R&D over a larger customer base, and competition in foreign markets increases the incentive to innovate.⁴⁸ The quality of governance carries a similar weight (9.5 percent), indicating that efficient interactions with the state incentivize and improve the ability to innovate.

Figure 5.8. Contributions of Policy Variables to the Probability of Investing in R&D (percentage share)



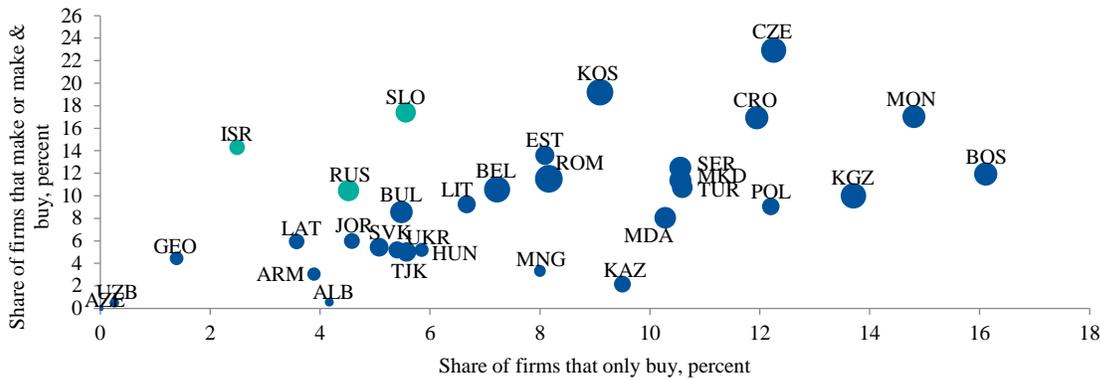
Source: Pena (2015). See Annex 3-A for details.

5.19. Few firms purchase knowledge or invest in producing it. Only 3 percent of surveyed firms in Armenia spend on in-house R&D, and around 4 percent purchase knowledge in the form of outsourced R&D or external licensing. In contrast a relatively large share of Israeli firms (14 percent) invest in producing knowledge. Figure 5.9 compares the propensity of Armenian firms to produce knowledge or purchase it. The horizontal axis shows the percentage of firms that only buy knowledge, while the vertical axis shows the percentage of firms that invest in producing knowledge or employ a combination of investment and knowledge-purchasing strategies. Cross-country differences reflect income levels for the most part, with firms in low-income countries being less likely to invest in purchasing knowledge or in-house R&D. Armenia is among the low innovation group in the 2014 EBRD Transition Report, along with Albania, Azerbaijan, Georgia and Uzbekistan.

5.20. Armenia lags behind comparators in introducing new products and marketing techniques, two important innovation outputs. Product innovation in the Enterprise Survey refers to the introduction of new or significantly improved products or services in the last three years. This does not include aesthetic changes and resale. Marketing method innovation refers to the introduction of new or significantly improved marketing methods in the last three years. A brief analysis of technological and non-technological innovation at the firm level reveals that a majority of Armenian enterprises are characterized by low product innovation and a low incidence of organizational and marketing innovation.

⁴⁸ See EBRD (2014)

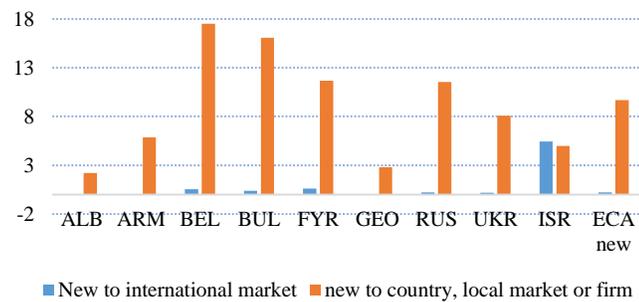
Figure 5.9. Percentage of Firms that Make and/or Buy Knowledge



Source: BEEPS V, MENA ES and EBRD (2014).

5.21. Innovative firms in Armenia are farther from the global technological frontier than most ECA countries. None of the Armenian firms surveyed had introduced a new product to international markets in the last three years, while 5 percent of Israeli firms had (Figure 5.10). The share of firms that introduced new products at the local or firm level was higher in Armenia than in Israel, but lagged behind the ECA average. This suggests that Armenian firms have considerable scope for adopting new technologies.

Figure 5.10. Product Innovation at the Global Technological Frontier and the Adoption of Existing Technologies



Source: BEEPS V, MENA ES and EBRD (2014).

Note: Based on cleaned data. Data represent unweighted cross-country averages and indicate the percentage of surveyed firms that have introduced new products in the last three years.

5.22. Product innovation is more common than process innovation.

Productivity-enhancing innovations include new or significantly improved production or delivery methods such as new inventory management software and quality-control measures. Firms may use process innovation to produce new products or to produce existing products more efficiently. Around 2.2 percent of respondents in Armenia had introduced a new process without engaging in product innovation. This is a relatively low rate when compared to the ECA average of 8 percent, and particularly to countries such as Moldova (15 percent) and Macedonia (10 percent). The share of firms that reported introducing both product and process innovations is low (Figure 5.11).

5.23. There is a low incidence of organizational and marketing innovation in Armenia when compared to the ECA average. Around 4.4 percent of surveyed Armenian firms reported introducing an organizational or marketing innovation. Firms in ECA are introducing a greater number of new organizational or marketing measures than firms in Israel. Around 14 percent of surveyed firms in ECA reported adopting new organizational practices or marketing techniques over the last three years, with marketing innovation leading in most countries. Around 7 percent of Armenian firms introduced new marketing arrangements and only 2.5 percent reported initiating new organizational practices (Figure 5.12). Organizational innovation typically includes the introduction of a supply-chain management system or the decentralization of decision-making responsibilities. Marketing innovations are often aimed at better addressing customer needs, expanding to new markets or repositioning in existing markets.

Figure 5.11. Percentage of Firms Engaging in Product and Process Innovation

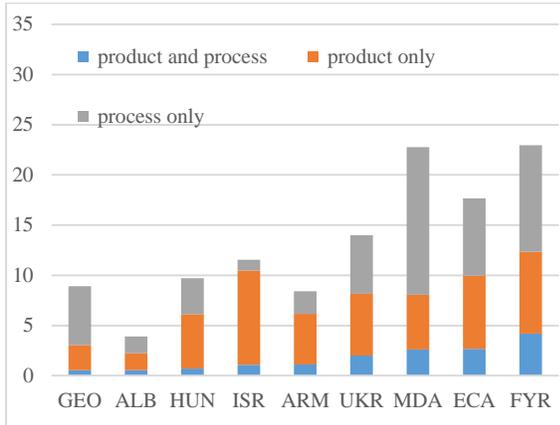


Figure 5.12. Percentage of Firms Engaging in Organizational or Marketing Innovation

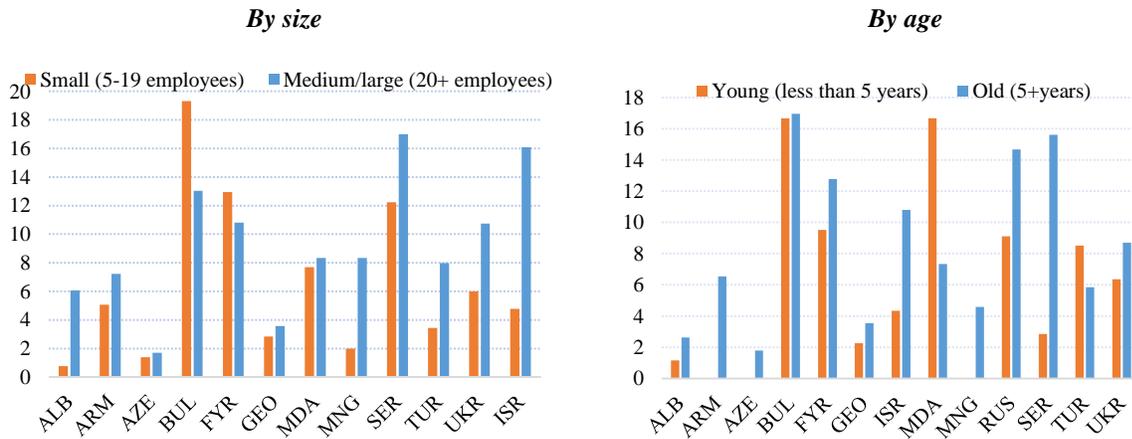


Source: BEEPS V, MENA ES and EBRD (2014).

Note: Charts are based on self-reported data. Firms were not asked to provide a description of their organizational and marketing innovations. Data represent unweighted averages and show the share of surveyed firms that have introduced organizational and marketing innovations in the last three years.

5.24. Innovation is more likely among larger and older firms. Around 8 percent of large firms have introduced a new product compared to 5 percent of small firms. Around 6.5 percent of older firms introduced a new product over the last three years, while none of the younger firms surveyed had done so. This suggests that firms founded prior to the fall of the Soviet Union may have more connections to businesses and research facilities in other parts of the former USSR, thereby facilitating the transfer and diffusion of knowledge (Figure 5.13).

Figure 5.13. Percentage of Firms Engaging in Product Innovation by Size and Age



Source: BEEPS V, MENA ES and EBRD (2014).

5.25. Foreign ownership is associated with a greater propensity to innovate, as well as higher spending on in-house R&D and the acquisition of external knowledge. The share of foreign-owned firms that have introduced a new product over the last three years is significantly higher than the share of domestically owned firms (Figure 5.14). The impact of foreign ownership on organizational and

marketing innovation is significant even when foreign investors hold a stake lower than 25 percent. This suggests that foreign owners may be an important source of information on new organizational and marketing techniques. Around 16 percent of foreign-owned firms reported pursuing external knowledge, compared to only 8 percent of domestic firms. By contrast, the percentage of firms that produce knowledge (Figure 5.15) is low whether the firm is domestically or internationally owned.

Figure 5.14. Percentages of Foreign-Owned and Domestic Firms that Are Engaged in Innovation

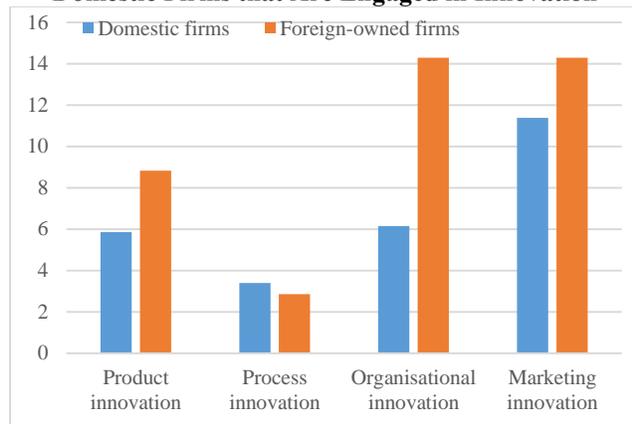
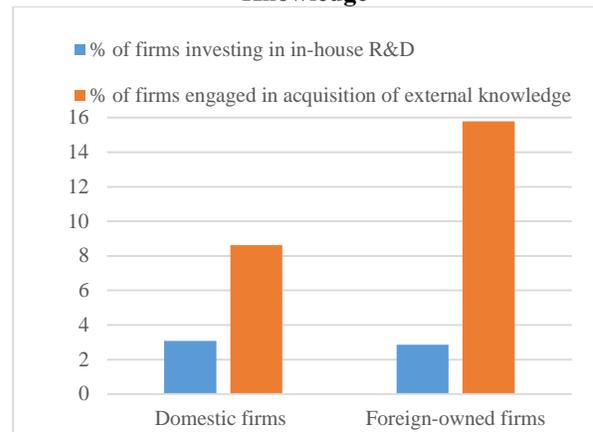


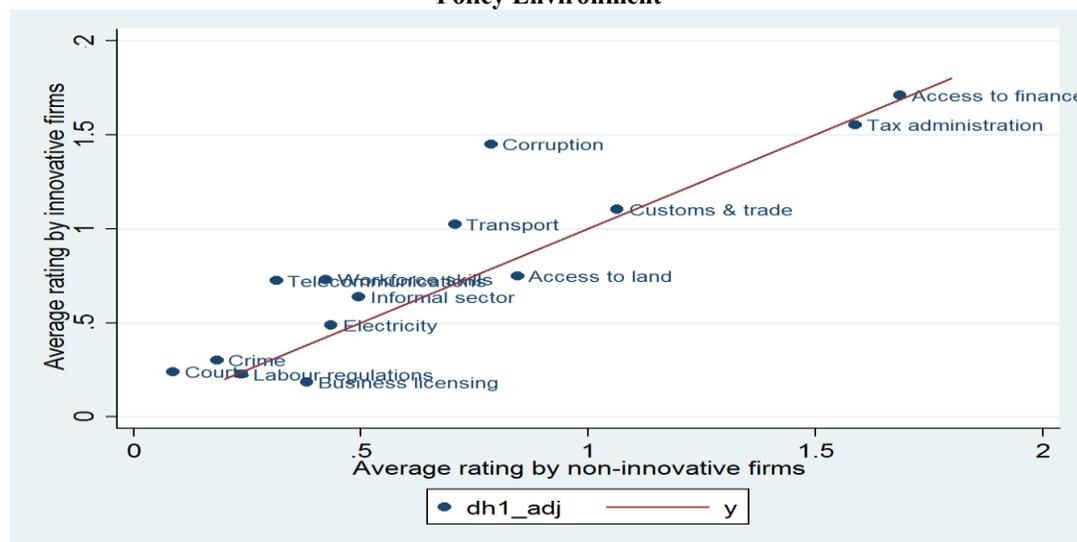
Figure 5.15. Foreign-Owned Firms Spend More on Knowledge



Source: BEEPS V, MENA ES and EBRD (2014).

Note: Cleaned data for product and process innovations, unadjusted data for organizational and marketing innovations. Foreign-owned firms are firms where the foreign stake is 25 percent or more. Domestic firms are firms where foreign ownership accounts for less than 25 percent. The acquisition of external knowledge includes R&D outsourcing and the purchasing or licensing of patented and non-patented inventions.

Figure 5.16. Differences Between Innovative and Non-Innovative Firms' Perception of the Policy Environment



Source: BEEPS V, MENA ES and EBRD (2014).

Note: Values on the vertical axis correspond to firms' perceptions that have introduced a new product in the last three years; values on the horizontal axis correspond to other firms' views. Values are averages across firms on a scale of 0 to 4, where 0 means "no obstacle" and 4 is "a very severe obstacle".

5.26. Innovative firms view corruption as the most significant constraint on their operations. A firm's ability to innovate depends on several factors that are influenced by the policy environment.

Widespread corruption, insufficient public investment in training and education, excessive bureaucracy and inconsistent policy implementation may increase the cost of introducing new products or processes, and create uncertainty regarding the returns to investment in productive technologies. As Figure 5.16 illustrates Armenian firms that have introduced a new product in the last three years generally perceive policy factors to be a more important constraint than firms which are not engaged in product innovation. Business licensing, access to land and tax administration are notable exceptions. Differences between the perceptions of innovative and non-innovative firms are relatively significant with respect to corruption, transport, telecommunication and skills development. Innovative firms in Armenia are also constrained by other issues such as access to finance, customs and trade.

Box 5.3. The Views of High-Tech Entrepreneurs on the Quality of Public Governance

Aram Salatyán is the Regional Director of National Instruments Corporation (NI), an international measurement and automation firm that provides engineering services. NI is a more established firm and encounters relatively few constraints with respect to the regulatory framework, tax regime and financing. “Those are the problems of startups,” according to Salatyán. Nevertheless, Salatyán revealed several institutional barriers that make doing business more difficult for his company. These include double taxation, which makes it harder for NI to recruit experts from the United States. Export procedures also take “a long time, and a lot of money and effort,” according to Salatyán. Export procedures are not unlike those in other countries, but according to Salatyán in Armenia “they take twice as long as elsewhere.” Salatyán’s opinions are supported by the 2013 Enterprise Survey for Armenia, where tax rates, tax administration, and customs and trade regulations were among the top four most cited business concerns by firms. The 2015 *Doing Business* report ranks Armenia 110 out of 189 countries in the ease of trade across borders.

Barriers to trade, combined with the country’s small size and landlocked geography, inhibit international integration, which is critical to preventing the monopolization of domestic markets. Currently the market power of large firms poses a major barrier for smaller businesses. Andrew Mkrtyán, Chairman of Ameriabank and CEO of Ameria Group of Companies, explained that large companies have an advantage over SMEs in overcoming the challenges of regional transport infrastructure, and in achieving the scale and reputation necessary to penetrate the Russian market, Armenia’s biggest export destination.

Other governance issues that frequently arose during interviews included difficult judicial processes, corruption and taxation. Aleksandr Khachaturyan, managing partner of local law firm TK Equity Partners CJSC, and Osipyan, CEO of Instigate Robotics, discussed the need for judicial and tax administration reform. The role of private institutions, particularly those involved in financing, was also cited. Ruben Vardanyan, a board member of the International Finance Corporation, has served as Advisor to the President and Chairman of the Board at Sberbank since August 2013 and previously served as Co-Head of CJSC “Sberbank CIB” (formerly, Troika Dialog). Vardanyan suggested improving the quality of banking infrastructure to make credit and financing more accessible. Professor Hajian, Dean of the College of Science and Engineering at AUA, and Noubar Afeyan, CEO of Flagship Ventures and an MIT lecturer, added that there is a very active venture capitalist and investment community of diaspora Armenians, which if properly tapped by startups could serve as a new source of financing. The infrastructure for initiating such a network, however, is still largely missing.

5.27. The few businesses involved in innovative fields report skills, governance and financial constraints. Skills shortages are particularly acute among high-tech firms (see Box 5.4). According to a study on innovation in the energy sector important constraints for small, high-tech businesses in Armenia include: (i) a shortage of qualified specialists in the fields of technology transfer, commercialization, and management, and a lack of intermediary organizations providing innovation support; (ii) a limited awareness of intellectual-property-related issues among executives involved in technological development; and (iii) a small number of financial institutions providing loans on suitable terms and a lack of mature venture capital funds.⁴⁹

⁴⁹ European Commission (2014a).

Box 5.4. The Views of High-Tech Entrepreneurs on the Relationship between Workforce Skills and Innovation

Human capital was an issue of particular concern during interviews with Armenian technology firms. The ICT and software solutions company OVAK delivers ICT equipment and services such as programming, industrial software design and automation. The firm requires highly skilled labor trained in specific areas and access to an extensive network of experts. CEO Robert Hovakimyan explained that OVAK invests heavily in collaborative programs with universities to develop skills and support knowledge exchange between businesses and academia. In forming this partnership OVAK was not only motivated by the prospect of recruiting trained engineering students, but also by the quality of university faculty and their networks of experts. Hovakimyan stated that, “in the universities such as the State Engineering University and Yerevan State University the faculty may be old but some are really strong and have good networks of [local and international] contacts.” In return for their collaboration professors working with OVAK can keep up-to-date on career prospects.

Hovakimyan’s perspective was echoed in interviews with other CEOs. Hovhannes Avoyan, CEO of the ICT incubator Monitis, believes that he could double the size of his business if he had sufficient access to qualified experts, managers and marketing personnel. In order to create a pool of qualified employees some Armenian firms have initiated in-house training programs and a few have even begun writing undergraduate curricula for major universities. For example, Mentor Graphics, a branch of the leading American electronic design automation firm Mentor Graphics Corporation, writes an undergraduate curriculum for the American University of Armenia (AUA). Irina Dumanyan, the Managing Director of Mentor Graphics, pointed out that state university programs are often outdated and professors do not always understand the needs of private firms. Mentor Graphics’ collaboration with AUA allows them to educate new, industry-relevant talent for the company’s R&D work in Armenia.

Some firms highlighted specific priorities for public investment in workforce skill development and education. The Armenian-U.S. tablet-making company Minno recommended that the government provide “more industry-oriented applied laboratories in the universities, and more opportunities for our professors to go abroad to study and invite professors from abroad to lecture at local universities.”

ENTERPRISE PERFORMANCE AND POLICY

5.28. The policy environment influences firm efficiency and accounts for a significant share of the variation in firm-level productivity. In Armenia relatively efficient firms coexist alongside less efficient competitors, dragging down overall productivity. The heterogeneous distribution of productivity across firms is due in part to historic legacies and other inherited firm-level characteristics, such as the location of firms and their sector of operation. Weakness in the policy environment are also a significant determinant of productivity. Government policy plays an important role in promoting the efficient reallocation of labor and capital from less efficient to more efficient firms and sectors. Indeed policy factors are estimated to account for 36 percent of the variation in firm-level productivity, a higher proportion than in all comparators considered in the analysis.

5.29. The quality of governance and availability of skilled workers have the most significant effect on firm-level productivity. Improvements in both of these areas will be gradual, and persistent coordinated action will be necessary to ensure lasting progress. Governance accounts for 42 percent of the share of productivity that can be influenced by policy, and includes both formal and informal aspects of the regulatory environment. While formal regulations in Armenia are typically adequate, mechanisms for implementing and enforcing existing regulations are deficient. These issues are compounded by the inadequate supply of highly educated workers and limited training efforts by firms. Human capital accounts for an additional 22 percent of productivity variation at the firm level.

5.30. The policy environment also influences the international orientation of Armenian manufacturers. Armenia’s trade openness is limited and FDI levels are relatively low, especially in the manufacturing sector. However, international openness is highly beneficial in the manufacturing sector. Exporters have greater financial resources, higher rates of ICT use, better access to infrastructure, are more integrated into import markets, and are more productive overall. Foreign-owned firms and firms with substantial foreign shareholders are more productive than domestic firms and are able to attract or

train more highly skilled workers. Improving the policy framework for exports and FDI would encourage the entry of new exporters and foreign-owned firms.

5.31. Armenian firms, particularly relatively smaller and younger firms, demonstrate low levels of innovation. Surveyed firms reported spending only 0.1 percent of their annual turnover on R&D. This rate is lower than that of most ECA countries and far below innovation-driven economies such as Israel. Very few Armenian firms develop new products or production processes, even compared with other small economies in ECA. Most innovation takes place in older, larger and foreign-owned firms. The climate for small domestic startups is generally inhospitable, especially in the manufacturing sector.

5.32. Innovative firms are particularly constrained by weaknesses in the policy environment, especially low governance quality and a limited availability of skilled labor. Corruption and inadequate workforce skills represent binding constraints on the development of innovative firms, especially entrepreneurs in the nascent ICT sector and in other high-tech industries. Consequently, measures to promote good governance and human-capital formation are essential prerequisites for promoting innovation among Armenian firm

6. Innovation and Dynamism: The Way Forward

In order to build a more dynamic, sophisticated and adaptable economy Armenia must establish a policy framework capable of not only increasing the supply of new technologies and productive systems, but also bolstering private-sector demand for innovation. On the supply side Armenia has made progress in implementing key legal and regulatory reforms, developing a national scientific strategy supported by sound governance mechanisms, and taking its first steps towards integrating the public research sector into the broader national economy. However, increasing economic dynamism also requires robust private demand for innovation, which only an open and competitive marketplace can generate. High bureaucratic costs, weak governance institutions and the dominance of a small business elite all diminish competitive incentives, discouraging the emergence of pioneering startups and reducing demand for new productive technologies among existing firms. A comprehensive strategy for promoting economic dynamism in Armenia must reflect not only supply-, but also demand-side constraints on firm-level innovation.

6.1. This chapter discusses policy options to improve the dynamism of the Armenian economy. The previous chapters established the potential economic impact of greater openness to trade, capital and data flows and underscored the critical importance of leveraging the resources of the diaspora. In order to successfully build a knowledge economy Armenia will need to improve its governance environment, ICT connectivity, workforce skills and the ability to create and use knowledge. Policy and institutional reforms in these areas have been discussed at length in several previous studies. World Bank (2013), for instance, presents a comprehensive assessment of the policies needed to enhance Armenia's ability to accumulate capital, connect with the world and open its markets to competition. The policy recommendations in this chapter build on the findings of previous analytical work with a focus on realizing the Armenian economy's potential for innovation and dynamism.

6.2. Innovation in Armenia faces constraints on both the supply and demand sides. While some elements of a strong national innovation system are in place, the government's efforts to foster the development of a knowledge-based economy are inhibited by poor policy coordination, a lack of strategic focus and weak administrative capacity. Moreover, innovation is also constrained on the demand side, as limited economic openness and low levels of competition reduce incentives to adopt new technologies and production processes. In this context, the following chapter considers two key questions:

- How can an improved policy framework increase the supply of innovation generated by both the public and private sectors?
- How can regulatory reforms enhance competition and bolster demand for innovation by Armenian firms?

BOOSTING THE SUPPLY OF INNOVATION

6.3. Armenia's national innovation strategies focus on supply-side issues, but a lack of coordination limits their effectiveness. As discussed in Chapter 4, Armenia has created the foundations for a national innovation system by developing strategies for promoting the growth of the science and technology sectors. However, the government's two main strategic documents have overlapping priorities, and no mechanisms are in place for jointly implementing programs with a common target. Moreover, although building a knowledge-based economy requires active, productive collaboration between public scientific institutions and private firms, Armenia's science policies are not coordinated with its industrial policies, and the government's current efforts concentrate almost exclusively on the supply side.

6.4. New governance mechanisms will be necessary to improve policy coordination and enhance the impact of innovation strategies. Many OECD countries have established innovation councils comprising representatives from the public and private sectors. These councils are tasked with defining policy priorities and monitoring the impact of innovation programs and national strategies. In Armenia an innovation council could mainstream innovation into the policy process and coordinate the development of a unified national innovation strategy. An innovation council could also provide input into budget allocation and program planning to ensure that innovation policies and programs are well designed and appropriately resourced.

6.5. Public research institutions must shift their focus from basic to applied research. Armenia's universities and other research institutions are weakly connected to the private sector. As a result public research tends to be highly academic and largely unresponsive to the needs of industry. The government should take steps to encourage partnerships between firms and research institutions and a larger share of research funding should reflect the priorities of the private sector. This reorientation toward industry-focused applied research could be supported by the addition of dedicated budget lines for funding research projects and fields that are clearly linked to economic innovation or national development priorities. Collaborative research by the public and private sectors should follow the example of the public-private partnerships established through the European Technology Platforms. Universities and public research institutions should also develop technology-transfer strategies and channels through which to disseminate their findings to the private sector.

6.6. Improving collaboration between Armenia's scientific organizations and private-sector firms will require institutional reform. The legal and governance framework in which universities and research institutes operate does not incentivize the production of economically applicable innovations and encourages the scientific community to isolate itself from the national economy. While some firms have begun engaging with universities to develop market-oriented vocational curricula, policymakers and educators could do much more to support active collaboration between science and industry. Promoting joint research and training initiatives, creating professional exchange programs, academic fellowships and other systems for transferring knowledge and experience, designing Master's and Doctoral courses that directly involve private counterparts and are tailored to meet the needs of the private sector, and developing agreements to share public and private scientific facilities would both increase the supply of innovation and enhance its economic applicability.

6.7. National innovation strategies should broaden their focus to include technology transfer, adaptation and upgrading outside the high-tech industrial and research sectors. The ISFIE places a strong emphasis on the national R&D system and on attracting investment by high-tech multinational companies with the objective of transforming Armenia into a regional technology hub. However, far less attention is devoted to innovation outside the technology sector. Technological extension services provided by public or private institutions, or through public-private partnerships, could greatly accelerate productivity growth throughout the Armenian economy by supporting innovation and technology transfer among firms in traditional industries and sectors. These programs should not focus exclusively on sophisticated ICT systems and cutting-edge equipment, but should also target innovative managerial techniques, new organizational practices, improved quality-control systems, production-process refinements, basic ICT connectivity, energy efficiency, and other forms of broadly construed productive technology.

6.8. An adequate legal framework and dedicated organizations are necessary to build commercial research capacity and facilitate technology transfer. Two essential components of a national innovation system are: (i) a clear legal framework entitling researchers and research institutions to benefit from the creation and exploitation of the intellectual property generated by publicly-funded research, and

(ii) intermediary organizations tasked with developing and managing research partnerships and technology-transfer arrangements (Box 6.1).

Box 6.1. Intellectual Property Rights and Innovation: Lessons from the International Experience

Creating incentives for applied research and active technology transfer by public research institutions begins with a transparent and unified legal framework governing the rights to intellectual property produced by publicly-funded research. Well-designed intellectual property rights enable researchers and institutions to benefit from the commercialization of technologies. They define responsibilities for different stakeholders involved in the research process and create incentives for researchers to develop and disseminate market-oriented technologies. These incentives typically include rights to product royalties and other forms of revenue, as well as equity participation in subsidiary technologies.

In China the Science and Technology Advancement Law and the Science and Technology Findings Conversion Law of 1998 included provisions for inventor compensation and incentives for firm creation. In 2002 a ministerial decree explicitly allowed for the ownership and commercialization of intellectual property rights. In some cases researchers can even use their findings as investment collateral. University researchers are also allowed to take part-time jobs in private firms as long as they continue to execute their academic responsibilities.

In Brazil the 2004 Innovation Law (Law n° 10.973) provided rules and incentives for intellectual property rights and collaborative public-private research relationships at universities and research institutions. The law enables researchers and research institutions to share between 5 and 33 percent of the licensing income generated by new technologies. The law encourages the public and private sectors to share staff, funding and research facilities. Researchers are authorized to conduct joint projects with outside institutions and may request special leave to become involved with a startup company. Complementary incentives include fiscal exemptions for private and collaborative R&D investment and subsidies for patenting.

In Malaysia the Technology Fund finances the development of products and services from newly-created or licensed technologies by both public and private research institutions. In Croatia the Proof of Concept Program strives to accelerate the commercialization of research findings by financing up to 75 percent of the total cost of verifying and protecting intellectual property rights, demonstrating the practical applications of new technologies and assessing their commercial potential. And in South Africa the Innovation Fund is designed to promote patent applications at research institutions by rewarding researchers for each South African patent granted.

Source: OECD (2008), Zuniga (2011) and Correa and Zuniga (2013) –Innovation Policy Platform.

6.9. Policy options for improving the supply of innovation in Armenia include:

- **Creating a National Innovation Council comprising representatives from the public and private sectors.** This institution would align the interests of stakeholders, enhance consultative and participatory processes, evaluate the impact of innovation programs, and implement joint public-private innovation and technology strategies.
- **Refocusing public R&D towards applied technology and market-driven research.** Encouraging research into technologies with clear commercial applications would help maximize the impact of public research on economic productivity.
- **Increasing funding for public R&D in line with the objectives of the ISFIE and SDS.** Funding should be increased not only for R&D projects but also for graduate and post-graduate programs in science and technology.
- **Establishing a monitoring and evaluation system for all science and technology programs and mandating impact evaluations for selected programs.** Impact evaluations could be quasi-

experimental, given adequate data, and experimental approaches could also be considered for new initiatives and pilot programs.

- **Revising the legal framework to clarify and enhance the protection of intellectual property rights in line with international best practices.** Incentives should also be reflected in the way researchers and public research organizations are evaluated and financed.
- **Creating market platforms to promote the commercialization of new technologies produced by public research institutions.** Specialized systems for marketing technological innovations would further leverage the economic impact of public R&D investment.
- **Facilitating cooperation with the Armenian scientific diaspora.** Armenian research institutions and private firms are currently making only limited use of the enormous talent and expansive professional networks of Armenian scientists abroad.
- **Adopting international standards for measuring the impact of R&D projects and innovation programs.** Assessments based on the OECD and Eurostat Oslo Manual for Innovation and OECD R&D Frascati Manual should be implemented annually for R&D projects and every other year for innovation programs. This will allow Armenia to gauge its progress against international comparators.
- **Undertaking studies designed to identify emerging opportunities in the Armenian R&D sector.** Reflecting the government's overarching objectives and the specific goals of its R&D policies these studies should focus on technologies with a large potential impact on economic and social development.

BOOSTING DEMAND FOR INNOVATION⁵⁰

6.10. **An uneven economic playing field can slow technology transfer and stifle innovation.** A regulatory regime that does not facilitate competition among firms discourages the adoption of new productive technologies. This is true for both physical technologies and organizational systems, and market competition has been found to be the most important factor in determining the relative sophistication of management practices.⁵¹ Creating incentives to adopt more efficient processes and production systems is particularly important for Armenia, which is far from the technological frontier, since the ability to innovate and adopt new technologies is essential to long-run convergence with developed economies.⁵²

6.11. **Despite recent reforms, Armenia's regulatory framework for competition remains deeply flawed.** As discussed at length in World Bank (2013) Armenia's current legislation does not effectively deter anticompetitive behavior, nor does it provide regulators with adequate authority to enforce a level playing field, and government agencies tend to focus on monitoring prices rather than addressing anticompetitive practices. Moreover, the contestability of markets is not taken into account in defining market dominance, and as a result imperfect competition is inaccurately identified in national legislation.

6.12. **Armenia's compares poorly against its peers in terms of competitive markets.** Indicators of the intensity of local market competition, the extent of market dominance, and the effectiveness of

⁵⁰ This section draws extensively on World Bank (2013).

⁵¹ Syverson (2004), Bloom and van Reenen (2007), Bloom et al. (2012).

⁵² See, for example, Aghion and Griffith (2005), Acemoglu et al. (2006), Bloom, Sadun, and Van Reenen (2012), Inklaar, Timmer, and van Ark (2008).

competition policy place Armenia low in the international rankings. In the 2014-2015 Global Competitiveness Index Armenia ranked 85th out of 144 countries in intensity of local competition, 93rd in the extent of market dominance and 105th in the effectiveness of anti-monopoly policy.

6.13. Weak competitive incentives explain why many Armenian firms are slow to innovate. While the country's fast-growing ICT sector has a relatively high rate of technological uptake, other sectors frequently rely on outdated technologies and tend to be relatively uncompetitive in international markets.⁵³ Whereas firms in the ICT sector are highly exposed to international competition—with a global operational focus and a large share of foreign investors—firms in traditional sectors tend to have a local or regional perspective, with little incentive to innovate or enter new markets because the returns to innovation and entrepreneurship are diminished by the structural economic power of incumbent firms.

6.14. Ownership of economic assets is highly concentrated. Focus groups identified 32 individuals who together own 126 firms, of which 52 were among the 1,000 largest taxpayers and accounted for 60 percent of the total sales attributable to the 1,000 largest taxpayers. Econometric analysis found that the firms believe to be owned by these 32 individuals had significantly higher sales and larger assets than their peers, even after controlling for firm size and sector. A complementary analysis of publicly available data established that at least 57 firms were owned by just 5 individuals, a subset of the 32 individuals identified through the focus groups. Of these 57 firms, 31 were among the 1,000 largest taxpayers and accounted for nearly 8 percent of their assets, 15 percent of their sales, and 14 percent of their taxes. Sectors in which the firms of the top five owners operate are highly concentrated, since each of the five individuals owns at least one company that has a substantial share of the relevant market.

6.15. Business elites often have close political connections and may receive preferential treatment. Focus group discussions indicated that owners of powerful business interests are often personally linked to the political leadership. Political connections may present an obstacle to the entry of new firms and the expansion of more productive firms by enabling low-productivity incumbents to defend their market position. While these large incumbent firms contribute to overall growth, they can hinder economic development by stifling competition and diminishing incentives to innovate.

6.16. Business elites benefit from preferential tax policies and tax administration. Preferential tax policies may include: (i) a special concessional regime for petroleum products; (ii) a personal income tax that is basically a wage tax with little focus on other income; and (iii) insufficient mechanisms or authority to undertake tax audits of individuals, including persons with significant assets or income. Key tax administration challenges include: (i) a lack of systematic investments in human and technical capacity; (ii) undeveloped risk-management mechanisms, including prohibitions on indirect audits; (iii) the limited use of e-filing; (iv) excessive contact between taxpayers and officials; (v) perceptions of corruption; (vi) a weak appeals system with low credibility among taxpayers; and (vii) vague internal rules and significant personal discretion in applying them within the State Revenue Committee.

6.17. Fiscal incentives to specific sectors or firms are not transparent and are often used to favor powerful incumbents. The criteria for granting state support do not focus on ensuring minimal distortion to competition, as it is in the EU, where state aid is regulated by EU treaties. In Armenia the state can grant deferral of tax payments, as well as offering direct subsidies, guarantees, government loans and subsidies for interest payments. Business projects that satisfy certain criteria can benefit from government support programs, including both financial and technical assistance. The government's website publishes a list of requirements, selection criteria, and a scoring system for applicants, but potential distortions to competition are not considered. Large companies account for 68 percent of all loans granted by the

⁵³ See, among others, Parente and Prescott (1999) or Acemoglu et al. (2006).

government. Two companies in particular have received significant credit support, while three other companies account for a sizeable portion of outstanding tax arrears.⁵⁴

6.18. The systemic advantages of business elites result in a general welfare loss. It is estimated that under-collection of direct taxes and duties owed by business elites amounts to between 1.4 and 2.6 percent of GDP, as weaknesses in tax policy and administration have eroded the tax bases. The welfare loss due to distorted food prices is estimated at 2.3 percent of per capita GDP and 4.2 percent of per capita consumption.⁵⁵ Empirical evidence on food-price elasticities indicates that the total consumer welfare loss is US\$295 million per year, about US\$91 per capita or 2.4 percent of per-capita GDP.

6.19. Greater disclosure of firm-level information would enable further analysis and more effective policy recommendations. Incomplete information limits assessments of the extent to which market concentration and anticompetitive behaviors are distorting economic sectors, slowing growth and diminishing fiscal revenues. The disclosure of three types of firm-level information is particularly important in Armenia: (i) financial information, (ii) non-financial disclosures, and (iii) trade data. Firm-level trade data are important to limit opportunities for corruption in the application of import duties, but statistics on firm exports and imports are not readily accessible.⁵⁶ Under the current customs code there is a valuation option that includes the application of referential prices, which interviewees identify as below market. The discretionary application of this valuation method creates distortions by allowing some companies to pay lower taxes. Disclosure of information on fiscal incentives is also critical to identifying anticompetitive distortions.

6.20. Policy reforms designed to enhance competition and incentivize innovation include:

- **Establishing a unified tax code.** A single tax policy supported by clear rules for tax administration would increase the transparency of the tax system, reduce anticompetitive advantages, and enable policymakers to expand the tax base and rationalize tax rates.
- **Strengthening disclosure requirements for firms.** Recent reforms to Armenia's accounting rules require greater disclosure of firm-level information, paving the way for adoption of International Financial Reporting Standards, and efforts are underway to enhance state control over audit firms. However, auditors and regulators continue to face serious capacity constraints and the financial statements of many Armenian enterprises fall short of international standards. Publication of financial statements remains limited and inconsistent and additional work will be required to increase access to non-financial information, such as ownership structure and investor rights.
- **Tightening conflict-of-interest regulations.** The disclosure of potential conflicts of interest among members of the legislature is important to ensure the integrity of the public trust. Consistent implementation of the relevant provisions of the 2011 Law on Public Service, including online publication of conflict-of-interest declarations, would greatly enhance public accountability.
- **Reinforcing the legal framework for competition.** To ensure a level playing field in the private sector reforms clarifying the definition of economic entities, anticompetitive practices and market dominance should be complemented by more robust regulatory authority. The State Commission for

⁵⁴ World Bank (2013).

⁵⁵ Food prices in Armenia are about 17 percent higher on average relative to the other CIS countries, even after adjusting for per capita GDP, cost of imports, product variables and time control variables (World Bank, 2013).

⁵⁶ By contrast these data are available in a number of countries, including Argentina, Peru, Brazil, Chile, Germany, Indonesia, Korea, Taiwan and the United Kingdom.

the Protection of Economic Competition (SCPEC) needs to shift focus from price fluctuations to actual and potential barriers to market entry and contestability.

- **Eliminating anticompetitive government interventions and distortive regulations.** Strengthening the SCPEC's advocacy mandate would enable it to draw attention to inefficient policies and open excessively concentrated markets to greater competition. The SCPEC could also help to deter the passage of new anticompetitive regulation by increasing the awareness of other government agencies, regulators and the public regarding the distortive effects of specific provisions. Close collaboration with other regulatory agencies will help to avoid duplicative efforts and maximize the impact of limited institutional capacity.
- **Reforming state aid to minimize potentially distortive effects on competition.** The introduction of a comprehensive state aid framework could help prevent the abuse of these policies by entrenched incumbents. Reforming incentives would also support the achievement of economy-wide development objectives, including increasing R&D output, accelerating technology transfer and boosting innovation.

CREATING A MORE DYNAMIC ARMENIAN ECONOMY

6.21. Policies and institutional arrangements that facilitate the emergence of more competitive firms, incentivize innovation and promote the spread of new productive technologies are the foundation of economic dynamism.⁵⁷ In Armenia, as in many other countries in the former Soviet sphere, market mechanisms remain compromised by a confluence of historical influences, geographic factors and contemporary policy decisions that discourage technological adaptation and limit international integration. In this context policymakers may target the development of high-tech manufacturing without first ensuring that the country's underlying physical capital, human capital and institutional structure are capable of fostering and sustaining highly sophisticated, globally competitive industries.

6.22. Weaknesses in Armenia's national innovation system reduce the supply of innovation and slow its adoption by firms. Armenia has begun to define an effective national strategy for promoting innovation supported by an improved legal framework and appropriate institutional mechanisms and funding arrangements. However, important progress has yet to be achieved in a number of key areas, including the active engagement of the private sector in research and development, as well as the long-term process of levelling the economic playing field. These deficiencies prevent private firms from fully leveraging the knowledge base of public research institutions and undermine demand for new productive technologies.

6.23. Armenia has completed the first generation of reforms that have transformed it into a market economy, yet limited competition and the dominance of business elites threaten its ultimate goal of convergence with the industrialized world. Market incentives drive efficiency improvements, encouraging the entry of pioneering firms, the opening of new markets and the adoption of new technologies. However, when the fundamental elements of a competitive policy framework are compromised by the influence of powerful firms, these incentives cannot function effectively. In order to achieve its development objectives Armenia must further strengthen its economic policies and institutions to support more robust competition and spur more rapid technological advancement.

⁵⁷ The focus on underlying capabilities, endowments or assets has been emphasized in a number of recent World Bank reports, including: "Diversified Development. Making the Most of Natural Resources in Eurasia" (2014), "Implications of a Changing China for Brazil: A New Window of Opportunity" (2014), "China 2030. Building a Modern, Harmonious, and Creative Society" (2013) and "Does what you Export Matter? In Search of Empirical Guidance for Industrial Policies" (2012).

Annexes

Annex 1. Decomposition of Effects on Long-Run Growth

Theoretical Background

Structural factors are expected to influence long-run aggregate supply. In basic neoclassical long-run models output per capita is determined by the long-run aggregate supply curve based on an aggregate production function including capital accumulation and technology. In the empirical model used in this analysis structural policy variables reflecting human capital, financial development, infrastructure or trade openness proxy for these effects. Furthermore, we consider institutional quality and government consumption, which could affect capital formation and allocative efficiency.

Cyclical factors and stabilization policies also have potential effects on growth. Over the short-term demand factors should be taken into account. For example, expansive monetary policy can boost output in the short run. However, higher inflationary pressures can cause cyclical distortions that might adversely affect the allocation of productive factors in the economy. Ensuring a stable macroeconomic environment will support the most efficient allocation of resources, as will institutional stability and a level regulatory playing field. In our empirical model stabilization policies such as the inflation rate, a proxy for exchange rate misalignment, and banking crisis reflect this channel.

External conditions are particularly important for emerging and developing economies. Virtually all developing countries are commodity exporters and higher export prices, as observed over the last decade, will impact their income through export revenues. While the impact of commodity price booms may be temporary, they they can influence long-term aggregate supply if revenue windfalls are spent wisely, e.g. on institution building. Abundant international liquidity similarly eases access to finance and supports capital accumulation in capital-scarce countries. In our empirical model external factors are captured by the terms-of-trade growth, growth in (country-specific) commodity prices and time dummies reflecting global effects such as liquidity.

Data and Methodology

The analysis employs the methodology of Araujo et al (2014) that builds on and expands the econometric approach developed by Loayza et al (2005). Using dynamic panel data regressions this approach investigates how aggregate economic, political and social variables affect per-capita GDP growth rates using a sample of 126 countries during the 1970-2010 period. The dataset is extended to include 2010-2013 data for Armenia. To smooth out cyclical short-run effects the model is estimated using the 5-year averages of non-overlapping panel data. The period used in this study, 1996-2013, consists of 4 data points (2000, 2005, 2010 and 2013) and captures average values for the following time periods:

The 2000s: $\text{Avg.}[2006-2010] - \text{Avg.}[1996-2000] = 2010-2000$
Early 2000s: $\text{Avg.}[2001-2005] - \text{Avg.}[1996-2000] = 2005-2000$
Late 2000s: $\text{Avg.}[2006-2010] - \text{Avg.}[2001-2005] = 2010-2005$
Early 2010s: $\text{Avg.}[2011-2013] - \text{Avg.}[2006-2010] = 2013-2010$

The “Early 2000s” period reflects change between the 1996-2000 and 2001-2005 averages; the “Late 2000s” measures performance between the 2001-2005 and 2006-2010 averages; and the “Early 2010s” compares 2006-2010 averages with 2013 values.

The model incorporates the most relevant factors influencing growth in neoclassical models. Variables are grouped to capture the effects of different policies on GDP per capita growth over time.⁵⁸ Structural policy variables which reflect the effects of capital accumulation and technology are proxied by human capital (schooling), financial development (private credit/GDP), trade openness and infrastructure (telephone lines). The effects of government consumption and institutional quality (polity2) on capital formation and allocative efficiency are also considered. Stabilization policies such as the inflation rate, a proxy for exchange rate misalignment, and the banking crisis reflect macroeconomic environment inductive for efficient allocation of resources. External factors, captured by the terms-of-trade growth, growth in (country-specific) commodity prices, and time dummies capturing global effects such as liquidity, reflect commodity price booms and access to international liquidity, both of which are favorable conditions for commodity exporters. The model also includes a growth-persistence parameter capturing the effects of past shocks and interventions, which is introduced by the lagged dependent variable. See Table A-1.1 for a detailed description of variables and their sources.

The following model is estimated to explain per capita GDP growth in country c in year t as the dynamic (“steady-state”) process:

$$\ln y_{ct} = \theta \ln y_{ct-1} + \Gamma \ln(X)_{ct} + \alpha_c + b_t + e_{ct} \quad (1)$$

where $\ln y_{ct}$ is the natural log of real PPP GDP per capita of country c in period t ; X_{ct} is a vector of growth determinants; α_c and b_t are country and year fixed effects; and e_{ct} is an error term. The model is estimated using the System Generalized Methods of Moments (GMM) method, which uses internal instruments to prevent endogeneity biases due to the lagged dependent and explanatory variables.

The main finding of this study is that the structure of growth drivers in Armenia have remained mostly unchanged over the past two decades. This study finds that external conditions have played a relatively modest role in the recent growth of the Armenian economy. Like other countries in the region Armenia is reaping the growth benefits of structural changes in the financial sector and infrastructure. Past reforms continue to drive growth, and structural features remain a robust determinant of economic performance. Stabilization-related variables were not an essential driver of growth, reflecting macroeconomic instability and periods of high inflation volatility, particularly in the late 1990s and 2000s.

⁵⁸ While the model was developed and variables were chosen to reflect the Latin American & Caribbean region (LAC), it could be relevant for other countries, although fitted values might be further away from the regression line.

Table A1-1. Description of Variables

Variable	Description	Source
Growth Rate of GDP per capita	The change in the natural logarithm of real PPP GDP per capita between period t and t-1.	PWT 7.1
Schooling	The natural logarithm of the secondary school enrolment rate.	WDI (2013)
Private Credit/GDP	The natural logarithm of the ratio of domestic credit to the private sector divided by GDP. Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment.	WDI (2013)
Trade Openness	The natural logarithm of the ratio of exports plus imports over PPP GDP adjusted for countries' population size.	PWT 7.1
Telephone Lines	The natural logarithm of main telephone lines per capita. Telephone lines are fixed telephone lines that connect a subscriber's terminal equipment to the public switched telephone network and that have a port on a telephone exchange. Integrated services digital network channels and fixed wireless subscribers are included.	WDI (2013)
Mobile Phones	The natural logarithm of mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included.	WDI (2013)
Government Size	The logarithm of the ratio of government consumption expenditures over GDP.	PWT 7.1
Polity2	The polity2 score measures the degree of political constraints, political competition, and executive recruitment. It ranges between -10 to 10 with higher values denoting more democratic institutions.	Polity IV (2012)
CPI Inflation	The natural logarithm of 100+consumer price inflation rate. CPI inflation reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	WDI (2013)
Real Exchange Rate	The natural logarithm of the GDP price level divided by the nominal exchange rate.	PWT 7.1
Banking Crisis	Indicator Variable that is unity in period t if the country experienced a banking crisis.	Reinhart and Rogoff (2011)
Terms of Trade Growth	The change in the natural logarithm of the net barter terms of trade index. The net barter terms of trade index is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000.	WDI (2013)
ComPI Growth	The change in an international commodity export price index. The index is constructed as $\text{ComPI}_{ct} = \prod_{i \in I} \text{ComPrice}_{it}^{\theta_{ic}}$ <p>where ComPrice_{it} is the international price of commodity i in year t, and θ_{ic} is the average (time-invariant) value of exports of commodity i in the GDP of country c. Data on international commodity prices are from UNCTAD Commodity Statistics and data on the value of commodity exports are from the NBER-United Nations Trade Database (Feenstra <i>et al.</i>, 2004). The commodities included in the index are aluminum, beef, coffee, cocoa, copper, cotton, gold, iron, maize, oil, rice, rubber, sugar, tea, tobacco, wheat, and wood.</p>	Arezki and Brueckner (2012)

Annex 2-A. Legal Framework in Science, Technology and Innovation

1. Innovation Policy and Regulation

- **Law on Small and Medium Entrepreneurship State Support, 2000.**
- **Government Resolution on the ICT Development Concept Paper and Action Plan (May 2001).** Highlights the existence of adequate potential in the country for development of the ICT sector, as well as the need for further improvements to infrastructure and legislation supporting development of the ICT industry.
- **Law on the State Support to Innovation Activity (May 2006).** Defines the legal and economic bases for the development of a national innovation policy and discusses state support for innovation activities.
- **Government resolution on authorizing the Ministry of Economy as the body responsible for development and implementation of innovation policy (September 2006).**
- **Government Resolution No. 1269 on the State Committee of Science (October 2007).** Directed to improve policymaking and coordination in the field of S&T, and the State Committee of Science was empowered to carry out integrated S&T policy in the country.
- **Government resolution on optimization of the infrastructure of NAS (2006).**
- **Strategy on the Development of Science for 2011-2020 (May 2010).** Outlines the state's policy on the development of science in 2011-2020.
- **Law on the NAS (2011).** Assigns a special status to the Academy, which is empowered to coordinate and carry out basic and applied research directed toward the creation of a knowledge-based economy, and social and cultural advancement. The Law provides more power to the Academy and its research institutes to carry out business activities geared towards the commercialization of R&D outcomes and the creation of spin-offs.
- **Concept Paper on the Initial Strategy for Formation of the Innovation Economy (2011).**
- **Government Resolution on the Strategy of Export-led Industrial Policy of the Republic of Armenia (December 2011).**

2. Intellectual Property

- **The Law on Trademarks (2010).** A new Trademark Law, effective from July 1, 2010, is harmonized with EU directives and the TRIPS Agreement.
- **Law on Inventions, Utility Models and Industrial Designs (2008).** Regulates the property and non-property relationships related to the creation, legal protection and utilization of inventions, utility models and industrial designs.
- **Law on Trade Names of (November 1999).** Manages issues related to the registration, legal protection and use of trade names by legal entities.
- **Law on the Legal Protection of Topographies of Integrated Circuits (February 1998).** Governs relationships related to the creation, legal protection and use of topographies.

3. Science and scientific activities

- **Law on Scientific and Technological Activity, (December 2000).** Regulates the relationships between R&D performers, state bodies and R&D outcome consumers, and outlines the general principles of forming and implementing state policy in the field of S&T.
- **Science and Technology Development Priorities for 2015-2019 (December 2014).** Defines the following science and technology priorities: Armenian studies, life sciences, renewable energy, new energy sources, advanced technologies, information technologies, space, earth sciences, sustainable use of natural resources and basic sciences for key applied research.

Annex 2-B. List of Research Organizations

Institute of Mathematics
Institute of Mechanics
Institute for Informatics and Automation Problems
Institute for Physical Research
Institute of Radiophysics & Electronics
Institute of Applied Problems of Physics
Byurakan Astrophysical Observatory after V. Hambardzumyan
Institute of Geological Sciences
Institute of Geophysics and Engineering Seismology after A. Nazarov of NAS
Institute of Chemical Physics after A. Nalbandyan of NAS
Scientific Technological Centre of Organic and Pharmaceutical Chemistry
Institute of General and Inorganic Chemistry after M. Manvelyan
G.S.Davtyan Institute of Hydroponics Problems
Institute of Botany
Scientific Centre of Zoology and Hydroecology
Institute of Biochemistry after H. Buniatian
Institute of Physiology after L. Orbeli
Institute of Molecular Biology
Centre for Ecological Noosphere Studies
Institute of History
Institute of Oriental Studies
Institute of Archaeology and Ethnography
Museum-Institute of Genocide
Shirak Armenology Research Centre
M.Kotanyan Institute of Economics
Institute of Philosophy, Sociology and Law
Institute of Literature after M.Abeghyan
Institute of Linguistics after H. Atcharian
Institute of Arts
National Bureau of Expertises
Armbiotechnology Scientific and Production Centre SNCO
International Scientific-Educational Centre
CJSC "Department of Hydromechanics and Vibro-techniques" at NAS
"Armenian Encyclopaedia" Publishing House State Non-Profit Organization
Yerevan State University
State Engineering University of Armenia
National University Of Architecture And Construction Of Armenia
Yerevan State Medical University after M. Heratsi
Armenian National Agrarian University
Research Centre for Soil Science, Agrochemistry and Land-Reclamation Named After H.Petrosyan
Scientific Centre of Viticulture, Fruit Growing and Wine Making SNPO
Scientific Centre of Agrobiotechnology SNCO
Centre for the Advancement of Natural Discoveries using Light Emission
A.I. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Foundation
Armenian State Pedagogical University after Kh. Abovyan
Armenian State University of Economics
Yerevan State Linguistic University after V. Brusov
Goris State University
Gyumri State Pedagogical Institute
Yerevan Komitas State Conservatory
Russian - Armenian (Slavonic) University
Unesco Chair - Life Sciences International Postgraduate Educational Centre
National Institute of Education CJSC
The Mesrop Mashtots Institute of Ancient Manuscripts

Research Institute of Epidemiology, Virology and Medical Parasitology named after A.B. Alexanian
 SNCO
 Haematology Centre after prof. R. Yolyan
 Scientific Centre of Trauma and Orthopaedics
 Scientific Research Institute of Spa Treatment And Physical Medicine
 National Centre for Disease Control and Prevention
 Scientific Centre of Radiation Medicine and Burns CJSC
 Scientific-Research Institute of General Hygiene and Occupational Diseases Named After
 N.B.Hakobian
 Food Safety Risk Analysis and Assessment Research Centre State Non-Commercial Organization
 Scientific Centre of Agriculture State Non-Commercial Organization
 Scientific Centre of Vegetable and Industrial Crops (SCVIC)
 'Crops experimental station" State Closed Joint-Stock Company
 Scientific Research Centre of the Historical and Cultural Heritage
 SJSC "Centre for Restoration of the Monuments"
 Ervand Kochar Museum
 'Service for the Protection of Historical Environment and Cultural Museum-Reservations" NSO of
 the Ministry of
 National Institute of Metrology CJSC
 "Scientific Research Institute of Cardiology after I.A. Hovhannisyan"
 "Armatom" Armenian Scientific Research Institute For Nuclear Plant Operation CJSC
 National Archives of Armenia
 "Noravank" Foundation
 Appraisal and Testing Center SNCO
 Public Administration Academy of the Republic of Armenia
 "Arabkir" Joint Medical Centre – Institute of Child and Adolescent Health (Arabkir JMC)
 Institute of Water Problems and Hydro-Engineering Named After I.V. Eghiazarov
 "Multi Agro" Scientific and Production Centre
 Barva Innovation Centre
 Armenian Institute of Applied Chemistry "ARIAC"
 'Precision Sensors & Instruments Ltd" (PSI)
 "Yerevan Telecommunication Research Institute" CJSC

Source: SCS.

Annex 2-C. State Budget Financing for Research

State budget financing of NAS by research institutes in 2012-2013, mln. AMD

	2012	2013
Institute of Mathematics	63.4	67.7
Institute of Mechanics	145.9	151.7
Institute for Informatics and Automation Problems	225.4	246.7
CJSC “Department of Hydromechanics and Vibro-techniques” at NAS	3.2	4.4
Byurakan Astrophysical Observatory after V. Hambardzumyan	65.5	202.0
Institute for Physical Research	147.0	169.5
Institute of Applied Problems of Physics	197.0	210.6
Institute of Radiophysics & Electronics	163.8	155.3
Centre for Ecological Noosphere Studies	100.2	102.7
Institute of Botany	97.7	106.7
Scientific Centre of Zoology and Hydroecology	91.1	108.4
Armbiotechnology scientific and production centre SNCO	233.5	244.8
G.S.Davtyan Institute of Hydroponics Problems	58.5	54.4
Institute of Molecular Biology	150.0	139.0
Institute of Physiology after L. Orbeli	106.6	110.0
Institute of Biochemistry after H. Buniatian	139.9	165.0
Institute of Chemical Physics after A. Nalbandyan of NAS	95.2	91.4
Institute of General and Inorganic Chemistry after M. Manvelyan	99.6	95.8
Scientific Technological Centre of Organic and Pharmaceutical Chemistry	247.3	275.8
Institute of Geological Sciences	161.0	161.6
Institute of Geophysics and Engineering Seismology after A. Nazarov of NAS	59.1	85.1
Institute of History	127.9	150.3
Institute of Philosophy, Sociology and Law	39.6	44.2
M.Kotanyan Institute of Economics	83.1	144.3
Institute of Linguistics after H. Atcharian	54.4	70.8
Institute of Literature after M.Abeghyan	46.5	51.9
Institute of Oriental Studies	73.0	79.5
Institute of Arts	65.3	66.8
Institute of Archaeology and Ethnography	280.5	306.9
Museum-Institute of Genocide	90.5	92.0
Shirak Armenology Research Centre	21.2	23.6
National Bureau of Expertises	171.7	173.1
ISTC Armenian office	7.8	9.3
NAS	557.8	616.3
Total	4270.5	4777.7

Source: staff calculations based on MOF data.

Annex 3-A. Policy Environment Analysis

As detailed in Pena (2015) the econometric methodology used to assess the effects of the policy environment on enterprise performance consists of two steps:

- a. *Identification of statistically significant policy environment (X) effects on productivity and other performance variables.* For the identification of the statistically significant X effects on economic performance, the analysis uses a simultaneous equations system that relates the interactions between the policy environment with productivity, demand for labor, exports, FDI inflows and R&D activity. Estimation always controls for firms' size, region and sector. The X elasticities and semi-elasticities with respect to firms' economic performance provide a measure of the sensitivity of outcome variables form marginal changes in the policy environment.
- b. *Evaluation of relative policy environment contribution to aggregate (weighted average) productivity.* The analysis also evaluates the policy environment in terms of the Olley and Pakes (O&P) decomposition of aggregate productivity (or weighted average using the share of sales as weights) into average productivity and allocative efficiency and on the average values of the remaining firms' economic performance variables.

Estimation of policy environment effects on productivity

In the system of equations, policy environment information (X) and other firm-level information (W) are both used as proxies of idiosyncratic firm-level differences. Specifically, we assume that cross-sectional $\ln(\text{TFP})$, which we refer to as ω_i , is determined by:

$$y_i = a_l l_i + a_m m_i + a_k k_i + w_i \tag{1.a}$$

$$w_i = a_p + X_i a_X + W_i a_W + D_i a_D + u_{w,i} \tag{1.b}$$

The first equation is a Cobb Douglas production function, where lower cases denote variables in logs and y is sales, l is labor, m is materials and k is capital stock, with productivity the residual of the production process. The second equation gives form to TFP by decomposing it into a wide set of firm level attributes such as location, sector of activity and firm size (all represented by dummy variables included in the matrix D), policy environment variables (X), other firm level attributes (W), a constant technical efficiency term α_p , and by an error term ($u_{\omega,i}$).

The complete list of X and W variables are in Tables 1.1 and 1.2 respectively. We considered an initial set comprised by more than 50 variables, which was eventually reduced to 35 due to data quality. Note that there are three types of variables depending on how we measure them: i) dummy or dichotomous variables which we denote by d; ii) variables in percentage (%) and iii) variables in natural logarithms (ln). The parameters of the first two are interpreted as semi-elasticities (provided productivity is in logs), while the interpretation of the effect of variables in logs is as an elasticity.

Summary of econometric issues regarding data quality

To carry out the analysis, we pool together observations for manufacturing firms from years 2009 and 2012. This is due to small sample size in some countries and to increase the degrees of freedom in the analysis. We implicitly assume the 2009 and 2012 samples are independent random draws of the same underlying populations (Table A3-1).

Table A3-1. Manufacturing firms surveyed by country and year

Country	2009	2012	Total
Albania	65	110	175
Belarus	104	117	221
Georgia	125	111	236
Russia	706	1,373	2,079
Serbia	136	118	254
Moldova	108	108	216
Armenia	115	109	224
Total	1,359	2,046	3,405

Source: Author's calculations with BEEPs data.

Missing values are found for production function variables y , l , m , k , and for X and W variables. The model uses an imputation strategy based on the method of multiple imputation by chained equations (MICE) (van Buuren, et al., 1999 and Raghunathan et al., 2001), which has been shown to work well under different missing data patterns (Escribano and Pena, 2014). The general idea of MICE is to use Markov-Chain Monte Carlo (MCMC) simulation to create several copies of the data. In each link of the Markov chain, say t , MI first takes draws from the distribution of the variables conditional on the set of information, or what we observe, $X(t+1) \sim F(X_{mis}|X_{obs}; \theta(t))$. This is the imputation step. In the prediction step the method draws a new set of parameters from its posterior distribution, $p(\theta|X(t+1), X_{obs})$, which will be used in the imputation step at $t+1$ to draw a new set of missing values estimates. The process is repeated until convergence is achieved, and estimated imputations and parameters do not change significantly.

Summary of econometric issues in productivity estimation

We estimate equation (1.a) and (1.b) using 6 different methods for each country considered: Armenia, Albania, Belarus, Georgia, Moldova, Russia and Serbia. We want the estimates (elasticities and semi-elasticities) to be robust for all of the methods proposed. The different productivity measures derive from: i) different functional forms of the production function, Cobb-Douglas and Translog; ii) different sets of assumptions (technology and market conditions), either the Solow residual or OLS estimation of (1); and iii) different levels of aggregation in measuring input-output elasticities of equation (6) at the industry level or at the aggregate country level. The productivity measures used in this report are summarized in Table A3-2 below:

Table A3-2. Summary of Estimation Methods of Productivity Equation

Functional forms of production function	Estimation procedure	Aggregation level of coefficients of PF	Result
1. Solow's Residual	Two-step estimation	1.1 Unrestricted coefficients	2 (ω) measures; 2 (X) elasticities & semi-elast.
		2.2 Unrestricted coefficient	
2. Cobb-Douglas	Single-step estimation	2.1 Restricted coefficient	2 (ω) measures; 2 (X) elasticities & semi-elast.
		2.2 Unrestricted coefficient	
3. Translog	Single-step estimation	3.1 Restricted coefficient	2 (ω) measures; 2 (X) elasticities & semi-elast.
		3.2 Unrestricted coefficient	
Total			6 (ω) measures; 6 (X) elasticities & semi-elast.

- **Endogeneity of the inputs.** There is an identification issue separating TFP from the production function (PF). When a PF input is influenced by unobserved common causes affecting productivity—such as a firm’s fixed effects—there is a simultaneous equation problem in equations (1.a) and (1.b) and hence in the single step estimation procedure.
 - **Solution:** To address this problem (Marschak and Andrews, 1944, and Griliches and Mairesse, 1995) the analysis follows the approach proposed by Escribano and Guasch (2005, 2008). The usually unobserved firm-specific fixed effects, which are the main cause of the inputs’ endogeneity, are proxied by a long list of observed firm-specific fixed effects deriving from the Enterprise Survey. Controlling for the largest possible set of X variables and plant characteristics (W), under standard regularity conditions estimation yields consistent and unbiased least squares estimators of the parameters of the PF and the X elasticities.
- **Endogeneity of X variables:** For consistency in estimation the error term must be uncorrelated with any variable contained in the X vector. It can be argued that the error term may contain unmeasured effects correlated with X, thus rendering the OLS estimator of X effects inconsistent.
 - **Solution:** Correction for observable fixed effects. By using the full set of information contained in the X variables we are able to control for more than 35 variables in the estimation, eliminating a large degree of endogeneity and spurious correlations as expectation of the outcome variables is conditioned on as much information as possible.
- **Selection of the relevant model.** The population model is unknown and needs to be approximated based on a broad set of more than 35 variables, including X and other controls.
 - **Solution:** The econometric methodology applied for the selection of variables goes from the general to the specific; otherwise, an omitted variables problem would generate biased and inconsistent parameter estimates. Estimation proceeds by removing the less significant variables from the regressions one by one until a final set of variables is obtained, all significant in at least one of the regressions and with parameters varying within a reasonable range of values.
- **Heteroskedasticity in the error term.**
 - **Solution:** the heteroskedasticity of the error is addressed by using robust (White) standard errors. In response to the fact that data was collected using a random sampling by clusters, cluster standard errors are also computed, allowing for correlation within industry and region.

Estimation of the effects on other firm performance measures

We decompose firm level productivity into two terms. The first is demeaned productivity, ω^d , the part of productivity related to the policy environment, and is computed as:

$$W_i^d = W_i - \hat{\alpha}_p - W_i \hat{\alpha}_W - D_i \hat{\alpha}_D - \hat{u}_{w,i} = X_i \hat{\alpha}_X. \quad (2)$$

The other productivity measure is the remainder or undemeaned productivity:

$$W_i^u = W_i - W_i^d. \quad (3)$$

We use both measures of productivity as explanatory variables as each offers different interpretations. Demeaned productivity is the share of productivity explained by the policy environment. The remainder contains the constant technical efficiency (α_p), firm level variables (W and D) or unpredictable shocks (u).

Demand for labor is assumed to be determined by both firm level productivities, by real wages in logs ($\ln W_i$) or w_i in logs, output (y_i), firm level differences approximated by X , firm level variables W , sector/location/size information (D), and an error term (ε_i^L), with variables other than real wage assumed to shift labor demand:

$$l_i = g_0 + g_y y_i + g_w w_i + g_d W_i^d + g_u W_i^u + X_i g_x + W_i g_w + D_i g_D + u_{L,i} \quad (4)$$

The probability of firms entering the export market is modeled through:

$$y_i^{Exp} = d_0 + d_d W_i^d + d_u W_i^u + X_i d_x + W_i d_w + D_i d_D + u_{Exp,i} \quad (5)$$

The probability of receiving foreign direct investment (FDI) is modeled through:

$$y_i^{FDI} = r_0 + r_d W_i^d + r_u W_i^u + X_i r_x + W_i r_w + D_i r_D + u_{FDI,i} \quad (6)$$

The probability of investing in R&D is modeled through:

$$y_i^{RnD} = j_0 + j_d W_i^d + j_u W_i^u + X_i j_x + W_i j_w + D_i j_D + u_{RnD,i} \quad (7)$$

Since the variables y_i^r , with $r = \text{Exp, FDI and RnD}$, are binary random variables taking 0 and 1 values, $P(y_{it}^r = 1 / x) = E(y_{it}^r / x)$, the conditional probability, is equal to the conditional expectation, which is usually assumed to follow a Probit or a Logit model. In general linear probability models (LPM) approximate well Probit and Logit nonlinear models when the variables are evaluated close to their sample means. Since we are interested in the mean X contributions relative to the mean values of the economic performance variables we will concentrate only on linear probability specifications.

International comparisons: demeaned log-productivity

Interpretation of TFP is assumed conditional on the understanding of firms' operating conditions. Any productivity measure is subject to measurement errors, unmeasured effects, differences in the deflators used, etc. To make cross-country comparisons based on X impacts on productivity it is desirable to create an index (demeaned productivity). After subtracting the mean (that is, the constant term, time effects, industry effects and firm level effects) from firm level log-productivity we can concentrate on the part of log-productivity explained by the X variables. Thus, demeaned log-productivity at the firm level is simply:

$$W_i^d = X_i \hat{\alpha}_X \quad (8)$$

Expression (8) is comparable across countries because the set of X variables is the same in all countries and the same methodology is applied to select the set of significant X variables. In addition O&P decompositions can be easily computed based on the demeaned portion of productivity. This allows for international comparisons of X impacts on aggregate productivity. The Olley and Pakes (O&P) decomposition of aggregate productivity in logs is:

$$W = \bar{W} + N \hat{\text{cov}}(s_i, W_i) \quad (9)$$

Where ω_i is aggregate log-productivity (or weighted average productivity, where the weights are given by the shares of sales), \bar{W} is un-weighted average log-productivity, and the last term is the covariance between share of sales and firm-level productivity, the allocative efficiency term, which describes the ability of markets to reallocate resources from less to more productive establishments.

The useful additive property of equation (9) in logarithms, allows obtaining an exact closed form solution of the decomposition of aggregate log-productivity. Following Escribano et al. (2008b) we can express aggregate log-productivity as a weighted sum of the average values of two composite terms: a) the X, W and D variables, the intercept and the productivity residuals (u_{ω}); and b) the sum of the covariances between the share of sales and X, W, D and the productivity residuals:

$$W = \bar{X}\hat{a}_X + \bar{W}\hat{a}_W + \bar{D}\hat{a}_D + \hat{a}_\rho + n\hat{C}(s_i, X_i)\hat{a}_X + n\hat{C}(s_i, W_i)\hat{a}_W + n\hat{C}(s_i, D_i)\hat{a}_D + n\hat{cov}(s_i, \hat{u}_{w_i}) \quad (10)$$

The contributions of X variables to aggregate log-productivity of equation (10) can be computed for the whole sample, by industry/sector, by region, by firm size, etc., n being the number of firms contained in each sub-sample.

Table A3-3. Summary of Information of Production Function Variables

		Albania	Belarus	Georgia	Russia	Serbia	Moldova	Armenia
Sales (y) (ln)	N	153	187	187	1,628	236	200	170
	% lost	12.6	15.4	20.8	21.7	7.1	7.4	24.1
	Mean	17.3	21.7	12.8	17.5	18.3	15.3	18.4
	S.D	1.7	2	2.1	1.9	1.8	2	1.7
Labor (l) (ln)	N	172	221	234	2,076	254	216	224
	% lost	1.7	0.0	0.8	0.1	0.0	0.0	0.0
	Mean	10.6	11.4	11	11.4	11.2	11.1	11
	S.D	1.4	1.4	1.2	1.4	1.3	1.3	1.3
Materials (m) (ln)	N	66	158	173	1,192	219	165	143
	% lost	62.3	28.5	26.7	42.7	13.8	23.6	36.2
	Mean	16.2	20.4	12	16.3	17.1	14.2	17.2
	S.D	2.4	2.4	2.2	2.2	2.1	2.2	1.9
Capital stock (k) (ln)	N	63	138	163	904	207	144	113
	% lost	64.0	37.6	30.9	56.5	18.5	33.3	49.6
	Mean	16.3	19.5	11	15.2	16.7	13.5	17.2
	S.D	2.2	2.5	2.3	2.4	2.3	2.4	2.4

Source: Author's calculations with BEEPs data.

Table A3-4. Policy Environment Variables (X) in Armenia

	N	% lost	Mean	S.D
I. Infrastructure				
Shpim. lss. exp. (%)	221	1.3	0.26	1.5
Power outages (ln)	195	12.9	0.47	0.99
Generator (d)	222	0.9	0.16	0.37
II. Informality, bureaucracy, corruption				
Customs exp. (ln)	220	1.8	0.32	0.76
Customs imp. (ln)	216	3.6	0.87	1.4
Manager's time (%)	215	4.0	12	14
Inf. payms. taxes (d)	221	1.3	0.059	0.24
Security (d)	224	0.0	0.54	0.5
Auditory (d)	224	0.0	0.24	0.43
Courts (d)	222	0.9	0.24	0.43
Inf. comp. (d)	215	4.0	0.22	0.41
III. Finance				
Purchs. aft. delivery (%)	222	0.9	22	28
Sales aft. delivery (%)	220	1.8	30	33
Fix. assets internal (%)	220	1.8	23	39
Fix. assets equity (%)	220	1.8	10	28
Fix. assets banks (%)	220	1.8	7.1	22
Overdraft (d)	212	5.4	0.39	0.49
Loan (d)	223	0.4	0.45	0.5
Subsidy (d)	222	0.9	0.036	0.19
IV. Innovation				
ISO (d)	221	1.3	0.32	0.47
R&D sub. (d)	224	0.0	0.2	0.4
R&D p.worker	201	10.3	1.2	3.4
Sales new prds. (%)	219	2.2	12	20
Forgn. tech. (d)	222	0.9	0.27	0.45
Staff compts. (%)	189	15.6	31	28
Web page (d)	224	0.0	0.63	0.48
V. Labor skills				
Manager exp. (%)	224	0.0	2.7	0.63
Prod. staff (%)	217	3.1	69	19
Skilled staff (%)	210	6.3	45	30
High school staff (%)	221	1.3	42	28
Training (%)	222	0.9	0.16	0.37
VI. Openess				
FDI (d)	223	0.4	0.099	0.3
Exports (d)	223	0.4	0.2	0.4
Exports exp. (ln)	216	3.6	0.35	0.84
Imports (d)	221	1.3	0.35	0.48

Source: Author's calculations with BEEPs data.

Table A3-5. Other Firm Level Variables (W) in Armenia

	N	% lost	Mean	S.D
Undiversified (%)	222	0.9	76	25
Shareholder (%)	218	2.7	81	24
Inc. (d)	224	0.0	0.96	0.19
Local (d)	224	0.0	0.2	0.4
Age (ln)	224	0.0	2.6	0.7
Market share (%)	170	24.1	7.1	13

Source: Author's calculations with BEEPs data.

Table A3-6. Armenia - Robust Productivity Estimations, X and W Elasticities and Semi-Elasticities

	Two-steps					
	Single step with Solow residual		Cobb Douglas		Translog	
	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted
II. Informality, bureaucracy, corruption						
Customs imp. (ln)	-0.199*	-0.162	-0.091	-0.143	-0.05	-0.131
Manager's time (%)	0.012*	0.013*	0.013**	0.016***	0.014**	0.013**
Courts (d)	0.362**	0.352**	0.498***	0.376**	0.499***	0.330**
III. Finance						
Overdraft (d)	0.295**	0.285**	0.241*	0.182	0.213	-0.021
Subsidy (d)	-1.408***	-1.460***	-1.233***	-1.113***	-1.127***	-1.042***
IV. Innovation						
Forgn. tech. (d)	0.197	0.184	0.282**	0.328**	0.301**	0.288*
Sales new prds. (%)	0.007**	0.007**	0.004	0.003	0.005	0.004
V. Labor skills						
Skilled staff (%)	0.007***	0.006**	0.006**	0.004*	0.007***	0.006**
VI. Openness						
Imports (d)	0.28	0.194	0.08	0.146	0.088	0.087
FDI (d)	0.568***	0.585***	0.572***	0.645***	0.642***	0.586***
Firm level variables (W)						
Undiversified (%)	-0.002	-0.002	-0.003	-0.004	-0.003	-0.003
R ²	0.277	0.333	0.741	0.781	0.76	0.835
N	224	224	224	224	224	224

Significance is given by robust standard errors corrected by clusters, *p<.1, **p<.05, *** p<.01. Source: author's calculations with BEEPs data.

Table A3-7. Armenia - Robust X and W Elasticities and Semi-Elasticities on Labor Demand and on the Probabilities of Exporting Receiving FDI and Investing in R&D, OLS Estimations

	Labor demand		Prob. Exports		Prob. FDI		Prob. R&D	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
Demeaned Prd.	-0.341***		0.053*		0.204***		0.002	
Undem. Prd.	-0.355***		0.001		-0.006		0.001	
Total productivity		-0.352***		0.012		0.034*		0.001
Generator (d)	0.564***	0.566***	-0.098	-0.095				
Power outages (ln)			-0.063**	-0.062**			-0.021	-0.021
Customs exp. (ln)					-0.077*	-0.094	-0.080**	-0.080**
Manager's time (%)					-0.003**	-0.001		
Inf. payms. taxes (d)	-0.167*	-0.164						
Overdraft (d)	0.234**	0.238***						
Purchs. aft. Delv. (%)							0.002*	0.002*
Sales aft. Delivery (%)			-0.002**	-0.002**	-0.001*	-0.001		
Fix. assets banks (%)	0.005***	0.005***	-0.004***	-0.005***				
ISO (d)					0.083	0.086*		
Staff compts. (%)	0.004**	0.004**						
R&D p. Worker (ln)	-0.028***	-0.028**						
Manager exp. (%)	0.167**	0.168**					0.060*	0.060*
Training (%)							0.161**	0.161**
Prod. staff (%)					-0.002**	-0.002*		
High school staff (%)	-0.005***	-0.005***						
Exports exp. (ln)	0.206***	0.206***			0.106*	0.135**	0.07	0.071
Age (ln)	0.185***	0.184***	-0.106***	-0.111***	-0.054	-0.072**		
Market share (%)			-0.005*	-0.005*			0.003*	0.003*
Shareholder (%)			-0.003***	-0.003***	-0.002***	-0.002**	0.002**	0.002**
Employment			0.120***	0.122***			-0.03	-0.03
Sales (y) (ln)	0.635***	0.635***						
Real wage p.worker	-0.224***	-0.225***						
R-sqr	0.815	0.815	0.362	0.359	0.303	0.223	0.222	0.222
N	224	224	224	224	224	224	222	222

Results from equations (4), (5), (6) and (7). Significance is given by robust standard errors corrected by clusters, *p<.1, **p<.05, *** p<.01.

Source: author's calculations with BEEPs data.

Table A3-8. Decomposition of Aggregate Productivity into Components

	ALB	BLR	GRG	RUS	SRB	MLD	ARM
Shipm. lss. exp. (%)	0	-0.05	0	0	-0.37	0	0
Generator (d)	0	0	0	-0.54	0	0	0
Customs exp. (ln)	0	-3.07	0	-0.53	0	0	0
Customs imp. (ln)	0	-1.93	0	0	0	0	-7.57
Manager's time (%)	2.96	2.89	0	0	0	0	6.19
Inf. payms. taxes (d)	0	0	-0.31	0	0	-1.71	0
Security (d)	6.19	0	0	-0.03	0	0	0
Courts (d)	0	0	0	0.92	0	0	4.28
Loan (d)	0	0.66	0	0.69	6.1	0	0
Fix. assets internal (%)	4.37	0	3.01	0	0	0	0
Fix. assets banks (%)	0	0	0	0	1.74	0	0
Fix. assets equity (%)	0	0	0	0	0	-0.43	0
Overdraft (d)	0	0	0	0.86	0	0	5.08
Subsidy (d)	0	-2.35	-1.85	-0.49	-0.28	0	-1.24
Sales aft. delivery (%)	0	-7.42	0	0	0	-5.22	0
Purchs. aft. delivery (%)	0	0	0	0	-3.89	0	0
ISO (d)	0	0	0	1.35	0	7.72	0
Forgn. tech. (d)	0	0	0	0	0	3.5	1.64
Sales new prd. (%)	0	0	0	0	0	0	2.09
R&D sub.	0	3.26	9.1	0	0	0	0
Web page (d)	0	0	0	1.61	5.04	0	0
Staff compts. (%)	0	0	0	1.63	5.64	3.22	0
Prod. staff (%)	0	0	0	2.6	0	0	0
High school staff (%)	1.73	0	0	0	0	0	0
Training (%)	5.04	0	0	0	0	0	0
Skilled staff (%)	0	7.05	0	0	0	0	9.24
Manager exp. (%)	0	0	0	3	0	0	0
Imports (d)	6.56	4.13	0	1.75	0	0	3.61
FDI (d)	0	0	6.2	0	0	0	1.85
Exports (d)	0	0	6.43	-0.09	0	0	0
Age (ln)	0	-15.41	-12.76	0	-5.63	-13.73	0
Local (d)	0	0	-9.86	-2.09	0	0	0
Shareholder (%)	-0.67	-0.87	-1.74	-0.07	0	-1.31	0
Undiversified (%)	-12.95	0	-34.74	0	0	0	-3.44
Ind/reg/time dummies	8.46	6.34	7.79	2.12	-4.62	1.36	-3.23
Constant technical efficiency	49.68	102.96	103.77	55.86	85.02	86.4	66.66

Results from equation (10). Source: author's calculations with BEEPs data.

Table A3-9. Probability of Exporting, Decomposition into Components

	ALB	BLR	GRG	RUS	SRB	MLD	ARM
Demeaned Prod. (ln)	0	0	27.6	254.54	20.44	1.23	19.09
Undem. Prod. (ln)	0	0	0	0	0	0	0
Power outages (ln)	0	0	-10.51	-4.2	0	0	-14.12
Generator (d)	-33.12	0	0	0	0	0	-7.86
Customs imp. (ln)	0	0	0	-19.68	0	0	0
Manager's time (%)	0	0	18.88	0	12.41	17.03	0
Inf. payms. taxes (d)	0	-1.07	-1.24	3.25	0	0	0
Security (d)	0	0	0	0	-9.93	0	0
Courts (d)	0	6.84	0	0	0	0	17.69
Loan (d)	0	0	0	0	0	16.3	22.08
Fix. assets internal (%)	0	1.09	0	0	0	0	0
Fix. assets banks (%)	-4.67	0	0	0	0	-12.14	-16.4
Fix. assets equity (%)	0	-0.3	0	0	0	0	0
Sales aft. delivery (%)	44.94	-20.35	0	0	0	17.24	-22.38
Purchs. aft. delivery (%)	0	0	0	-18.55	-9.14	0	0
Subsidy (d)	0	0	0	0	0	0	0
ISO (d)	0	0	0	0	0	14.31	0
Web page (d)	0	0	19.34	0	0	15.75	32.29
Staff compts. (%)	0	0	0	-27.16	0	0	0
R&D subc. (d)	0	0	0	9.21	0	0	0
Prod. staff (%)	110.19	-66.56	-112.01	0	0	0	0
FDI (d)	0	0	0	0	0	13.18	0
Imports (d)	28.45	0	0	14.26	31.55	0	22.47
Age (ln)	0	0	0	-69.07	0	0	-136.96
Local (d)	0	0	-39.14	-47.47	-7.99	0	0
Inc. (d)	52.74	13.75	0	0	0	0	0
Shareholder (%)	124.9	0	0	0	0	0	-130.23
Market share (%)	0	-11.33	14.97	9.15	0	0	-16.25
Employment (ln)	97.99	211.08	81.16	35.92	30.52	117.82	211.41
Ind/reg/time dummies	27.19	47.3	-22.33	37.37	38.1	-2.98	-67.77
Constant	-348.61	-80.45	123.19	-77.57	-5.96	-97.75	186.95

Results from equation (14). Source: author's calculations with BEEPs data.

Table A3-10. Probability of Receiving FDI Decomposition into Components

	ALB	BLR	GRG	RUS	SRB	MLD	ARM
Demeaned Prod. (ln)	0	0	94.2	151.52	0	0	150.27
Undem. Prod.	0	0	0	0	0	0	0
Shipm. lss. exp. (%)	0	0	0	-1.71	0	0	0
Power outages (ln)	0	0	0	0	0	-16.77	0
Customs exp. (ln)	0	0	0	0	0	0	-26.58
Customs imp. (ln)	0	0	0	0	0	-22.72	0
Manager's time (%)	0	0	-7.83	0	-23.23	0	-42.92
Inf. payms. taxes (d)	0	0	0	0	0	0	0
Auditory (d)	0	29.29	0	30.66	46.51	0	0
Inf. comp. (d)	0	0	0	-13.18	0	0	0
Courts (d)	0	0	0	0	0	0	0
Security (d)	0	30.34	0	0	0	0	0
Loan (d)	0	0	20.45	0	0	0	0
Fix. assets int. (%)	0	0	-30.53	0	0	0	0
Fix. assets banks (%)	0	7.66	-4.92	0	0	0	0
Purchs. aft. delivery (%)	29.83	0	0	29.02	62.8	0	0
Sales aft. delivery (%)	38.57	0	0	0	0	0	-20.76
Subsidy (d)	-3.68	-4.53	0	0	0	0	0
ISO (d)	0	0	0	0	0	0	27.38
Web page (d)	0	0	0	0	0	0	0
Forgn. tech. (d)	0	17.64	0	17.02	0	0	0
Prod. staff (%)	103.84	-230.19	0	-105.81	0	-224.88	-167.1
High school staff (%)	0	0	61.21	0	0	0	0
Manager exp. (%)	0	0	0	-116.05	0	168.71	0
Training (%)	0	0	0	18.71	0	0	0
Exports exp. (ln)	0	0	0	0	0	0	43.59
Imports (d)	0	43.49	0	0	26.96	27.6	0
Age (ln)	0	-211.74	0	-131.2	0	-322.41	-143.42
Inc. (d)	-87.87	0	0	0	0	71.86	0
Undiversified (%)	0	0	0	0	0	0	0
Shareholder (%)	0	0	0	0	0	0	-194.47
Market share (%)	0	0	-11.86	9.2	27.87	0	0
Employment (ln)	196.24	131.04	0	0	79.91	252.46	0
D	21.74	2.72	10.38	-5.19	-1.26	53.65	-28.58
Constant	-198.68	284.29	-27.92	216.99	-119.57	112.5	502.6

Results from equation (15). Source: author's calculations with BEEPs data.

Table A3-11. Probability of investing in R&D, decomposition into components

	ALB	BLR	GRG	RUS	SRB	MLD	ARM
Demeaned Prod. (ln)	0	67.71	52.89	16.95	24.8	0.9	0
Undem. Prod.	0	0	0	0	0	0	0
Power outages (ln)	-113.9	0	0	0	0	0	-8.34
Customs exp. (ln)	-14.41	13.07	0	0	-13.69	0	-25.19
Auditory (d)	35.3	0	0	0	0	0	0
Inf. comp. (d)	0	-11.71	0	-2.98	0	0	0
Security (d)	0	32.5	0	0	0	0	0
Courts (d)	0	0	0	10.29	18.03	0	0
Overdraft (d)	0	8.48	0	0	0	15.8	0
Loan (d)	0	0	21.37	0	0	0	0
Fix. assets internal (%)	0	21.04	0	8.11	9.55	24.18	0
Fix. assets equity (%)	8.78	0	0	2.19	0	6.46	0
Fix. assets banks (%)	0	0	0	1.67	0	0	0
Purchs. aft. delivery (%)	0	0	0	0	0	0	33.84
Sales aft. delivery (%)	0	0	0	12.18	0	0	0
Subsidy (d)	0	11.4	0	0	0	0	0
ISO (d)	0	7.26	0	0	0	0	0
Web page (d)	0	0	0	12.03	0	0	0
Staff compts. (%)	0	13.56	25.32	16.28	0	25.01	0
Forgn. tech. (d)	0	0	12.07	0	0	0	0
Prod. staff (%)	-151.59	-272.18	0	0	60.5	0	0
High school staff (%)	59.42	0	0	17.36	0	0	0
Skilled staff (%)	99.87	0	0	0	0	0	0
Training (%)	0	0	30.54	21.1	22.7	0	23.21
Manager exp. (%)	0	49.25	0	19.66	0	0	147.95
Exports (d)	0	18.17	0	3.05	0	13.25	0
Exports exp. (ln)	19.96	0	0	0	18.92	0	26.37
Imports (d)	0	0	36.27	0	21.58	0	0
Age (ln)	139.79	86.56	0	0	0	0	0
Local (d)	-22.43	0	0	-23.86	0	0	0
Inc. (d)	0	0	0	0	-48.98	0	0
Shareholder (%)	0	0	0	0	0	0	123.24
Undiversified (%)	0	0	134.26	0	-54.48	0	0
Market share (%)	0	0	-12.82	0	7.43	0	22.3
Employment (ln)	0	0	0	0	41.28	0	-94.25
D	-237.19	-50.33	-0.99	-33.5	-72.75	-66.9	-104.15
Constant	276.4	105.21	-201.05	19.48	65.09	81.28	-45.1

Results from equation (16). Source: author's calculations with BEEPs data.

References

- Acemoglu, D., P. Aghion and F. Zilibotti. 2006. "Distance to Frontier, Selection, and Economic Growth, *Journal of the European Economic Association*, Volume 4, Issue 1, pages 37–74, March.
- Aghion, P. and R. Griffith (2005) *Competition and Growth. Reconciling Theory and Evidence*. The MIT Press, Cambridge MA.
- Araujo, Jorge de Thompson; Brueckner, Markus; Clavijo, Mateo; Vostroknutova, Ekaterina; Wacker, Konstantin M. 2014. *Beyond Commodities: the Growth Challenge of Latin America and the Caribbean*. Washington, DC: World Bank Group.
- Arezki, Rabah and Markus Brueckner. 2012. "Commodity Windfalls, Democracy, and External Debt." *Economic Journal* 122: 848-866.
- Bloom, Nicholas, Raffaella Sadun, and John Van Reenen. 2012. "Americans Do IT Better: US Multinationals and the Productivity Miracle." *American Economic Review* 102 (1): 167–201.
- Bresnahan, T. F., E. Brynjolfsson, and L. M. Hitt. 2002. "Information technology, workplace organization, and the demand for skilled labour: firm-level evidence." *The Quarterly Journal of Economics* 117 (1): 339–76.
- Brynjolfsson, E., and L. M. Hitt. 2003. "Computing productivity: Firm-level evidence." *The Review of Economics and Statistics* 85 (4): 793–808.
- Conway Paul, Donato De Rosa, Giuseppe Nicoletti and Faye Steiner. 2006. "Product Market Regulation and Productivity Convergence." *OECD Economic Studies* 43: 39-76.
- Correa, Paulo and Pluvia Zuniga 2013. "Public Policies to foster Knowledge Transfer from Public Research." Policy Brief, Report number 90534, vol. (1) and Innovation Policy Platform, World Bank.
- Crépon, B., E. Duguet and J. Mairesse. 1998. "Research, innovation and productivity: An econometric analysis at the firm level." *Economics of Innovation and New Technology*, Vol. 7(2), pp. 115-158.
- Crespi, G. and P. Zuniga. 2012. "Innovation and productivity: Evidence from six Latin American countries", *World Development*, vol. 40, No. 2, pp. 273-290.
- De Rosa, Donato, Sanja Madzarevic-Sujster, Ana-Maria Boromisa and Velimir Sonje. 2009. "Barriers to Competition in Croatia: The Role of Government Regulation". *Policy Research Working Paper*, No. WPS 5100. The World Bank.

- Docquier, Frédéric, Elisabetta Lodigiani, Hillel Rapoport and Maurice Schiff. 2010. “Emigration and the quality of home country institutions”. Discussion Paper 2010-35, Université Catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES).
- Duernecker, Georg, Moritz Meyer and Fernando Vega-Redondo. 2014. “The Network Origins of Economic Growth.” University of Mannheim, Department of Economics, Working Paper 14-06
- European Bank for Reconstruction and Development. 2014. *Transition Report 2014: Innovation in Transition*. EBRD, London.
- European Commission. 2014a. “Armenia Country Report on Energy” prepared by NAS and European Commission.
- European Commission. 2014b. Participation of Eastern Partnership Countries in FP 7: Lessons Learned.
- EV Consulting Research Center. 2014. National Competitiveness Report of Armenia.
- Frankel, J.A. and D. Romer. 1999. “Does Trade Cause Growth?” *American Economic Review* 89:379-399.
- Ghatak, Subrata, Monica Ioana Pop Silaghi, and Vince Daly. 2009. “Trade and migration flows between some CEE countries and the UK.” *The Journal of International Trade & Economic Development* 18.1: 61-78.
- Gill, Indermit S., Ivailo Izvorski, Willem van Eeghen, and Donato De Rosa. 2014. *Diversified Development: Making the Most of Natural Resources in Eurasia*. ECA Regional Flagship Report Washington, DC: World Bank.
- Goldberg, Itzhak, John Gabriel Goddard, Smita Kuriakose, and Jean-Louis Racine. 2011. *Igniting Innovation: Rethinking the Role of Government in Emerging Europe and Central Asia*. Washington, DC: World Bank.
- Gould, David M. 1994. “Immigrant links to the home country: empirical implications for US bilateral trade flows.” *The Review of Economics and Statistics* 76.2: 302-316.
- Heckman, James J., Lance Lochner, and Christopher Taber. 1998. “Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Earnings with Heterogenous Agents.” *Review of Economic Dynamics* 1 (1): 1–58.
- IncoNet .2014. Armenia Country Report
- Kali, R. and J. Reyes. 2007. “The Architecture of Globalization: A Network Approach to International Economic Integration.” *Journal of International Business Studies* 38.4: 595-620.

- Kali, R., F. Mendez, and J. Reyes. 2007. "Trade structure and economic growth." *Journal of International Trade and Economic Development* 16, 245-269.
- Keller, W. 2004. "International Technology Diffusion." *Journal of Economic Literature*, Volume XLII (September 2004), pp.752 – 782.
- Keller, W. and S. Yeaple. 2003. "Multinational Enterprises, International Trade, and Productivity Growth: Firm Level Evidence from the United States", IMF Working Papers 248.
- Li, Xiaoyang, McHale, John and Xuan, Zhou (November 5, 2013). Does Brain Drain Lead to Institutional Gain?
- Loayza, Norman, Pablo Fajnzylber, and César Calderón. 2005. *Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts*. Washington, DC: The World Bank Group
- Mitra, S. et al. 2007. *The Caucasian Tiger: Sustaining Economic Growth in Armenia*. Washington DC: The World Bank.
- OECD. 1997. *National Innovation Systems*. OECD, Paris.
- OECD. 2004. "Improving Skills for More and Better Jobs: Does Training Make a Difference?" In OECD Employment Outlook 2004, 183–224. OECD, Paris.
- OECD. 2005. "The Measurement of Scientific and Technological Activities: Guidelines for Collecting and Interpreting Innovation Data: Oslo Manual, Third Edition" prepared by the Working Party of National Experts on Scientific and Technology Indicators. OECD, Paris.
- OECD. 2008. *Education at a Glance*. OECD, Paris.
- Olley, G. S. and A. Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry". *Econometrica*, Vol. 64, 6, 1263-1297.
- Parente, Stephen L., and Edward C. Prescott, "Monopoly Rights: A Barrier to Riches," *American Economic Review* 89 (5): 1216-1233
- Pena, Jorge. 2015. Econometric methods used to assess business environment and other firm level variables on firm performance in Armenia and Comparators.
- Powell, Walter W. and Kaisa Snellman. 2004. "The Knowledge Economy." *Annual Review of Sociology* 30: 199-220.
- Sondergaard, Lars; Murthi, Mamta; Abu-Ghaida, Dina; Bodewig, Christian; Rutkowski. 2012. *Skills, Not Just Diplomas: Managing Education for Results in Eastern Europe and Central Asia*. World Bank.

UNECE. 2014. "Innovation Performance Review of Armenia." UNECE, Geneva.

USAID. 2013. ICT Country Profile, Armenia

Wagner, Joachim. 2007. "Exports and Productivity: A Survey of the Evidence from Firm Level Data." *The World Economy*, 30(1), pp. 60-82.

World Bank. 2013. "Republic of Armenia: Accumulation, Competition, and Connectivity." The World Bank, Washington DC.

World Bank. 2015. "World Development Report 2016." The World Bank, Washington DC.

Zuniga, Pluvia 2011. "The State of Patenting at Research Institutions in Developing Countries: Policy Approaches and Practices." WIPO Economic Research Working Papers 04, World Intellectual Property Organization - Economics and Statistics Division, revised Dec 2011.